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www.dsir.gov.in

Annual Report 2020-21

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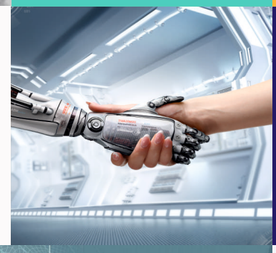
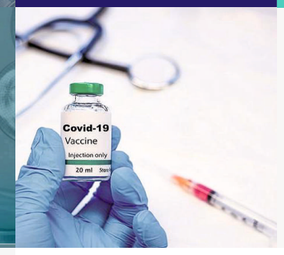
Department of Scientific and Industrial Research
Ministry of Science and Technology
Government of India

ANNUAL REPORT 2020-21





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DSIR

ANNUAL REPORT
2020-21

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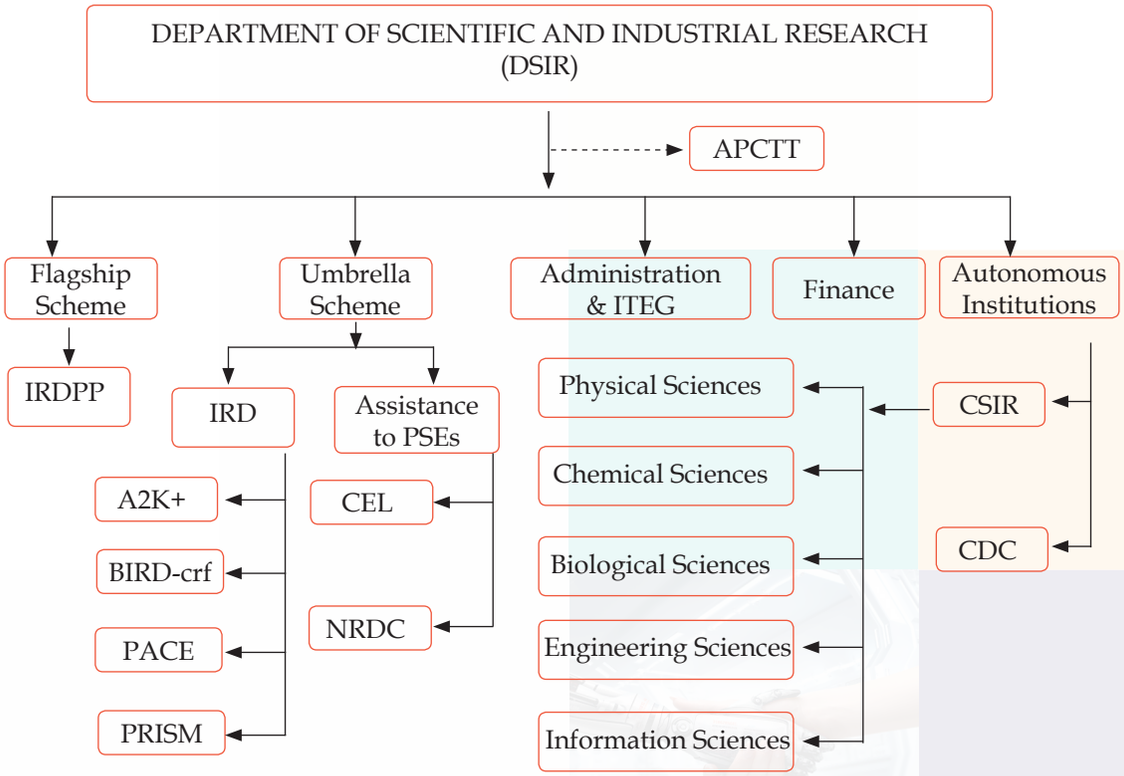


IRDPP	Industrial R&D Promotion Programme
IRD Schemes	Industrial Research & Development Schemes
A2K+	Access to Knowledge Development and Dissemination.
BIRD-crf	Building Industrial Research & Development and Common Research Facility
PACE	Patent Acquisition and Collaborative Research and Technology Development
PRISM	Promoting Innovation in Individual, Start-ups and MSMEs
PSEs	Public Sector Enterprises
NRDC	National Research Development Corporation
CEL	Central Electronic Limited
CSIR	Council for Scientific and Industrial Research
CDC	Consultancy Development Centre
APCTT	Asian and Pacific Centre for Transfer of Technology

Highlights of Annual Report 2020-21

i. DSIR is the nodal department for granting recognition to In-house Research & Development centres established by industry. During this period 102 In-house R&D centres were granted fresh recognition and 506 In-house R&D centres were granted renewal of recognition. DSIR has given recognition to 2340 In-house R&D centres of companies.

ii. Public funded research institutions (PFRIs), Universities, IITs, IISc and NITs registered under PFRI program of DSIR can avail custom duty exemption & concessional GST vide relevant notification and other amendment from time to time for research purposes. During the period under report 22 such institutions were newly registered with DSIR and 121 institutions were granted renewal of registration.

iii. During the period under report 39 new Scientific & Industrial Research Organisations (SIROs) were recognized by DSIR and 162 SIROs were granted renewal of recognition.

iv. Secretary DSIR, designated as the Prescribed Authority accorded fresh approvals to **59** companies under section 35(2AB) of Income-tax Act, 1961. The detailed R&D expenditure of the approved companies has been examined by DSIR and **405** reports valued at **Rs. 5983.22 crores** have been forwarded to Chief Commisioner Income Tax (Exemption) in Form 3CL, as required under the IT Act.

v. Common Research & Technology Development Hubs (CRTDH) programme has established 12 CRTDHs in 3 phase in sector like Affordable health, Electronics/Renewable energy, Environmental intervention, low cost machining & new material/ chemical process. These CRTDHs are equipped with analyticalequipment and pilot plant facilities to facilitate and encourage innovator, startups and micro, small and medium enterprise for R&D and technology development.

vi. Department under PRISM (Promoting Innovations in Individuals, Start-ups and MSME's) scheme has supported 7 new projects. This scheme has successfully completed a total of 6 projects supported during the period under report. Some of the completed projects are - Fle Datun; Development of peripheral blood smear instrument; Self propelled three row potato seeding device for restricted holdings.

vii. IT-eG division progressively implements e-Governance in the Department, which is in conformance to the National eGovernance Action Plan. Division has successfully implemented office automation solution in the form of E-office in the Department.

viii. Department under PACE (Patent Acquisition & Collaborative Research and technology Development) scheme provides catalytic support to industries & institutions for traversing their journey from proof of concept to pilot scale. During the period under report three (03) projects were monitored during the year. These projects involve a total project cost of Rs. 616.2 Lakhs for which Rs. 242.5 Lakh is in the form of loan to industry.

ix. Department has partnered with

Ministry of Education (MoE) in implementing the program 'IMPacting Research INnovation and Technology (IMPRINT)'. Five supported technology development projects are under progress. These projects involve a total project cost of Rs.515.33 lakh for which DSIR is extending a support of Rs. 257.665 lakhs as grant to institutions and an equivalent grant is provided by MoE.

x. In A2K+ (Access to Knowledge Development and Dissemination) scheme of DSIR, 18 studies are under progress in A2K+-Studies and grants for two events were released under A2K+-Events. Under Technology Development & Utilization Programme for Women (TDUPW), 9 projects are under progress. The Technology Development and Demonstration Programme (TDDP) supported in total 254 R&D projects of Industrial units with a total project cost of Rs. 750.60 crores in which DSIR support is Rs. 280.40 crores. 102 technologies developed under the scheme have been commercialized and the department has received a cumulative royalty of Rs.79.82 Crore during the period 1997-2020. In the current financial year, progress of last 3 on-going projects was monitored.

xi. DSIR played an active role in APCTT's functioning, particularly relating to its programmes and policies. India being the host country has been providing institutional support to APCTT since its inception. DSIR has enhanced institutional support from USD 400,000 in the financial year 2019-20 to USD 870,000 in the financial year 2020-21.

xii. The Right to Information Act 2005 has been implemented successfully in the department. The proactive disclosures are regularly updated and available on the DSIR Website. DSIR has received 122 applications during the period under report and 116 applications were registered and disposed off on RTI Request & Appeal Management Information System.

xiii. CSIR, an autonomous organization under DSIR and comprises of 38 national laboratories. It has published 5010 research papers in SCI journals. CSIR has filed 176 patents abroad and 175 patents in India during 2019-20 and has been granted 288 patents abroad and 204 patents in India.

xiv. CSIR, with its strong network of 38 laboratories across India and multifarious portfolio of technologies and interventions, has deployed its might to tackle the Covid-19 pandemic.

xv. CSIR-CCMB developed the protocol for estimating the extent of SARS-CoV-2 population in large areas via checking for the virus in sewage samples collected from large parts of a city in sewage treatment plants.

xvi. CSIR-IGIB, New Delhi has developed a CRISPR/Cas based paper diagnostic test for Covid-19 detection called 'FELUDA'. CSIR has licensed this technology to TATA Sons and kit has been approved by DCGI.

xvii. CSIR-NCL, Pune has developed an Oxygen Enrichment Unit (OEU) based on Indigeneous, innovative hollow fibre membrane technology.

xviii. CSIR-NAL, Bangalore in a joint venture with private company has developed the PPE Coveralls with indigeneous heat sealing tape and polypropylene materials.

xix. CSIR-CRRI, New Delhi has developed a

Kisan Sabha App to connect farmers to supply chain and freight transportation management system.

xx. CSIR-CSMCRI, Bhavnagar has developed novel seaweed based animal feed additive formulations to enhance the productivity of animal, improving the quality of animal products and boosting immunity.

xxi. CSIR-NAL, Bangalore has developed a low cost indigenized, non-invasive bilvel positive airway pressure ventilator device named as 'Swasth Vayu'.

xxii. CSIR-CSIO, Chandigarh has developed a electrostatic disinfection unit for a 360 degree area and uniform coverage, small droplet size, applicable for all fluids types.

xxiii. CSIR-CEERI, Pilani has designed and developed 2.6 MW S-band tunable pulsed Magnetron, which was successfully tested ans used as a microwave source to generate the required X-ray dose using a LINAC system for cancer treatment.

xxiv. Consultancy Development Centre (CDC), an autonomous institution of DSIR set up for promotion, development and strengthening of consultancy skills and capabilities in the country including enhancement of export of consultancy and professional services. During the period under report, CDC has undertook various activities keeping in view its mandate.

xxv. The National Research Development Corporation (NRDC), a Public Sector Enterprise under DSIR was assigned 109 new processes/ technologies and signed 34 MoUs. The consolidated lumpsum premia & royalty income is 691.58 lakhs.

xxvi. Central Electronics Limited (CEL) is a Public Sector Enterprise under DSIR, has been the pioneer in the country for manufacturing of the many strategic electronic components for Solar energy, Defense, Space and Atomic energy. Company has recorded production of Rs. 249.09 Crore and annual turn over of Rs. 246.00 Crore in FY 2019-20.

AN OVERVIEW

1. INTRODUCTION

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

The Allocation of Business for the Department is as follows:

- All matters concerning the Council of Scientific and Industrial Research (CSIR).
- All matters relating to National Research Development Corporation (NRDC).
- All matters relating to Central Electronics Limited (CEL).
- Registration and Recognition of R&D Units.
- Technical matters relating to UNCTAD and WIPO.
- National register for foreign collaborations.
- Matters relating to creation of a pool for temporary placement of Indian Scientists and Technologists.

The primary endeavour of DSIR is to promote R&D by the industries; support industrial units to develop state-of-the-art globally competitive technologies of high commercial potential; catalyze faster commercialization of laboratory-scale R&D; augment technology transfer capabilities; enhance the share of technology intensive exports in overall exports; strengthen industrial consultancy and establish a user-friendly information network to facilitate scientific and industrial research in the country. The DSIR has two public sector enterprises viz. National Research Development Corporation (NRDC) and Central Electronics Ltd (CEL) and two autonomous organizations viz. 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) viz. Asian and Pacific Centre for Transfer of Technology (APCTT) as the focal point in the country.

2. DSIR Programmes

The Department of Scientific & Industrial Research (DSIR) operates a flagship program i.e. Industrial Research & Development Promotion Program (IRDPP) and two Umbrella Schemes on "Industrial Research & Development (IRD)" and "Assistance to PSEs".

Department 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.

Department's umbrella scheme on "Industrial Research & Development (IRD) consists of following four sub-schemes :

(i) Promoting Innovations in Individuals, Start-ups and MSMEs (PRISM) – This scheme primarily focuses on supporting individual innovators, start-up companies; incubate companies

in public funded technology business incubators and MSMEs.

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

(iii) Building Industrial Research & Development and Common Research Facility (BIRD-crf) – This is a scheme which focuses on creation of Common Research facilities for micro and small enterprises with an aim to enhance translational research and foster industry institution interaction targeted towards innovative product development.

(iv) Access to Knowledge for Technology Development and Dissemination (A2K+) – This sub-scheme includes components of Technology Development and Utilization Programme for Women (TDUPW); Support to Studies; Support to Events and Technology Development and Demonstration Programme (TDDP).

The umbrella scheme on "Assistance to PSEs" consist of two Public Sector Enterprises, the National Research Development Corporation (NRDC) and Central Electronics Ltd (CEL).

Apart from Flagship program and Umbrella program, the other activity of the Department includes (i) Matters pertaining to Asian and Pacific Centre for Transfer of Technology (APCTT) and UNESCAP, and (ii) Information Technology and e-Governance (ITeG).

Department of Scientific and Industrial Research (DSIR), has been the national focal point of Asian and Pacific Centre for Transfer of Technology (APCTT) for India since its inception in 1977. 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. ITeG division implements e-Governance in the Department progressively that needs be in conformance to the National e-Governance.

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 2340 (including 102 fresh recognition) In-house R&D centres in the country with DSIR recognition (December, 2020). During the year, 506 In-house R&D centres were accorded DSIR renewal of recognition (December 2019 to December 2020).

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) under the programme granting recognition to SIROs. The recognized and registered SIROs are eligible for availing Customs Duty exemption on imports required for R&D activities. During the period under report, **39** SIROs have been accorded fresh recognition.

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 and accessories and consumables for research purposes through a simple registration with the DSIR. The heads of the public funded re-

search 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 and corrigendum dated 22.07.2017-Custom Notification no. 43/2017 dt 30.06.2017. Ministry of Finance has amended the main notification No. 51/96-Customs dt.23.07.1996 from time to time. During the period under report, **22** such institutions were newly registered with DSIR; and **121** institutions were granted renewal of registration.

Secretary, DSIR is designated as the Prescribed Authority under section 35(2AB) of Income-tax Act, 1961. Fresh approvals were accorded to **59** companies by the prescribed authority. Agreements of co-operation for R&D were also signed with these companies. The detailed R&D expenditure of the approved companies have also been examined by DSIR and **405** reports valued at **Rs. 5983.22 crores** have been forwarded to Chief Commissioner of Income Tax (Exemption) CCIT (E) in Form 3CL, as required under the IT Act.

2.1.2 *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 31.03.2021 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 **6 (Six)** on-going PRISM projects supported during the period under report i.e. from 01.04.2020 to 30.11.2020.

The successfully completed projects are IoT Based Affordable Cattle Monitoring System (Working Prototype) for Empowerment of India farmers; Self-propelled three row potato seeding device for restricted holdings; Development of Working Model for Highly Miniaturized process Intensified Distillation Unit; Design and Development of a novel 3D Printed Splints & Arm Supports for Arthritis and Arm Injured Patients; Development of Peripheral Blood Smear Instrument and Flexi Datun.

The financial supports were extended to **9 (Nine)** new innovative projects of individual innovators during the period 01.04.2020 - 30.11.2020. The department also rendered financial support to **7 (Seven)** ongoing projects.

2.1.3 *Patent Acquisition and Collaborative Research and Technology Development (PACE).*

The Department of Scientific and Industrial Research (DSIR) is continuing to operate the 12th Five Year Plan scheme on "Patent Acquisition and Collaborative Research and Technology Development (PACE)" during 2017-2020. The 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. The scheme also jointly supports 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 are being supported for development and demonstration of technologies. During the period under report **three (03)** PACE projects were monitored during the year. These projects involve a total project cost of Rs. 596.20 Lakhs for which Rs. 242.5 Lakh is in the form of loan to industry.

5 (Five) ongoing technology development projects from institutions (IITs and IISc) in the Manufacturing and Water Resources domains are supported under IMPacting Research INnovation and Technology (IMPRINT) initiative of Ministry of Human Resource Development (MHRD) and are under progress. These projects involve a total project cost of Rs.515.33 lakh for which DSIR is extending a support of Rs. 257.665 lakhs as grant to institutions and an equivalent grant is provided by MHRD.

2.1.4 *Common Research and Technology Development Hubs (CRTDHs).*

Department of Scientific and Industrial Research (DSIR) had launched a program to establish Common Research and Technology Development Hubs (CRTDHs) in Public-Funded Institutions having linkages with and proximity to MSME clusters under its 12th Five Year Plan scheme on 'Building Industrial Research & Development and Common Research Facilities' (BIRD-crf). 12 CRTDHs have now been established across the country.

The CRTDH programme is aimed at creation of common research facilities equipped with analytical equipment and pilot plant facilities to facilitate and encourage innovators, start-ups and micro, small and medium enterprises for R&D and technology development. CRTDH programme facilitates start-ups and MSMEs to use the facilities available under the hubs, reside in the campus and work towards technology development, and grow to the next level (lab to market). The equipment and facilities under CRTDH are offered to the industries for usage under various models of engagement so as to adequately leverage not only the technologies developed at the host institute but also to develop new/improved technologies and processes based on needs of the enterprises. They are mentored and encouraged to file patents, trademarks, write publications, apply for grants under various other Government schemes thereby favourably impacting ease of doing business.

DSIR invited proposals from eligible organisations for setting up of CRTDH under five sectors, viz, Electronics/Renewable Energy, Affordable Health, Environmental Interventions, Low Cost Machining and New Materials/Chemical Process, during May to July, 2020. DSIR organized a webinar on "Funding schemes of DSIR" on 22nd July 2020, in association with PHDCCI.

2.1.5 *Access to Knowledge for Technology Development and Dissemination (A2K+):*

The continued 12th five-year plan scheme of **A2K+** has been evolved on the premises that access to knowledge is one of the most desirable inputs for any entrepreneur, innovator conceptualizing a business model to establish or run a company for wealth creation through innovative R&D interventions. The scheme includes the following programme components:

(i) National and International conferences, exhibitions (A2K+ Events)

(ii) Industrial Technology related studies (A2K+ Studies)

(iii) Technology Development and Utilization Programme for Women (TDUPW)

(iv) Technology Development and Demonstration Programme (TDDP)

The sub-scheme on A2K+ - Events 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. During the period under report **Two (02)** events were conducted.

The sub-scheme on A2K+ - Studies, support studies in 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, 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. During the period under report **18 studies** are under progress.

The TDUPW program is aimed to meet the specific needs of women and to enhance their technological capabilities. Currently **Nine (09) projects** were in progress under this program. Another component of TDUPW programme is to set up Skill Satellite Centres to enhance the quality of life of women by imparting knowledge and skills. These Centres are expected to help the local women uplift their socio-economic status significantly. The programme has been launched and the Department is getting proposals for setting up Skill Satellite Centres for women. For popularization / promote the Skill Satellite Centres, two webinar have been conducted with corporate foundations and women institute.

The Technology Development and Demonstration Programme (TDDP) started in 1992. Department has supported 254 R&D projects of Industrial units with a total project cost of Rs. 750.60 crores in which DSIR support is Rs. 280.40 crores. The projects cover a number of industry sectors and the share of these industry sectors in the project supported are: 32% engineering; 27% electronics; 21% Chemical; 7% energy & waste utilization and 13% Health & Pharma. The projects supported have been spread over 22 states of the country and the share of top five states in the number of projects supported is: Andhra Pradesh 18%, Karnataka 15%, Maharashtra 13%, Delhi 10% and Tamil Nadu 10%. The scheme was discontinued in XIth Five Year Plan and all spill over projects are completed in FY 2019-20. 102 technologies developed under the scheme have been commercialized and the department has received a cumulative royalty of Rs.79.82 Crore during the period 1997-2020.

3. *Asian and Pacific Centre for Transfer of Technology (APCTT).*

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 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 cooperation 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 Centre since its inception in 1977.

DSIR has enhanced institutional support to APCTT from USD 400,000 in the financial year 2019-2020 to USD 870,000 in the financial year 2020-2021. This enhanced funding provides for the critical operating requirements of the Centre, including salaries and allowances of internationally and locally recruited personnel, and other expenses of the Centre. As of 30 November 2020, APCTT had received institutional support fund of USD 659,038 out of pledged contribution of USD 870,000 from the Government of India (DSIR). This financial contribution received in cash is in addition to in-kind support received towards office premises such as those for building repairs, renovation work and municipal taxes.

4. *Information Technology and e-Governance (ITeG).*

Information Technology and e-Governance (ITeG) 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. Primarily aims to convert the existing procedures and processes into citizen centered, ITeG division implements e-Governance in the Department progressively that needs be in conformance to the National e-Governance Action Plan. ITeG Division operates on a separate IT Budget Head under Secretariat Economic Services during FY 2020-2021 for the implementation of IT Action Plan.

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

5. 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.

DSIR has received **122** Applications during

01/01/2020 to 31/12/2020 and all the Applications were registered and disposed off on RTI Request & Appeal Management Information System at *https://rtinonline.gov.in/RTI-MIS*. During 01/01/2019 to 31/12/2019, **10** applications were registered as first appeal.

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 *http://rtiar.nic.in* and *https://dsscic.nic.in/users/pn-login* wherein quarterly returns were uploaded regularly.

6. AUTONOMOUS INSTITUTIONS

6.1 Council of Scientific & Industrial research (CSIR)

The Council of Scientific & Industrial research (CSIR) establishment in the year 1942, is a premier research organization in the country. The organization has emerged as a multidisciplinary, multi-locational network of 38 national laboratories which undertake well focused basic and applied research in diverse fields of science and technology. List of CSIR establishment is mentioned in annexure 10. CSIR has also established 39 outreach centres, one Innovation Complex and three units.

CSIR's focus is on pursuing science which strives for global impact, technology that enables innovation driven industry and nurture trans-disciplinary leadership thereby catalysing inclusive economic development for the people of India. It thus provides: Science & Technology interventions to benefit society; cutting edge technologies to industry so as to enhance national competitiveness; and technological support to the strategic sector to strengthen and deepen the capability and capacity base. It catalyses S&T based entrepreneurship as well and has been building a sustainable ecosystem for S&T based Human Resource development including Skill Development.

CSIR has been providing significant technological interventions in many areas which include environment, health, drinking water, food, housing, energy, specialty chemicals & petrochemicals, glass & ceramics, medicinal plants & plants of economic value, leather, mining, metals & minerals, machinery & instrumentation, strategic sectors including aerospace etc. In doing so, CSIR partners with Industry in a significant manner.

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.

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. It has published around 5010 papers in SCI Journals during 2019 with average impact factor of 3.713.

CSIR has a strong connect with different stakeholders like industries, line ministries etc. and strong relation with international S&T institutions. Focus is also upon creating incubation facilities for spin off and startups through its various constituent laboratories and CSIR would hand hold these companies so as to create a new segment of knowledge enterprises.

CSIR has been focusing in a significant manner on the development of S&T Human Resource and provided the 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.

6.1.1 Significant Events

Drug Discovery Hackathon (DDH2020) jointly launched by Union Ministers Dr Harsh Vardhan and Shri Ramesh Pokhriyal

Human Resources and Development Minister Ramesh Pokhriyal Nishank and Health Minister Dr Harsh Vardhan today jointly launched the Drug Discovery Hackathon 2020 - an online competition.

The Hackathon is a joint initiative of CSIR, AICTE and MHRD with the guidance of Principal Scientific Advisor to GoI.

Speaking on the occasion, Mr Pokhriyal said, Drug Discovery Hackathon is the first of its kind national initiative for supporting the drug discovery process. He said, to attract international talent, the hackathon will be open to participation from across the globe from professionals, faculty, researchers and students.

Addressing the participants, Dr Harsh Vardhan emphasised the need to establish the culture of computational drug discovery in the country. In this initiative, HRD Innovation cell and AICTE will focus on identifying potential drug molecules through the Hackathon while CSIR will take these identified molecules forward for synthesis and laboratory testing. He said the objective of this Hackathon is to identify drug candidates against SARS-CoV-2 by in-silico drug discovery through the hackathon and follow up by chemical synthesis and biological testing.

Sewage Treatment Plant (STP) operated on a Phytorid Technology developed by CSIR-NEERI inaugurated at CSIR-NCL campus

CSIR–NCL commenced operations of a Sewage Treatment Plant (STP), which uses technology capable of generating portable water from processed sewage water.

Hon'ble Union Minister Dr. Harsh Vardhan virtually inaugurated the Sewage Treatment Plant. This plant has a storage capacity of 4 lakh litres and will be used to recycle water generated at both NCL as well as CSIR-URDIP. The STP operates on Phytorid technology, developed by CSIR-NEERI.

Launching of eco-friendly, efficient and DME fired "Aditi Urja Sanch" Unit

CSIR-NCL has developed the nation's first pilot plant operated with clean and cost-efficient fuel 'DME' with 20-24Kg/day capacity. Dimethyl ether (DME) is an ultra-clean fuel. The conventional LPG burner is not suitable for DME combustion as DME density is different from LPG. To address this issue, CSIR-NCL's "ADITI URJA SANCH" has come up with a helpful, innovative setup. The Union Minister of Science and Technology and Earth Sciences, Dr. Harsh Vardhan inaugurated the DME fired "Aditi Urja Sanch" unit along with the DME-LPG blended fuel cylinders and handed them over for common public and CSIR-NCL canteen use on a trial basis at CSIR-NCL premises virtually through video-conferencing.

CSIR Celebrated its 79th Foundation Day and Prestigious Bhatnagar Awardees for 2020 were announced on 26th Sept 2020

CSIR celebrated its 79th Foundation Day at the S S Bhatnagar Sabhaghar in CSIR Headquarters at New Delhi on 26th Sept 2020. Dr Harsh Vardhan, Union Minister of Science and Technology, Earth Sciences, Health and Family Welfare and Vice President, CSIR presided over the event. In view of the current Covid-19 pandemic while the physical event was a small gathering with appropriate social distancing, Dr. Shekhar C. Mande, DG, CSIR & Secretary, DSIR (Department for Scientific & Industrial Research), Mr. A. Chakraborty, Head, HRDG, and all CSIR labs and several others joined the event through various social media platforms. The Minister appreciated the work done by the entire CSIR during this current Covid-19 crisis. He said under the times of needs CSIR labs have risen to the occasion and delivered diagnostics, drugs and ventilators among many others. Dr Harsh Vardhan also released a digital book and a short film on the CSIR's COVID-19 efforts, which highlighted the people behind the various initiatives of CSIR in its fight against Covid-19.

At the occasion, various CSIR Awards were announced virtually, including CSIR Innovation Awards for School Children-2020, CSIR Young Scientist Awards-2020, CSIR Technology Awards-2020, CSIR Award for S&T Innovation for Rural Development (CAIRD) - 2017, 2018, 2019, CSIR Diamond Jubilee Technology Award -2019 and G N Ramachandran Gold Medal for Excellence in Biological S&T-2020. DG-CSIR Dr. Shekhar Mande announced the winners of the prestigious Shanti Swarup Bhatnagar Awards 2020.

Inauguration of Platinum Jubilee Foundation Day celebration of CSIR-CIMFR

Union Minister of Science & Technology, Dr. Harsh Vardhan inaugurated the Platinum

Jubilee Foundation Day celebration of CSIR-Central Institute of Mining and Fuel Research (CIMFR), Dhanbad, through video-conferencing in Delhi. On the occasion, Dr. Harsh Vardhan also dedicated to the nation the three indigenously developed technologies and facilities, first of its kind, as a step towards AtmaNirbhar Bharat Abhiyan. These indigenously developed technologies and facilities are (i) The Centre of Excellence for Coal Gasification- Coal to Syngas Plant; (ii) Centre of Excellence for Strategic and Infrastructure Sectors; (iii) Indigenously developed innovative technologies for import substitution of coking coal.

Guidelines for Public Transport and Feeder Modes considering Social Distancing Norms (CRRI)

CSIR-CRRI, New Delhi has come out with a document on "Guidelines for Public Transport and Feeder Modes considering Social Distancing Norms" which was released by the Hon'ble Minister Dr. Harsh Vardhan along with Dr. Sekhar C Mande, DG, CSIR and Prof. Satish Chandra, Director, CSIR-CRRI on May 04, 2020. The document mentions a systematic and strategic approach to be adopted to move ahead during the COVID-19 pandemic.

Inauguration of Makeshift hospitals

A modern, durable, portable, fast installable, safe and varying weather compatible 10-Bedded Make-Shift Hospital was inaugurated by Hon'ble Minister Dr. Harsh Vardhan at NDRF 8th Battalion Centre, Ghaziabad. The make-shift hospital has been set up by CSIR-Central Building Research Institute (CBRI), Roorkee in collaboration with National Disaster Response Force (NDRF) for demonstration purpose as well for use by NDRF. It would serve the purpose for disaster recovery stage including for use in a long pandemic or emergency situation. Dr Shekhar Mande, DG, CSIR; Shri S.N. Pradhan, DG, NDRF; Dr Gopalakrishnan, Director CSIR-CBRI were among the dignitaries present on the occasion. The structure has been named as 'Karuna Bhawan'.

Honourable Union Minister, Dr. Harsh Vardhan inaugurated a 10-Bedded Make Shift Hospital and isolation centre set up by CSIR at 4th Battalion Centre, Chennai, through video-conference. The new facility at Chennai is designed as a makeshift hospital solution for the patient to provide primary health facility with safety, security and a comfortable living environment. It is a foldable & framed steel structure can be assembled at any site without much loss of time. Speaking at the occasion, Dr. Harsh Vardhan congratulated CSIR-SERC (Structural Engineering Research Centre) and its scientists as well as National Disaster Response Force (NDRF) for finding innovative solutions to meet new challenges like the one presented by COVID-19.

Scientific Social Responsibility of CSIR-IITR on COVID-19 Prevention

CSIR-IITR has produced 4500 Litres of WHO formulated hand sanitiser. The sanitisers were provided to Chief Minister, Yogi Adityanath and Chief Secretary for distribution to various agencies. It was distributed to over 30000 personnel involved in essential services to provide them with the first line of protection for their safety. This initiative was part of the Scientific Social Responsibility of CSIR-IITR and was accomplished through the Corporate Social Responsibility contributions of various organisations as part of CSIR Vertical 'Hospital Assistive Devices and PPEs'. Further, M/s ASPL Green Ventures (P) Ltd, a startup of Lucknow has been incubated at CSIR-IITR BIRAC Bio-NEST centre for the preparation of hand sanitiser and developing disinfection solutions. Microwave based disinfection machine for disinfection of PPE and N-95 mask was developed by M/s SS Maser Technology Pvt Ltd, with the help of CSIR-IITR.

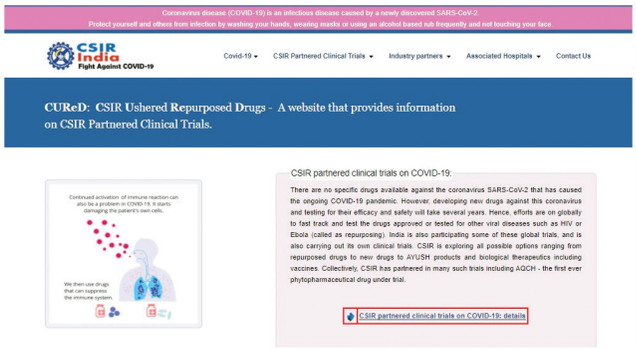
Launch of Compendium on CSIR Technologies for COVID-19 Mitigation

Honourable Union Minister Dr Harsh Vardhan released a compendium of "CSIR Technologies for COVID-19 Mitigation" which gives insights into the technologies, innovations and products developed and deployed by CSIR. Launching the compendium on technologies and products developed by CSIR to control COVID-19, Dr Harsh Vardhan appreciated the efforts of the CSIR scientists and said that developing more than a hundred technologies within three months shows their commitment to work. He further said that during this pandemic, the contribution of our scientists is commendable and they have proved how to serve the nation.

Launch of clinical trials website "CUReD: CSIR Ushered Repurposed Drugs"

The Union Minister Dr. Harsh Vardhan launched an online portal CuRED (CSIR Ushered Repurposed Drugs). A website developed by CSIR, will provide comprehensive information about the clinical trials of diagnostics, devices & drugs including ayurvedic interventions like AYUSH-64, Ashwagandha, Giloy etc. that CSIR is engaged in a partnership with ministries, Government Departments and Industries.

While addressing the event, Dr. Harsh Vardhan appreciated the efforts made by CSIR in being at the forefront to fight COVID-19. He also highlighted its role in giving priority to the clinical trials, helping the launch of drugs and diagnostics in the market, and generating data for the regulatory approval of the trials.



6.1.2. Significant S&T achievements

Major Achievements in Covid19 Mitigation

CSIR has undertaken multiple initiatives towards mitigation of Covid-19 from March onwards. Few significant achievements are highlighted below:

Diagnostic Testing of Coronavirus Samples

CSIR is involved in the testing of human samples for the presence of coronavirus infection using the RT-PCR test. Several of its laboratories are engaged in the work, and 13 CSIR labs across the country are testing, and as of mid-December, more than 7.0 lakh samples have been tested with CSIR-IITR and CSIR-CDRI having tested more than 1.5 and 1.0 lakh respectively. CSIR labs have also engaged in training of Human Resources for testing and have helped many hospitals and research institutes in carrying out RT-PCR. CSIR-CCMB is the only non-ICMR but ICMR-approved validation centre that is approved to test the different kits that are being used in COVID-19 testing.

Molecular Surveillance

CSIR laboratories have undertaken sequencing of SARS-CoV-2 to find the type of strains present in India and to understand if the virus undergoes genetic changes while it is spreading in the country. Several CSIR labs have sequenced the SARS-CoV-2 genome samples from Indian isolates, and more than 2000 have been sequenced and analysed providing insights into the strains prevalent in India.

Serological Surveillance

Several CSIR labs are participating in CSIR Phenome India Project led by CSIR-IGIB which is a long-term longitudinal observational cohort study of health outcomes within its employees with an aim to develop risk prediction tools and play an important role towards establishing precision health and medicine for the Indian population. In this regard, the Covid19 serological tests have been conducted across CSIR labs in the country spearheaded by CSIR-IGIB, and more than 10,000 samples have been tested. Repeat testing is on after three months for the positive cases.

Dry-Swab-Direct-RTPCR Diagnostic:

The simple and fast method of Dry Swab-Direct RT-PCR, developed by CSIRs constituent lab CCMB, Hyderabad, for scaling up of SARS-CoV-2 detection has been approved by ICMR based on their independent validation. This method is a simple variation of the existing gold standard RT-PCR method and can easily scale up the testing by 2 to 3 fold with no new investment of resources and training and makes diagnostic tests simpler, faster and cheaper scaling up the testing in the country immediately.

CRISPR/ Cas based paper diagnostic test FELUDA

A CRISPR/ Cas-based paper diagnostic test has been developed by CSIR. The FELUDA methodology has been developed in CSIR-IGIB for detecting single nucleotide variants in RNA or DNA or more broadly detecting any DNA or RNA fragment, without the need for sequencing. The principle of discrimination is derived from the natural property of the enzyme being used for the invention, *Francisella novicida* Cas9 (FnCas9) which shows a

very low binding affinity to mismatched substrates. CSIR has licensed this technology to TATA Sons. The kit has been approved by DCGI and TATA has launched this as Tata-MD CHECK.

Favipiravir

A cost-effective process of Favipiravir for the treatment of COVID-19 patients has been developed by CSIR-IICT. CSIR-IICT developed a cost-effective process using locally available chemicals to synthesise this Active Pharmaceutical Ingredient (API) and transferred the technology to Cipla. Cipla has launched this in the market as Ciplenza.

Sespivac (*Mycobacterium W*) for Covid-19

CSIR and M/s Cadila Pharmaceuticals Limited are conducting clinical trials to evaluate the efficacy of an existing gram-negative sepsis drug, called Sepisvac for COVID19 patients. The drug contains heat-killed *Mycobacterium* (Mw) and has been clinically developed and approved for gram-negative sepsis, a severe infection and is available commercially as Sepsivac® from M/s Cadila Pharmaceuticals Ltd. After successful completion of Phase II trials on critically ill Covid-19 patients, Phase III trials are underway.

Clinical Trials of Ayurveda based drugs for Covid19

For the prophylaxis and management of COVID-19 in the population with mild to moderate disease, CSIR and Ministry of AYUSH have joined hands to validate some of the traditional AYUSH formulations for their safety and efficacy through scientific evidence. Five clinical trials are currently under progress.

SwasthVayu: Bi-Level Positive Airway Pressure (BiPAP) System Portable Ventilator

CSIR-NAL developed a low-cost indigenised, non-Invasive bi-level positive airway pressure ventilator device named as "SwasthVayu". Developed in 36 days, it is a cost-effective device, easy to use in Make-shift hospitals, wards, dispensary and has three modes of operation, continuous, timed and spontaneous. It has successfully passed stringent electrical safety, performance, calibration, bio-compatibility tests at NABL accredited laboratory and certified. It has undergone clinical trials at many hospitals, and CSIR-NAL is providing 1200 ventilators to the Delhi Government.

Electrostatic Disinfection Unit

An electrostatic disinfection unit has been developed by CSIR-CSIO for a 360-degree area and uniform coverage, small droplet size, applicable for all fluid types. The technology was transferred to BHEL, Rite water, M/s. Jhosna Corporation and M/s. Dashmesh Industries. Close to 200 units have been produced. Further, the unit ENCEESPRAY was selected for Top COVID-19 Innovation Award with RITE Water Solution Pvt. Ltd, Nagpur, CSIR-CSIO and Univ. of Florida as partners by United States–India Science & Technology Endowment Fund (USISTEF).

Nasal-pharyngeal (NP) Swabs

CSIR-NCL has developed NP swabs that can be used for Covid19 sample collection. It is an appropriately small size for paediatric, nasopharyngeal or urethral genital sample collection. Approved by ICMR, the technology has been licensed to Ms. Chembond Polymers and Materials Pvt. Ltd. (CPML), Mumbai. CPML has now started commercial manufacturing of these nasal swabs under the name, "KEMYLON SWABS". The company has established a facility to produce 1 lakh swabs/day.

PPE Coveralls

CSIR-NAL in a joint Venture with M/s. MAF Clothing Pvt Limited has developed the PPE

Coveralls with Indigenous heat sealing tape and polypropylene materials. These are developed indigenously for frontline health workers involved in the containment zone of Covid-19. CSIR-NAL has prepared and implemented a strict Quality Assurance Plan, and the developed coverall passes ASTM F1670 and ISO 16603 tests and has been tested and passed for blood penetration test as required for covid-19.

Kisan Sabha App

Kisan Sabha App has been developed by CSIR-CRRI to connect farmers to the supply chain and freight transportation management system. This portal acts as a one-stop solution for farmers, transporters, and other entities engaged in the agriculture Industry.

Other (Non-Covid-19 related) Significant S & T Achievements

Drug Discovery

The IND application of IIIM-290 (anticancer lead) has been approved by DCGI, for conducting Phase I/II clinical trial in pancreatic cancer patients. The IND application of IIIM-160 (phytopharmaceutical lead) has been filed to DCGI to seek permission for conducting phase I clinical trial in rheumatoid arthritis patients.

Trials of car fitted with Fuel Cell Technology (LT-PEMFC) Stack successfully ran by CSIR and KPIT Ltd.

CSIR and M/s KPIT Technologies Ltd. successfully ran trials of India's first Hydrogen Fuel Cell (HFC) prototype car running on an indigenously developed fuel cell stack at CSIR-National Chemical Laboratory, Pune. The HFC technology uses chemical reactions between hydrogen and oxygen (from air) to generate electrical energy, eliminating the use of fossil fuels. Further, the fuel cell technology emits only water, thus cutting down the emission of harmful greenhouse gases along with other air pollutants. The fuel cell is a low-temperature PEM (Proton Exchange Membrane) type Fuel Cell that operates at 65-75°C, which is suitable for vehicular applications. CSIR and M/s KPIT Technologies Ltd have developed a 10 kWe (Kilowatt-electric) automotive grade LT-PEMFC (low-temperature PEM fuel cell) stack based on the CSIR's know-how.

Anaerobic Gas Lift Reactor (AGR):

CSIR-IICT has developed and patented a high rate biomethanation technology known as ANAEROBIC GAS LIFT REACTOR (AGR) for the generation of biogas and bio manure from organic solid waste like poultry litter, food waste, press mud, cattle manure, organic fraction of municipal solid waste (OFMSW), sewage sludge etc. This technology provides a decentralised treatment option for organic waste based on high rate biomethanation to generate biogas for combined heat and power (CHP) applications. This has been transferred to M/S Ahuja Engineering Services Pvt Limited, Hyderabad and M/s Nyrmalya Bio-Engineering Solutions Pvt. Ltd.

World's Largest Solar Tree

CSIR-CMERI has developed the World's Largest Solar Tree, which is installed at CSIR-CMERI Residential Colony, Durgapur. The installed capacity of the Solar Tree is above 11.5 kWp and has the annual capacity to generate 12,000-14,000 units of Clean and

Green Power. This Solar Tree is a Quantum Leap towards making an Energy Reliant and Carbon Negative India. The solar tree has 35 solar panels, each with a capacity of 330 watts. The solar panels connected through metal branches produce solar power. Has the potential to save 10–12 tons of CO2 from being released into the atmosphere every year. Since the shadow area is minimum in solar trees, they could be set up in agricultural farms to run pumps, e-tractors and tillers as an alternative to diesel. The excess power can be sent to the grid, providing an economic return to farmers.

Sustainable Road Pavements in High Altitude Regions using Geosynthetics'

Under the project 'Sustainable Road Pavements in High Altitude Regions using Geosynthetics' sponsored by the Ministry of Environment, Forest & Climate Change, different regions of the Indian Himalayan States like Arunachal Pradesh and Himachal Pradesh were chosen for the field implementation plan of the project. After having a preliminary design developed on the basis of laboratory model studies, different field test sections were laid at Lahaul & Spiti District of Himachal Pradesh in the month of August 2020 in addition to the previously laid test sections in Manali, Himachal Pradesh. Different combination and types of geosynthetic materials like Geogrid, Geocell and Geomembrane were considered in the study.

Made in India aviation weather monitoring system installed at Bengaluru International airport

An indigenously-developed **Aviation Weather Monitoring System (AWMS)** has been installed at the new runway of Kempegowda International Airport (KIA). With this, KIA has become the first airport in the country to install indigenous AWMS technology, developed by Bengaluru-based CSIR-National Aerospace Laboratories (NAL), at both ends of the new runway. In addition, KIA has installed four Drishti transmissometers – also developed by NAL, in association with the India Meteorological Department (IMD) – to measure the runway visibility range (RVR). KIA has the unique honour of having NAL's 50th Drishti installed at its runway. The Drishti Transmissometer is acclaimed for precise reporting, helping pilots with an accurate runway visual range. With the web-enabled feature, the data can be accessed, and maintenance carried out from any location. Meanwhile, the 10-meter mast on which AWMS sensors are installed is a first-of-its-kind, designed by NAL, with several unique features, including being eco-friendly and lightweight, with a life of over 60 years. The sliding mechanism enables easy maintenance - a useful feature-considering the busy traffic on the runway. Manufacturing Technology for DRISHTI Transmissometer has been transferred to TATA Power Company Limited -

Strategic Engineering Division, Bangalore.

One of the four Drishti transmissometers installed at the KIA runway to measure Runway Visibility Range (RVR).

Aviation Weather Monitoring System

Drishti Transmissometer

Indigenous Sodium metal production technology

The total demand for sodium metal in India is very high, and the demand is being met by import only. CSIR-NML has started the activity for production of sodium metal from 2008 onwards and based on the success, a pilot plant of 3000A capacity was installed and commissioned at the site of SRHHL, Kurnool in 2019. The 3000A closed cell was fabricated and successfully commissioned and operated continuously for a month and produced a significant amount of required grade of sodium metal with a cell efficiency of 82% and with a minimum purity of 99.8%. Based on the pilot-scale operation, the setup of an industrial plant is under progress at the site of SRHHL, Kurnool at their premises in association with CSIR-NML's technical expertise. The proposed plant is aimed to produce 2 ton/day sodium metal, and the plant is expected to be commissioned by 2021. Technology is for beneficiation of low-grade Limestone containing finely disseminated Silica grains for utilisation in the cement making industry

Technology for production of Tungsten metal powder from plant tailings or waste sample

Tungsten is a strategic metal and has critical applications in defence, mining and other sectors. Indian tungsten demand is mostly met through imports. Chinese monopoly in global tungsten supply, fluctuating international prices places us in a situation where development of indigenous technology for production of tungsten from domestically available resources (lean grade ores/ tungsten-containing mine/plant waste) becomes imperative. CSIR-NML has developed a technology for production of Tungsten metal powder from plant tailings or waste sample. This is a novel route for beneficiating extremely fine-grained and low tungsten assaying plant tailings/waste material to a product suitable for extraction of tungsten through hydrometallurgical extraction of tungsten from pre-concentrate involving alkali leaching, solvent extraction & crystallisation of ammonia para-tungstate (APT). The process delivers high purity (99.9%) tungsten metal powder from a high-temperature reduction of APT.

High-Power S-band, 2.6 MW, Magnetron

Magnetron, a high-powered vacuum tube, is an essential component for Medical LINAC (Lineal accelerator), which are widely used for external radiation treatment of cancer patients. CSIR-CEERI had, recently, designed and developed 2.6 MW S-band tunable pulsed Magnetron, which was successfully tested and used as a microwave source, to generate the required X-ray dose

using a LINAC system for Cancer treatment. On July 14, 2020, the technology know-how for S-band Magneton was transferred to M/s Panacea Pvt. Ltd., Bangalore, known for developing advanced radiotherapy systems for Cancer treatment.

Introduction of Asafoetida (Heeng) cultivation in the Indian Himalayan region

A historical shift in farming practices is in the offing with farmers of the remote Lahaul valley in Himachal Pradesh taking up cultivation of asafoetida (Heeng) to utilise vast expanses of wasteland in the cold desert conditions of the region. In their efforts, the farmers are being supported by scientists of the CSIR-IHBT, Palampur, who brought in seeds of asafoetida and developed its agro-technology. Since asafoetida is a major condiment in Indian cuisines, team CSIR-IHBT made relentless efforts for introduction of this important crop in the country through proper channel and finally, the institute introduced six accessions of seeds from Iran through ICAR-National Bureau of Plant Genetic Resources (ICAR-NBPGR), New Delhi.

The first seedling of asafoetida was planted by Dr. Sanjay Kumar, Director, CSIR-IHBT on 15th October 2020 at farmer's field in village Kwaring of Lahaul valley to mark the initiation of cultivation of asafoetida in India.

Foundation for Aerospace Innovation, Research and Entrepreneurship **(FAIRE),** a non-profit technology business incubator for aerospace & allied engineering is being set up by NRDC & FISE at CSIR-NAL, Bengaluru. The facilities, technologies, knowledge base, etc. from the CSIR-NAL will be brought in for commercial exploitation to the potential start-ups and MSMEs for the introduction of novel products and services.

6.1.3 Scientific Excellence

CSIR has published 5010 research papers during 2019 in SCI journals of repute. The new knowledge generated from CSIR laboratories is reflected in terms of high average Impact Factor (3.713)

6.1.4 Excellence in Intellectual Property

CSIR has filed 176 patents abroad and 175 patents in India during 2019-20, and it has been granted 288 patents abroad and 204 patents in India.

CSIR's Copyright Filing: CSIR has also explored the possibility of obtaining rights over other forms of IP generated by various laboratories. CSIR has filed 38 Copyright applications during 2019-20. The Copyright applications filed by CSIR subsist in different categories such as literary work, software and artistic work

6.1.5 Value Generation through External Cash Flow:

CSIR has generated External Cash Flow of Rs. 1815.85 crore during 2019-20, by working

with various Govt./ non-Govt. Indian and foreign organisations.

ECF (Rs in crore)	
Government	**1627.3**
Private	**177.4**
Foreign	**11.1**
Total	**1815.8**

6.2 CONSULTANCY DEVELOPMENT CENTRE (CDC):

The 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 has been getting an annual plan support from DSIR for carrying out schemes, projects and activities aimed largely at competency enhancement and capacity building of consultants in the country.

During the year, CDC undertook various activities keeping in view its mandate of promotion and development of consultancy covering capacity building, creation of trained human resources in the consulting domain and facilitation of client organizations in the selection of right consultants for their projects.

7. PUBLIC SECTOR ENTERPRISES

7.1 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 1800 patents.

During the period under report, NRDC has signed **34** MOUs/MOAs/Agreements with Institutions/Organizations for intellectual property protection, technology commercialization, technology consultation and other value-added services. During the financial year **109** new processes/technologies were assigned to the Corporation for licensing

and NRDC managed to sign **19** license agreements. The consolidated Lump sum Premia & Royalty income is 691.58 Lakhs for NRDC.

7.2 Central Electronics Limited (CEL):

Central Electronics Limited (CEL) is a 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. 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, Space, Atomic Energy. (iii) Signaling and Safety in Public Transport Systems (iv) Infrastructure, Eco-systems management and energy conservation and (v)Security and Surveillance in strategic establishments. CEL has been the pioneer in the country in the different areas of manufacturing &proprietary manufacturer of the many strategic electronic components for use by defense organizations 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 the country through its own R & D efforts and in close association with the premier National & International Laboratories including Defense Laboratories.

The Company has achieved production of Rs.249.09 Crore and turnover Rs.246.00 Crores. CEL is a continuous profit-making organization since FY2013-14. It has highest ever Networth of Rs.80.76 Cr. as on 31.3.2020 with positive reserves and Debt equity Ratio less than 15% as on 30.09.2020.

INDUSTRIAL R&D PROMOTION PROGRAMME

(IRDPP)

INDUSTRIAL R&D PROMOTION PROGRAMME

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:

- Bring in-house R&D into sharper focus;
- Strengthen R&D infrastructure in industry and Scientific and Industrial Research Organisations (SIROs);
- Promote R&D initiatives of the industry and SIROs;
- 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:

- In-house R&D in Industry.
- Scientific and Industrial Research Organisations (SIROs) and
- 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 Units

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 issue 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.

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 exclusive-

ly 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 units 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, and 2340 in November, 2020. Of these nearly **1904** are in the private sector and the remaining units are in public/joint sector. The last 'Directory of Recognized in-house R&D Units' was brought out in December, 2017 and it 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 three year existence of the company for according short term fresh recognition was relaxed to Biotech Start-ups established in Incubation Centre or Technology Park with effect from July 2015. 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 and invited for 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.

During the period under report, the Screening Committee met **11** times and **169** applications received for recognition. During the period under report, the screening committee considered **154** applications including new application and deferred cases. During the period under report, total cumulative disposal were 193 applications, of which **102** R&D units were granted fresh recognition based on their satisfactory R&D Infrastructure, Qualified Manpower and Programmes; **7** applications were deferred and **91** 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 **248** 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 since 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 2020, **631** in-house R&D centres were due for renewal of recognition out of which **596** applications were received. During the period under report, the Research Review group (RRG) met **6** times. Based on the evaluation of the performance of the R&D centres, renewal of recognition was granted to **506** R&D centres. 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 Infrastructure

The in-house R&D centers have created State of art design & simulation facilities, Prototyping, fabrication, analytical, 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, shop floor for fabrication, design software's, predictive testing and advanced raw material characterization facilities for carrying out their research activities.

The major equipment include: Automatic Seed cum Fertilizer sowing machine,

Drip & Sprinkler Irrigation System, combined load bank 500, Data logger along with Temperature sensors & actuators, Flash chromatography by CombiFlash, Catalyst screening systems (Six reactors in parallel), Malvern Zetasizer Nano ZS90, CGMP colloid mill 3HP , Pigment Grinding Mills, pultrusion machine , UTM machine, Radleys Reactor, Safety Can with metering device, Muffle Furnace, XRD Instrument, LC-MS Orbitrap, ICP-MS, 500 Spectrophotometer, Humidity Chamber, PGM (NGS) Equipment, Next Seq 500 Seq.System, DNA Sequencer 48 Capillary, QPCR System, DNA Synthesizer, Ultrasonicator, Auto samplers, Agricultural Tractor, Pressure Regulators, RF receiver 2.4 GHz type, Pedal Force Transducer for 4 Wheelers, LC MS QQQ System with 1290 UHPLC, Moving Die Rheometer, Fusion Instrument , Standards of ICP, Spares of XRF, DSC and Sedigraph, Fusion Instrument, Magnetic Detector, Optical Fiber Sensor, Torque Signal Cable, Torque Transducer, Fiber glass cloth, Vertical CNC Milling, Emulators EVM, Vaccum Furnace, 5-Axis milling, CNC blade bending machine, Electronic Crock meter CMC103886, Auto die cutting machine, Digi-

tal Dev Platform, FTIR, Electron beam welding, Horizontal CNC lathe, Homogenizer, Rotovapor, Dissolution Apparatus, NMR SFC Analyzer,

1.2.4 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 2340 in-house R&D units is over 1,97,845.

1.2.5 Achievements of In-house R&D Units

Some of the R&D achievements reported by the recognized in-house R&D units are listed below:

Agricultural Sciences:

- Development of full season single and double cross hybrids in yellow and white corn suitable for kharif and winter cultivation.
- Development of new varieties of food grains like rice, wheat, maize, bajra etc.
- Development of new varieties of vegetables like ocra, chilli, tomato, bringal, cauliflower, cucumber etc.
- Development of smart pisciculture and feed formulation for aquaculture
- Development of new varieties of poultry having traits of early maturity, good feed conversion ratio and innovative feed formulation for poultry
- Development of Sixer- organic fish arch which is used for itching sensation to the insects and also organic manure helps to protect the plant health.
- Development of specific/ specialized products like sweet corn, baby corn, popcorn, oil corn, high protein corn and high starch corn etc for value addition.
- Development of Kitogold, a chitosan and essential oil based fungicide (for the control of foliar as well as root pathogens including bacteria)
- Development of Pushpgold, cut flower food to increase shelf life of the cut flowers in the vase; it is being tested in the nursery on growing plants too
- Development of Shaktivaan having Triacontanol, a plant growth promoter
- Development of Sterial Bio Synthesis Inhibitor (SBI) as fungicide, insecticide and nematicide
- Development of embedded software products with IoT and AI for animal farm management to smart control and coordination in the whole value chain of milk production management like milk collection, milk transport, milk chilling and milk distribution
- Development of embedded system, "Contrak" is to help remotely monitor bulk milk and rapid milk chillers that are deployed in the procurement chains (specifically in Chilling Centers) in the dairy companies
- Development of a phosphorous solubilising fungi (avatar), a biofungicide is made up of beneficial fungi and bacteria that colonize and assail plant pathogens, thereby thwarting the diseases they cause
- Development of new products such as Bispyribac sodium, Diafenthiuron & Indoxacarb and improvement in existing products such as Diafenthiuron, Indoxacarb & Fluopicolide.

Biological / Biomedical Sciences/Pharmaceuticals:

- Clinical Studies of Metadichol; Novel TMPRSS inhibitor as therapeutic target for Anti-SARS-COV-2 in collaboration with NanoRx, USA
- Preclinical development of novel Immunomodulatory Peptides as therapeutic target for Respiratory viral infections in Association with Neo7Logix LLC, USA
- Preclinical development of novel glucagon-like peptide-1 receptor agonist for Diabetes management in collaboration with Bhami Research, India
- Preclinical Development of novel anti-HIV reverse transcriptase inhibitors
- Development of camel anti-IL-6 humanized antibody and Evaluation of anti-IL-6 as a therapy for COVID-19 infections
- Development of a method for the quantitative estimation of BCR-ABL transcripts
- Development of a method for the qualitative detection of PML-RARa transcripts
- Development of Vaginal Tightening & Rejuvenation serum
- Alternate process development of 2,3,4 Trimethoxy Benzaldehyde
- Indigenous novel process development of API-Favipiravir
- MDI Formulation development of Remdesivir
- Development of N,N'-Dicyclohexyl carbodiimide product as import substitute.
- Developed process of Nitrofurantoin Monohydrate and Nitrofurantoin Macrocrystal
- Development of Fiber blanket system for phototherapy
- Development of IOT Systems: This is a system for neonatal application, where the temperature as well as phototherapy
- Development of a wearable device for dead and dumb
- Development of APIs like Efavirenz Tablets USP 600mg, Darunavir Tablets 600mg, Tenofovir Disoproxil Fumarate & Emtricitabine Tablets (300mg+200mg)

Chemical Sciences:

- Development of Extraction technology of alumina from Partially Lateritised Khondalite (PLK) with acid route
- Development of Basecoat and clear coat technology with improved appearance, acid-epoxy chemistry, improved scratch performance
- Development of FRP Pultruded Gratings used for Flooring, walkway, Stair treads
- Development of FRP Rod for Optic Fiber Cable which is used as a central strengthening member or embedded in a sheath
- Development of lithim ion Battery packs for electric scooter, bike application
- Development of improved Process for the Preparation of Escitalopram Oxalate-S(+) Dapoxetine and Luliconazole
- Development of Biofibre enzyme cocktail (FIBERZYME for the treatment of raw bast fibres
- Development of Palm oil enzyme cocktail for enhancing Oil recovery from palm fruit (POWER)

- Development of Citicoline Sodium commercial feasible process to give injectable grade API.
- Development of Phosphoryl Choline chloride Calcium salts (PCCS) for Citicoline sodium and product development for backward integration.
- Development of Zn-Mn (3%,6%,10%) alloys for dry cell batteries, replacing lead , bismuth and other heavy metals to prevent environmental pollution.
- Development of Al-3Ti-1B Advance Grain refiner provides better grain refining efficiency even after 20% reduction in addition rate as compared to Al-5Ti-1B
- Development of process for 2-Butyl1-3-diazospirol (4,4)-non-l-en-4-one; (S)-3-Amino-1,2- propanediol hydrochloride; 3-(Chloro Phenyl) Boronic acid; 2-Methyl 3-Nitrophenylacetic acid; 3,4-dihydro-6-hydroxyquinolin-2(1H)-one.
- Development of new products such as Anaerobics -5, Epoxies-33, Silicones-20, Synthetic elastomer solvent based -6, Synthetic elastomer tapes, putties Polyurethane-4, and Polyurethane-5.
- Development of new products such as ROR 6115FF, 108PB, FPB N, 7111FF, NFIB (BR), CP110, Offset varnish 10, CP series, 611NT, IXAS G 11J, and NPS, IV blue 10

Engineering / Information Technology :

- Development of Centrally monitored Wireless Emergency Lighting Solution
- Development of Environmental Control System Integration in Nuclear Submarines
- Development of smart IoT enabled Air Sterilization Unit for covid ward
- Development of Mineral Fortification for RO Products
- Development of Auto Fresh Cycle development water heater
- Development of IoT enabled smart Chimney with noise reduction
- Development of indigenized Ring Shroud assembly
- Development of Vent Glass Assembly
- Development of Spray Suppression Systems
- Development of Plastic Injection Molded Mud Guard
- Development of wall mounted light pipe and sunlight output measurement-light integration boxes
- Development of new products for the pharma industry such as Bin Washing System; CIP Trolley; 12Bar PCS System; Dipbath Washing System; Rotor Insert for Dry Powder Layering.
- Development of concrete mix design for 3D printable concrete, synthesis of carbon nanostructures from waste etc. and new processes developed such as Process for Beneficiation of Low Grade Bauxite, Grain refinement in AA 3003 Flat Rolled products, Anodized quality of AA5052-H32 sheets.
- Development of HV DC EP Contactor, HV DC EM Contactor, Master Controller, Earthing Switch for On Board application, Safety Interlocking System, Passenger information Display Systems for Road vehicles and Railway / Metro Systems and Bus Shelters.
- Development of 10-line tint manufacturing, fast drying PU Eco Primer 4210-02; low bake TSA system, unicoat sunrise orange.

- Development of new products such as Platina ES UG, BM 125, V12, V15 BSIV, Platina UG ES / KS BSIV, CT 100 BSIV, CT 100 B BSIV.
- Suspension Bearing Grease for ALCO locomotives of Indian Railways, synthetic traction gear case oil for Indian Railways, Energy efficient synthetic Gear Oil (VG 150 TO VG 680), High performance grease for Aluminum Overhead Electrical conductors, chlorine Free water soluble Cutting oil for machining Hard Materials.
- Development of Amogha Anti-Tank Guided Missile (ATGM), Counter Measures Dispensing System (CMDS) for Light Combat Helicopter (LCH), CMDS for mirage aircraft, I n - tegrated level test system for IMI make CMDS.
- New steel development to minimize AGG during HT, New steel development for high temp carburizing, RF Homing Sensor, software defined RF sensor.
- BrahMos Missile Container, BrahMos Air-Borne Launcher, RFQ (Radio-Frequency Quadrapole), F3 Metallic Section, Cryo Engine, accum Brazing for RFQ, Electron Beam welding of Ti alloys, Nickel Aluminide & Aluminum coating for SITVC tanks, Titanium Anodizing of MAC.

1.2.6 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: Radleys Reactor, Safety Can with metering device, Muffle Furnace, XRD Instrument, LC-MS Orbitrap, ICP-MS, 500 Spectrophotometer, Humidity Chamber, PGM (NGS) Equipment, Next Seq 500 Seq.System, DNA Sequencer 48 Capillary, QPCR System, DNA Synthesizer, Ultrasonicator, Auto samplers, Agricultural Tractor, Pressure Regulators, RF receiver 2.4 GHz type, Pedal Force Transducer for 4 Wheelers, LC MS QQQ System with 1290 UHPLC, Moving Die Rheometer, Fusion Instrument, Standards of ICP, Spares of XRF, DSC and Sedigraph, Fusion Instrument, Magnetic Detector, Optical Fiber Sensor, Torque Signal Cable, Torque Transducer, Fiber glass cloth, Vertical CNC Milling, Emulators EVM, Vaccum Furnace, 5-Axis milling, CNC blade bending machine, Electronic Crock meter CMC103886, Auto die cutting machine, Digital Dev Platform, FTIR, Electron beam welding, Horizontal CNC lathe, Homogenizer, Rotovapor, Dissolution Apparatus,NMR SFC Analyzer 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 and concessional GST 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. 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.

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. Retrospective approval is not granted.

During the period December 2019 to November 2020, the Screening Committee met 9 times and recommended 39 cases for recognition as SIROs. These include 26 cases in the Natural and Applied Sciences, 2 cases in the area of Agricultural Sciences and 11 cases in the area of Medical Sciences. The sector-wise list of these SIROs is furnished at **Annexure - 3.** Out of the 39 recognized SIROs, 28 SIROs were issued registration certificates for obtaining customs duty exemptions and concessional GST.

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 2019 to November 2020, RRG met 05 times and recommended 159 SIROs for renewal of recognition beyond 31.03.2020 excluding the cases under consideration. Out of the 159 recognized SIROs, 57 SIROs were issued registration certificates for obtaining customs duty exemptions and concessional GST. During the period, RRG also recommended 3 SIROs for renewal of recognition beyond 31.03.2019.

At present, there are 725 SIROs duly recognized by DSIR; of these, 361 are in the area of natural and applied sciences, 266 are in the area of medical sciences, 38 are in the area of agricultural sciences and 60 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

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:

- Income-tax relief on R&D expenditure (capital & revenue);
- Weighted tax deduction U/s 35(2AA) of IT Act 1961 for sponsored research programs in approved national laboratories, universities and IITs;
- 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.
- Customs Duty exemption on capital equipment, spares, accessories and consumables imported for R&D by approved institutions/SIROs;
- Customs Duty exemption on specified goods (comprising of analytical and specialty equipment) for use in pharmaceutical and biotechnology sector;
- Accelerated depreciation allowance on plant and machinery set-up based on indigenous technology;
- 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 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, 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.

1.4.4 Concessional GST to Recognized & Registered SIROs

The SIROs recognized by DSIR (other than hospitals) are eligible for concessional GST on import 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.

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

Ministry of Finance has issued 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. 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 above amendments, all DSIR recognized in-house R&D units other than hospitals can avail customs duty exemption and concessional GSTon their procurements for research purposes. All the eligible in-house R&D units recognized by DSIR have been issued the certificates of registration.

1.4.6 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.

1.4.7 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 and accessories and consumables for research purposes through a simple 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 and corrigendum dated 22.07.2017-Custom Notification no. 43/2017 dt 30.06.2017. Ministry of Finance has 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 is that Regional Cancer Centres 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 required amendments in the constitution 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 would be treated as inter-state supplies and would be subject to integrated tax (IGST) in addition to the applicable customs duties. For latest update visit 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 has granted concessional GST benefits to Public funded research institutions, universities, IITs, IISc., Bangalore; Regional Engineering Colleges (other than a hospital).

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.

The Screening Committee met twice during the period under report and considered **33** applications received from various public funded research institutions. During the period under report, **22** registration certificates were issued to such public funded research institutions for availing Customs Duty exemption on import of scientific equipment, spares and accessories, consumable items and concessional GST benefits for Scientific Research Purposes. There are about **592** PFRIs registered by DSIR. The registration to public funded research and other institutions mentioned in the notification is granted for maximum period of five years. The registered institutions are advised to apply for renewal of registration well in advance of the date of expiry of the registration.

During the period under report, **112** institutions were due for renewal of registration. The department received **126** renewal applications, including **14** due from previous years. These were processed on individual files and approval of Competent Authority was obtained and **121** renewal certificates were issued.

1.4.8 Approval of In-house R&D Centres 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 has been lowered from 200% to 150% from 1st April 2017. The expenditure on scientific research (not being expenditure in the nature of cost of any land or building) on in-house research and development facility is incurred in assessment year beginning on or after the 1st day of April, 2021, the deduction under this clause shall be equal to the expenditure so incurred.

During the period from January 2020 to November 2020, new approvals in Form 3CM were accorded to **59** companies under Section 35(2AB) of Income Tax Act, 1961. A list of such companies is furnished in **Annexure 4.** Further, reported R&D expenditure of Rs. **5983.22** Crores for **405** approved companies in Form 3CL were also issued to CCIT as prescribed in IT Act.

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

PROMOTING INNOVATIONS IN INDIVIDUALS, START-UPS AND MSMES (PRISM)

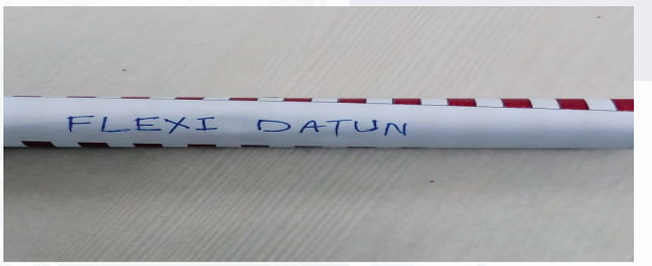
1. PREAMBLE

Department of Scientific and Industrial Research (DSIR) has launched a new programme viz. Promoting Innovations in Individuals, Start-ups and MSMEs (PRISM) during 12th Five Year Plan. The Scheme has now been extended till 30.03.2021. The programme aims at 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 now a component scheme of Industrial Research and Development (IRD) Scheme of DSIR. The Department has supported around Nine (09) new projects during the period under report i.e. from 01.04.2020 to 30.11.2020. The department also rendered financial support to **7 (seven)** ongoing projects during the period from 01.04.2020 to 30.11.2020. The details of the new projects and ongoing projects supported under PRISM are given in **Annexure-5.** The Department has also successfully completed **Six (06)** PRISM projects during the period under report i.e. from 01.04.2020 to 30.11.2020. The details of the completed projects supported under PRISM are given in **Annexure-6.**

2. HIGHLIGHTS OF SOME OF THE COMPLETED PRISM PROJECTS

2.1 Flexi Datun

The PRISM project "**FLEXI DATUN"** is executed by the innovator, **Sh. Shailendra Rakhecha, Kolkata** through the TOCIC (TePP Outreach cum Cluster Innovation Centre) at CSIR-CGCRI, Kolkata. The innovator designed and developed a bio degradable and ecofriendly natural toothbrush which may be termed as "Flexi Datun". The product is made from recycled paper along with edible natural binding adhesive and other natural ingredients. The product is hygienic and sterilized. The product can be cut as per required size for brushing. This is basically the replacement of Neem Datun, Babla datun etc. These natural datun (natural toothbrush) mostly used in rural India are very hard on gums. Direct use of natural datum from trees may also infect with germs and finally this natural datun is not flexible enough to clean the teeth from all corners. The "Flexi Datun" can solve all these problems and large scale production can reduce the price and of comparable to natural datun. The "Flexi Datun" idea has already won the award for Original Start up idea in IFLA-2018 organized by INFOCOM in Kolkata. The project has been successfully completed.



Flexi datum

2.2 Self Propelled 3- Row Potato Seeding Device for restricted holdings

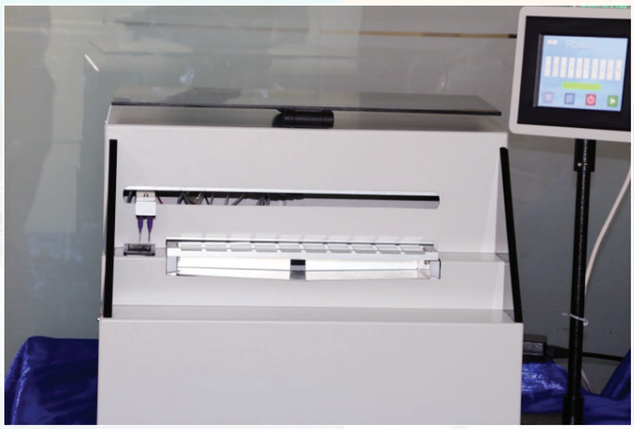
The PRISM project "**Self Propelled 3- Row Potato Seeding Device for restricted holdings"** is executed by the innovator, Shri S. K. Abdul Aziz, Burdwan, W.B through the TOCIC (TePP Outreach cum Cluster Innovation Centre) at CSIR-CMERI, Durgapur. The innovator designed and developed Self Propelled 3- Row Potato Seeding Device which performs the tasks of digging furrows at proper depths for planting potatoes, plant-

ing the seed potatoes at the proper depth and providing soil cover for the protection and eventual germination of the seeds. The primary attraction of the device is that it helps in drastically reducing the time required for planting of potatoes, as it appropriately mechanizes the three main functions required for sowing. The device simultaneously creates irrigation furrows for subsequent irrigation. It has been estimated that use of this device can afford savings up to 80% in the labour cost and up to 75% in the time required for sowing potatoes. The product is a novel and economic agricultural machine which has been designed and developed with the specific purpose of easing planting of potato and speeding up the entire process of planting utilizing minimum labour through mechanization. The project has been successfully completed.

Self Propelled 3- Row Potato Seeding Device for restricted holdings

2.3 Peripheral Blood Smear Instrument

The PRISM project "**Peripheral Blood Smear Instrument"** is executed by the innovator, Shri Sandeep Khua Zope, Palghar (Maharashtra) through the TOCIC (TePP Outreach cum Cluster Innovation Centre) at CSIR-CSIO, Chandigarh. The innovator designed and developed peripheral blood smear staining machine. The machine is capable of performing automatic staining of blood smear with user define programs with accuracy and consistency. This machine works on valves and special function of pumps. Presently, blood smear staining is carried out manually or by using spray technology. The work is routine in nature and very laborious. Attendant is required to sit for long hours and carry out the procedure. The product will be useful for automation of a manual process which ensures uniform staining of each slide, no fatigue for laboratory attendants, zero error because of automatic controlling of timing cycle, consistent staining layer, better straining resulting in an enhanced diagnosis of patient's diseases. The project has been successfully completed.



Peripheral Blood Smear Instrument

2.4 IoT Based Affordable Cattle Monitoring System (working prototype) for Empowerment of Indian Farmers

The PRISM project "**IoT Based Affordable Cattle Monitoring System (working prototype) for Empowerment of Indian Farmers"** is executed by the innovator, **Ms. Debeshi Dutta, Durgapur** through the TOCIC (TePP Outreach cum Cluster Innovation Centre) at CSIR-CMERI, Durgapur. The innovator designed and developed a device which focuses on cattle position, tracking during grazing, cattle health assessment from body temperature or rumination patterns and determination of best time for fertilization. This would be achieved by an IoT enabled afford-

able cattle management system what houses two modules. The first module comprises of a cattle neck belt that incorporates GPS sensor for location tracking, temperature sensor, accelerometer and other supporting circuitry for cattle health and rumination monitoring. The second module collects data from a number of cattle neck belts worn by cattle and processes them to send necessary alerts to the farmers / owners via SMS. Such a system would ensure simplicity and robustness. The innovation will help cattle farmers for ease animal husbandry. The project has been successfully completed.

IoT Based Affordable Cattle Monitoring System

3. OTHER ACTIVITIES

A number of other activities were organized / participated by DSIR along with TOCICs during the year to sensitize academia, disseminate information on PRISM to the larger mass of the populace network partners and impact generation among common masses.

PATENT ACQUISITION AND COLLABORATIVE RESEARCH AND TECHNOLOGY DEVELOPMENT (PACE)

PATENT ACQUISITION AND COLLABORATIVE RESEARCH AND TECHNOLOGY DEVELOPMENT (PACE)

1. PREAMBLE

The Department of Scientific and Industrial Research (DSIR) is continuing to operate the 12th Five Year Plan scheme on "Patent Acquisition and Collaborative Research and Technology Development (PACE)" during 2017-2020. The 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. The scheme also jointly supports 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 are being supported for development and demonstration of technologies.

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. Focus sectors include (i) Energy & Environment, (ii) Affordable healthcare including Drugs & Pharmaceuticals and Medical Equipment & Devices (iii) Agriculture, food & nutrition, (iv) Engineering (such as automobiles & autocomponents, machine tools & foundry, automation & robotics, sensors etc.), (v) Specialty Chemicals etc.

2. 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 jointly support initiatives of other Ministries / Departments aimed at technology development and demonstration, e.g. IMPRINT initiative of Ministry of Human Resource Development and DST, wherein institutions of higher learning are being supported for development and demonstration of technologies.

iii. 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. ONGOING TECHNOLOGY DEVELOPMENT AND DEMONSTRATION PROJECTS DURING 2020-21

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

M/s Sanzyme Ltd., Hyderabad in collaboration with Department of Pharmaceutical Sciences & Technology, Institute of Chemical Technology, Mumbai had undertaken a project on "Development of Controlled Release (CR) Formulation of Natural Highly - Purified Human Chorionic Gonadotropin (hCG) under PACE-TDD scheme. Natural highly purified hCG (99%) is used as a surrogate for LH (Lutenising Hormone) for triggering ovulation and maintenance of pregnancy. The role of hCG is not restricted to infertility treatment 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. Currently two forms or variants of hCG are available, either as highly purified form or the recombinant version of hCG. Despite recombinant version being available, only a single dosage form is available for clinical use. The project aims to improve compliance and reduce the frequency of injections and make the treatment more affordable and available to masses rather than to people of a certain class alone. The CR formulation using nano technology with release rates of either 15 or 30 days will reduce the frequency of injections required in infertility problems, maintenance of pregnancy and controlling metabolic disorders such as Diabetes. Project has demonstrated high serum level of hCG loaded PLGA microsphere formulation as compared to marketed formulation in pre-clinical animal studies. Stability studies performed using gel electrophoresis indicated intact single band of hCG in the formulation as similar as standard hCG. In addition, bioassay study of hCG loaded PLGA microsphere formulation in animal model showed bioactive nature of hCG. Project is currently looking forward to devise a method to scale up and latter commercial application. The project has been 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. The Project is under progress.

3.2 *Next Generation Data Processor Unit (NGDPU)- Rajasthan Electronics & Instruments Limited, Jaipur*

M/s Rajasthan Electronics & Instruments Limited, Jaipur manufactures Data Processor Milk Collection Unit (DPMCU), a dedicated unit which receives, processes and transmits data and is used by various milk collection agencies in the dairy sector as one of its product line. The company is looking at new requirement for a scalable and modular product and has undertaken to develop and 67 commercialize Next Generation Data Processor Unit (NGDPU) with a dedicated Single Board Computer based solution with customized hardware & software design having all smart and advanced features at a cost that is lower in comparison to their existing and prospective customers. The NGDPU will have a number of smart features and functionality of performing transaction viz. instant data upload on centralized server, instant calculation for payment etc. Initial prototype has been integrated and tested. NGDPU initial box design is ready with Interface PCB has been designed and tested successfully, interfacing with peripherals like Milk Analyzer, Printer, EWS and DI has been performed successfully. Software has been developed that includes Milk transaction (taking milk FAT and SNF data from Milk Analyzer, weighing data from EWS, slip printing and displaying the data in DI), Shift end summary, dispatch and rate pick-

ing.The project has been recommended for DSIR loan support of Rs. 40.00 lakh out of total project cost of Rs.117.00 lakh. The Project is under progress.

3.3 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 -M/s 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 establish a 100 litres suspension culture pilot plant facility. The company is currently manufacturing the targeted secondary metabolites by direct extraction methods and the current project proposes to upscale and optimize the procedure developed at lab level through 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 is expected to lead to cost reduction, reduction in energy consumption /emissions and would have positive impact on environment by sparing the medicinal plants from destruction. Project team were able to extract the cambium layer, able to grow it in varied solid medium and were able to sub-culture it for further proliferation. They were also able to extract secondary metabolites via solvent extraction method and performed standard analytical test to confirm the metabolite. Since inception of the project, project team were able to report best culture medium / conditions for the initiation of callus from 3 woody plant species. The project has been recommended for DSIR loan support of Rs.150.00 lakh out of a total project cost of Rs.329.65 lakh. The Project is under progress.

4 TECHNOLOGY DEVELOPMENT PROJECTS UNDER IMPRINT INITIATIVE

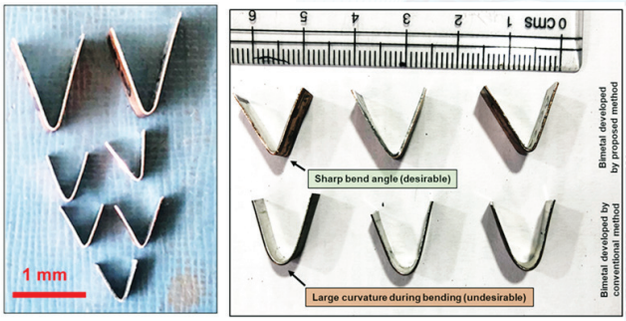
IMPacting Research INnovation and Technology (IMPRINT), the first-of-its-kind Pan-IIT and IISc joint initiative, is a Ministry of Education (MoE) and DST initiative to address major engineering challenges that the country must address and champion to enable, empower and embolden the nation for inclusive 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 microforming applications - IIT Madras

The project aims to develop micro deep drawn components made up of bimetals with ultrafine grained microstructure. Such micro-components have potential application in many industries such as consumer electronics, telecommunication, micro electro-mechanical system (MEMS), aerospace and defence. For this purpose, a novel approach involving combination of cryorolling (CR), warm roll bonding (RB) and asymmetric rolling (AR) have been used, aimed to fabricate thin bimetallic sheet, with

equiaxed ultra-fine grained (UFG) microstructure. Possible advantages of using such material in microforming are: (i) Improved microformability by engineering desirable texture (ii) Overcoming challenges associated with size effect as observed during micro-manufacturing (iii) Strong interfacial bonding at bimetallic interface (iv) Excellent mechanical strength due to presence of UFG microstructure.

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 nanometric 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. 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 project is under progress.



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

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

A recipe was developed for batch fabrication of tip-less AFM probes. Suitable masks were designed and fabricated. Subsequently, batch fabrication of tip-less AFM probes has been successfully completed. The probes were fabricated using Silicon-on-insulator wafers by employing a combination of dry etching and wet etching. AFM tips have been fabricated on a substrate with the help of dry etching techniques. AFM probes with tips have also been successfully fabricated. New masks have been designed and fabricated for AFM cantilevers and the batch fabrication process of AFM probes with tips has begun. Masks have been designed for batch fabrication of detachable tips and the batch fabrication process has been started. Investigation of an alternate design for the AFM probe has been undertaken, wherein the AFM probes would pick up tips by employing solid materials that can be temporarily melted by application of heat. Two materials were successfully evaluated for this capability, namely, paraffin wax and polycaprolactone (PCL). Centrifugal atomization has been employed to generate wax microspheres. The heating was provided by a green laser diode (wavelength 532nm) of power about 6mW focused on a tip-less micro-cantilever beam.

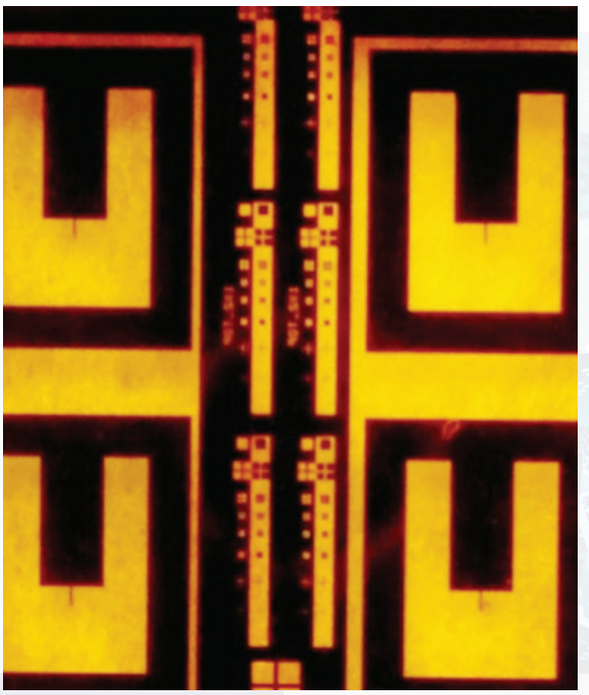
A Vibration Isolation Table has been purchased for development of an AFM with automatic tip-exchange capability. Automated tip pick-up been experimentally demonstrated. Automated tip detachment has been demonstrated. Fig. 6 shows the process of tip detachment. The tips picked up were evaluated by imaging a standard calibration grating in both contact mode and tapping modes of operation. The evaluation was done in commercial AFM. Further, they were evalu-

ated both in air and in water. In all cases the image obtained was found to be identical to that obtained using a conventional AFM.

The automated tip-exchange module has been successfully demonstrated to replace tips during nano-indentation experiments. An artifact that enables determination of the sharpness of the AFM tip has been employed to detect tip quality and subsequently initiate automatic tip exchange.

Under the project, AFM cantilevers without tips and AFM tip using dry-etching techniques has been batch-fabricated. A wax-based micro-grippers and automation of tip pick-up and drop-off has also been successfully developed. Activities of fabrication of AFM probes with tips, detachable AFM tips and automated detection of tip-blunting and execution of tip replacement are under progress.

The project has been supported by DSIR with a grant of Rs. 18.075 Lakhs out of a total project cost of Rs. 36.15 Lakhs. The Project is under progress.



Mask for fabrication of tip-less AFM probes

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

The objectives of this research project is to develop a low-cost manufacturing technique to fabricate Through-Substrate Vias based 3D microstructures in non-conductive substrates, required in advanced radio-frequency Microelectromechanical systems (MEMS) applications. For the upcoming 5th generation (5G) telecommunication devices, the traditional silicon is not an ideal substrate material. Due to the semiconductor nature, silicon has substantial substrate loss when the signal is transmitted at higher frequencies, therefore, there are attempts to use substrate such as fused silica, quartz, which are having superior electrical insulation characteristics. However, the brittle and non-reactive nature of these substrates make the creation of microstructures difficult by the conventional methods such as micro-drilling, plasma etching, etc. Although, through-holes in fused silica can be created by Femto-second laser ablation, the required infrastructures is very expensive and thus, is not easily available.

In this project, a cost-effective electrochemical discharge (ECDM) based technique is established which is successfully used to create multiple through-holes at the predefined locations on a full wafer, simultaneously. ECDM is a hybrid process that combines the principles of electrochemical machining (ECM) and electro-discharge machining (EDM) while machining electrically non-conductive materials. 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. To overcome the existing issues, a novel 'multi-tip array tool' electrode is used, in which the simultaneous machining of multiple holes in a single run is demonstrated to reduce the overall process time.

An experimental 3-axis prototype capable of linear positioning accuracy of 1 µm. was in-house developed in this project. A customised multi-tip array tool electrode was made up of stainless steel by using wire-EDM. The size, length and the number of tips in the tool electrode can be varied as per the required design. An extensive experimental investigation was carried out to understand and optimize the effect of critical process parameters. The customized tool electrode was used to create through-holes having average diameter of 400 µm in a 500 µm thick, 2" diameter fused silica substrate (Figure 2), which was later filled with copper by using bottom-up electrodeposition technique to create Through-glass vias (TGV). The average electrical resistance of these TGVs was 270 mΩ. This is the first-time demonstration of copper-filled TGVs by using a simple ECDM technique. These TGVs acts as an electrical interconnection between front and back-side surfaces of the substrate. In order to demonstrate the capability of 3D devices, front and back-side redistribution lines (RDL) were formed by copper electrodeposition. This TGV based coiled structures can be used as 3D inductors in various MEMS applications. The process developed in this project can also be used in creating different kinds of microchannels required in bio-medical and microfluidics domain. Due to the transparent nature of the substrate, the on-going chemical/biological reactions can be easily monitored.

Based on the experimental results obtained in this project, 15 research articles have been published in peer-reviewed journals. The research work has also been presented in prestigious international conferences like 47th NaMRC, USA, 70th IEEE ECTC, USA and 21st IEEE EPTC, Singapore, One PhD student has already graduated while the second one is in advanced stage of his PhD research. The project has also supported 5 MTech degree students who have contributed in this project. 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 Project is under progress.

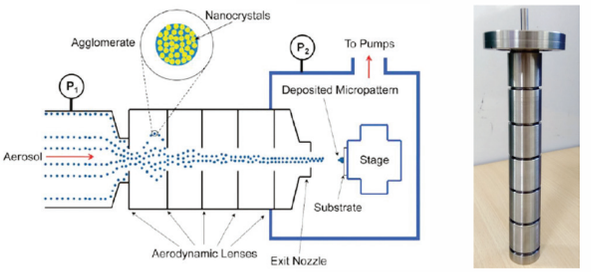
FIn-house developed 3-axis ECDM prototype

4.4 *Designing and fabrication of an aero-dynamic 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, upto a mass of 800 amu., with fast response rates upto 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.

An imaging mass-spectrometer coupled with the aerodynamic lens has been successfully developed and tested the system for atmospheric gases. The same set-up can further be utilized to examine the air-quality near defense mining area. The current work led to open a start-up where a portable mass-

spectrometer for nutrition analysis is being developed. It utilizes aerodynamic lens as an innovative sample delivery system.



Schematic of the particle deposition system

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.

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

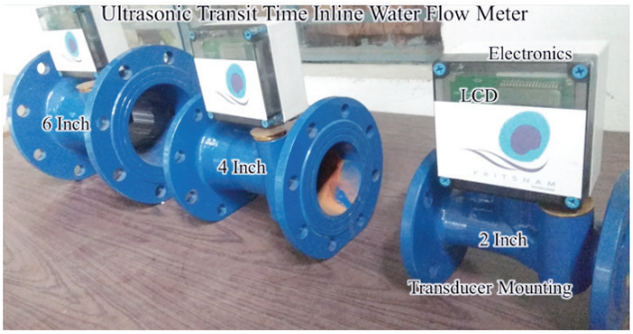
The project aims to develop a continuous real-time discharge monitoring system for small open channels (width 1 to 50 m) by tomographic reconstruction of ultrasonic transit-time measurements. The system will be designed to be accurate, cost-effective, field deployable, easy to calibrate and capable of 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%.

Automated calibration setups (gravity mass method) for high (up to 40 LPS) and low (up to 0.55 LPS) flows have designed and successfully fabricated. Ultrasonic transducers for developing flowmeters are identified and tested with commercially available and in-house designed electronic circuitry. An in-house inline ultrasonic flowmeters (UFM) was developed for pipes. The flow rates estimated by the developed UFM are found to be in good agreement with actual flow rates. The results suggest that ADC circuit boards are more suitable for UFMs compared to more commonly used TDC circuit boards. The developed UFM got ISO 4185 certification.

The UFM developed for pipe has been successfully deployed in field for continuous monitoring. Build an ultrasonic transit time open channel flowmeter using the selected pair of transducers and developed circuit boards. Discharge measured in a laboratory flume using two pairs of transducers. Developed a flow meter system with four pairs of sensors and made a real time velocity plotter for data acquisition. Setup a gravity mass method calibration system to validate the discharge and setup Particle Image Velocimetry (PIV) to validate the velocity profile from the developed system. 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 Project is under progress.



UFM for 2, 4, and 6-inch pipes.

3.5 Call for Proposals and Webinar for Popularization of the Scheme: DSIR invited proposals from eligible industries/ organisations under "PACE" programme for funding development and demonstration of innovative product/process technologies, traversing the journey from proof of concept or laboratory stage to pilot stage, ready to be launched for commercialization, during May to July, 2020. DSIR also organized a webinar to sensitize its stakeholders about the various schemes of DSIR on 3rd July, 2020, in association with Confederation of Indian Industries (CII).

CREATION OF
COMMON RESEARCH AND TECHNOLOGY DEVELOPMENT HUBS
(CRTDH)

COMMON RESEARCH AND TECHNOLOGY DEVELOPMENT HUBS (CRTDH)

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.

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 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/centres, which include R&D facilities/infrastructure, analytical test facilities, design centres, pilot plant production facility, design engineering and prototype development, demonstration units, product display centre etc. The facilities at CRTDHs are used by the Micro, Small and Medium Enterprises (MSMEs), Innovators and startups. The CRTDHs evolve a business model for self-sustainability and operate on a cost plus non commercial basis.

1.1 Aims and Objectives

The CRTDH programme is aimed at creation of common research facilities equipped with analytical equipment and pilot plant facilities to facilitate and encourage innovators, start-ups and micro, small and medium enterprises for R&D and technology development. The highlights of objectives of the twelve CRTDHs established in different phases are summarized below.

1.2 CRTDHs set up in first phase (2014-15)

Three hubs set up in first phase 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.

1.2.1 CRTDH at CSIR- Centre for Cellular and Molecular Biology (CCMB), Hyderabad

The CRTDH at CCMB, Hyderabad is set up with the objectives to support and nurture product development in the field of health care and biotechnology covering inter alia, diagnostics, biopharma and medical devices. In particular, the products and technologies that are targeted, relate to development of DNA based diagnostic kits for screening of eye infections, acute encephalitis, septicaemia, antibiotic resistance etc. Through the current unprecedented times of COVID-19, CRDTH's facilities and expertise have aided MSMEs to innovative and come up with temporal solutions. One such solution, developed by HuwelLife Sciences is a low-cost COVID-19 rapid diagnostic kit. Such examples demonstrate the success of CRTDH-CCMB in bridging the gap between translational research and industry-institute interaction.

Around 10,000 sq. ft. of fully functional air conditioned facility has been created under CRTDH that can physically accommodate 6-10 incubatee companies. The CRTDH has all the essential facilities including modular

lab tables, discussion tables, chairs, cubicles / partitions, modular movable tables with granite top and wheels, staff sitting room, a conference hall with sitting space for 30 people, band width of 8 MBPS and a video conferencing facility. The area has open lab facilities with access to industrial biological equipment such as super speed centrifuge, Sorvall Lynx 6000, SU8 Station, (Photolithography), Micro fluidic controllers, Stereomicroscope with Camera, Class 1000 clean room etc.

Ten start-ups/MSMEs have been incubated so far at this CRTDH and are working on process/product/technology development in a project mode with set targets and defined deliverables. They are being mentored by CCMB scientists and offered technical support for usage of facility at a nominal charge. Currently 31 persons of 10 incubating companies are working at CCMB CRTDH facility. More than 60 companies have utilized the sophisticated research and testing facilities available at CRTDH. Apart from utilizing the equipment and analytical services, more and more industry partners are now showing interest in CRDTH's mentoring, training, regulatory & intellectual support. One of the companies working on cell engineering to produce protein drugs has been awarded DBT/BIG grant of Rs. 50 lakhs, has filed 7 patents and 3 trademarks for two technologies developed by it, and is now a DSIR recognized start-up in biotechnology. Another company working on a novel process for production of medical grade water was awarded DBT/BIG grant of Rs. 50 lakhs. Another incubate company working on POC based on DNA amplification for a virus on prawns has received a grant of Rs. 2 Crores from National Fisheries Development Board. Another company working on production of peptide drugs for diabetes has filed 2 patents on an improved process for preparation SMW protein/peptide.

The CRTDH has been visited and appreciated by the Hon. Vice-President of India, Shri. Venkaiah Naidu. In addition, the facility was also visited by senior officials from NITI AAYOG and Economic Advisory Council to Prime Minister. The CRTDH center has been constantly sensitizing industry to engage with it through different workshops/seminars and outreach events. The team has organized several events such as "Technology showcase to", "Café Mandala – On Technology Transfer In Govt. R&D Institutes", "Dagar – City Camp – IP clinic & Regulatory clinic by BRBC", "Venture Centre, NASI (National Academy of Sciences, India) – Technology Showcase at ICMR- NAARM" during the current year to publicize the facilities available under CRTDH including trainings on instrumentation / facilities, lectures from experts on funding opportunities for startups, mentoring researches to successful entrepreneurs etc. The center organized an Outreach event for DERBI-EMERGE acceleration Program to "focus on late stage tech startups that are into Health Care". The team also participated in Bio Asia 2020 (Trade show) to reach out to established MSMEs with the complete suite of analytical services offered by CRTDH. More than 60 MSMEs actively engaged with CRTDH team during the event, some of whom have already contacted the team.

Technology showcase to Hon. Vice-President of India, Shri. Venkaiah Naidu.

BioAsia 2020 – Trade Show

1.2.2 CRTDH at CSIR - Institute of Himalayan Bioresource Technology (IHBT), Palampur

The CRTDH at IHBT, Palampur has been setup to take advantage of the institute's expertise in development of value added products such as thermo-stable enzymes, zero-calorie sugar substitutes etc. The hub aims to catalyse development of biopharmaceutical ingredients such as black carrot anthocyanin, beetroot betaine, mango peel carotenoids etc. by industries located in its vicinity.

The equipment and pilot plant facilities under CRTDH have been set up under Natural Plant Products (NPP) Division and are functional. Complete extraction and drying processing unit of anthocyanin and natural colorant is now available in the CRTDH set up at IHBT. Pilot scale trials were carried out for extraction of anthocyanin rich fraction from *Brassica Oleracea* (Wild cabbage plants). In addition extraction of other colourants such as Red rose and Rhododendron was also carried out in the facility. Extraction of nutraceuticals from mango, pomegranate peel and citrus peel has also been done at the pilot scale. The team has also standardized natural colorant extraction and purification process at pilot scale in case of beet root, black carrot and red cabbage. Technical data related to entire process has been generated and functional properties as well as quality assessment of standardized products has been achieved. Institute has conducted pre-clinical animal trails on certain products such as black carrot colour for its anti-diabetic properties under research regulatory lab and acute oral toxicity studies for pomegranate peel extract. The techno-economic feasibility studies are also being done.

The institute has now established an incubation centre/area which is now fully functional and compliments the facilities available under CRTDH for food processing. A complete ready to eat canning unit and crispy fruit manufacturing facility were installed for incubates and start-ups in the incubation centre. Subsequent to being identified as an 'Empanelled Incubator' to nurture new ideas/ innovations to support them in their entire life cycle till the same is turned into a commercial enterprise, CSIR-IHBT has signed agreements with 14 incubatees/ start-ups working on different products/ processes/technology development. One of the incubatee working on processing of stevia leaves and its value added products like stevia drops has successfully exited and the products are now being marketed in the states of HP and Punjab. Another incubatee who worked on fruit juices has set up his unit for selling premium juices with about 2 months' shelf-life. One more incubatee working on Kangra tea is also currently marketing the product as ready to serve beverage. In all, 14 incubates are working at CSIR-IHBT till the year 2020-21 in the areas of aloe-vera processing, value addition of herbal produce, detox drink, fruits and vegetables products etc. One of the participating industry M/s. A Qube Inc., Ludhiana is currently incubated in IHBT and working in food processing area with licensed technology from the institute. Within days of incubation, this company has been able to supply 1 lakh cans/ 55 tons of dal-chawal-aloo ready to eat packs for Orissa flood hit areas during May, 2019 by utiliz-

ing facilities such as complete 50 kg capacity canning unit, a commercial scale freeze dryer etc. available at the incubation facility. Various industrial meets have been organized over the year to sensitize stakeholders, where industry participants visited the facilities available with CRTDH and incubation centre. CRTDH has also designed a brochure showcasing facilities at CRTDH to encourage the entrepreneurship development using incubation center of CSIR-IHBT. Over the 5 years of CRTDH, institute has signed technology transfer and licensing agreements with 07 enterprises in food processing sector.

Products developed by CSIR-IHBT

1.2.3 CRTDH at CSIR - National Institute for Interdisciplinary Science and Technology (NIIST), Thiruvananthapuram

The objective of CRTDH at NIIST, Thiruvananthapuram is to develop products and technologies addressing environmental issues. The institute's experience in technologies related to odour control, anaerobic treatment, nitrification treatment, water quality analysis and others are being used to provide R&D solutions to MSME's to improve their environmental performance. The CRTDH project is relevant for the state of Kerala as it has many small industries in areas of cashew, plywood, fisheries, spices etc., that require S&T interventions especially in solving the environmental issues that are being taken up by the CRTDH team at NIIST, Thiruvananthapuram.

The hub has a dioxin analysis research facility that has been upgraded with new instruments and equipment procured under the CRTDH funds, such as GC-triple quadruple mass spectrometer (Agilent Technologies), Automated sample preparation system, Sample concentrator Isokinetic stack sampler, Ambient air PUF sampler and High Temperature Oven. CSIR-NIIST has got NABL accreditation as per ISO/IEC 17025:2005 in November 2018 for dioxin and PCB analysis in environmental and food samples. In addition, NIIST is also recommended by MoEF-CC as a referral laboratory for dioxin analysis for environmental clearances.

DIOXIN Research & Monitoring activities at CRTDH at NIIST have been helpful in business development. The center received work order from Bhabha Atomic Research Centre, Mumbai for analysis of dioxins and furans in stack air samples collected from their ongoing process development studies on industrial waste plasma gasification system. A work order from CSIR- NEERI has also been received for the analysis of dioxins and furans in stack air, ash and soil samples from small scale biomedical waste incinerators. Marine Products Export Development Authority (MPEDA) has sanctioned an order for the analysis of dioxins and dioxin- like furans in 10 fish samples and samples. Another work order received from MG University, Environmental Department for analysis of 10 sediment samples.

CSIR-NIIST conducted ambient air and residual ash sampling (photos given below) during the solid waste dumpyard fire break out at Brahmapuram Plant, Kochi during February 2020. The study was taken up suo moto by CSIR- NIIST in view of serious societal implications.

The center has also made process interventions in identified MSME sectors. KSPCB has sanctioned a project on setting up of a model demonstration emission control unit" at an identified Plywood Factory. CSIR- NIIST, Thiruvanathpuram has undertaken preliminary site visit and discussions with KSPCB on other aspects such as civil work and subsequent signing of MoU. The CRTDH center conducted a visit to cashew factories and collected emission data. An order has been placed to construct a pilot scale cashew drum roaster and conduct simulated roasting studies and testing of scrubbing unit.

The high strength wastewater treatment in desiccated coconut industries was one of the problems taken up by NIIST-CRTDH. NIIST has developed a patented advanced treatment process named Buoyant Filter Bioreactor (BFBR) for the treatment of DC industries effluents. NIIST has transferred the technology of BFBR to two clients: M/s. Galaxy Environ and M/s. Victoria Pvt Ltd. M/s. Galaxy Environ has installed several units in rice mills, ice cream plants, fish industries, hospital and temple. Similarly, the odour control biofilter technology was transferred to two companies; M/s Elixir Environ Pvt Ltd. and M/s. API Industries. They have installed several bio filters in fish meal factories, bone meal factories, MSW treatment plants and so on.

A state of the art odour testing Laboratory has been commissioned at CSIR – NIIST as the Bench top Olfactometer procured under CRTDH project has been installed. It is the first odour testing laboratory in the Country. The centre is expecting more business from services and projects based on the facility.

Another major facility installed under the project is the establishment of Continuous Flow Analyzer (CFA) for automated analysis of water and wastewater such as NH_4^+, Total Kjeldahl nitrogen, Orthophosphate/Total phosphate, Nitrite/Nitrate, Total sufide and Total phenol. It is an extremely useful instrument to support the ongoing activities on process/technology development for wastewater treatment.

Sampling from Brahampuram

1.3 CRTDHs set up in second phase (2016-17)

In the second phase, during 2016-17, the department approved setting up of four new hubs in the sectors of Low cost machining, New Materials/ Chemical Process and Electronics/ Renewable Energy. These hubs are currently engaged in activities like procurement of equipment, and setting up infrastructure and essential facilities for R&D. The hubs have started identifying needs of the enterprises through seminars and work-

shops as well as through interaction with the MSME-DIs, DICs, S&T Councils, industry representatives and associations and other state government agencies.

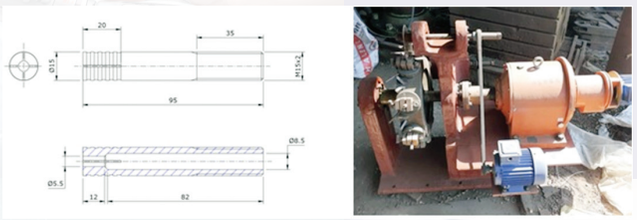
1.3.1 CRTDH at CSIR - Central Mechanical Engineering Research Institute (CMERI), Durgapur

CRTDH at CSIR-CMERI is set up with the objective 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. The centre proposes to adopt a cluster approach for improving the manufacturing competence of these enterprises.

CRTDH has initiated interactions with various target clusters such as 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; Makhana cluster in North Bengal, Brass Cluster of Goghat; Oil expelling cluster of Dinajpur, etc. Under this CRTDH, a machine shop facility and near-net-shape manufacturing facility for Metal Injection Moulding (MIM) will be created. Recently, CMERI has demonstrated Makhana popping machine for Makhana Cluster in North Bengal, through DIC Maldah. These will be used by the MSMEs for small production batches for market seeding.

The existing expertise and facilities set at CRTDH-CMERI has been utilised to develop copper nozzle for gas cutting/welding torch mainly targeting Bargachia Cluster of Metal Product Manufacturers. The copper nozzles are being developed through metal injection moulding (MIM) route in a single step, whereby machining time, material wastage and ultimately cost will be saved substantially.

The second intervention under the CRTDH is the design and development of special slitting machine for reduction of production cycle time for anchor bolts. A special slitting machine in order to reduce the production cycle time for anchor bolts as shown in figure below, in association with Bargachia Spare Parts Manufacturing Cluster is under development. The production cycle of manufacturing of anchor bolt involves various machining operation like blanking, facing, drilling, threading and slotting. The machining time for each operation has been studied and details and the objective is reduce the overall cycle time by incorporating specially designed machine.



Special slitting machine for reduction of production cycle time for anchor bolts

Through the CRTDH facility, CSIR-CMERI is eying to attract Startups & MSMEs in Design and Manufacturing who (i) can utilize sophisticated testing facilities, equipment & infrastructure along with R&D support, necessary to test and validate their ideas; (ii) can get initial hand holding through training and skill development programs; (iii) can get access to already developed technologies available at CSIR-CMERI for taking their ideas to market. CMERI has undertaken several Skill Development Programmes on Computer aided Drawings (CAD) and showcased facility to stakeholders. Moreover, two major events have been organized in which more

than 100 stakeholders were benefited.

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

The CRTDH at CSIR- CEERI, Pilani is dedicated to MSMEs/ Start-ups 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 meet the unmet R&D and technology development needs of MSME cluster like non-availability of infrastructure, workspace, state of the art R&D equipment, technologies and design solutions in electronics and renewable energy sector.

The DSIR supported CRTDH is located at Jaipur in Malviya Industrial Area and is functional. Some of the major facilities that are in place at the CRTDH Hub include Grid-tied inverter test equipment system, design engineering facility, conference hall, video conference facility, intervolved incubation unit and centre of eminence for skill development. A total of Eight companies viz. M/s Parappadi Technologies Pvt Ltd.; M/s Shock safe Internation techies Pvt Ltd.; M/s Alphaeronics Pvt Ltd.; M/s Raytrig Innovations Pvt Ltd.; M/s YOUWE Purifiers; M/s Pavone Technologies Pvt Ltd,; M/s Emuron Technologies Pvt Ltd.; M/s Aryabhata Sciences Pvt Ltd. are incubated at the CRTDH, CSIR-CEERI, Jaipur Center and almost Seventeen companies have used the facilities of the CRTDH, CSIR-CEERI, Jaipur. The CRTDH centre also undertakes to sensitize the industries, NGO's, Start-ups, professional teachers, students and innovators through various workshop and trainings under the various specialized themes. The few specialized themes recognized by the CRTDH Hub for training and workshops are Milk Adulteration Detection System; Smart Solar Tree, Mercury Free Plasma -UV lamp & Supply Chain Management of Milk.

During the COVID-19 pandemic, the DSIR-CRTDH at CSIR-CEERI facility provided technical support for COVID-19 mitigation to the firm Project Lab India. CRTDH facility provided technical support for the automatic sanitization dispensation. The industry has benefitted immensely with the technological intervention provided by the CRTDH facility and the system in place automatically dispenses 5 ml of sanitizer whenever a hand is placed under the nozzle.

The CRTDH centre took up several Industry Interactions during the year**.** Director, MSME, Jaipur, visited DSIR supported CRTDH, CSIR-CEERI, Jaipur on 5th August 2020 and discussed on possible collaboration to support the various MSME industries in the state of Rajasthan.. The Director, MSME expressed his views on the testing capabilites of grid tied solar inverters and opined that the facility may be NABL accredited to enable provide help to the local inverter manufacturers. It was also emphasised on the need for having proper training facilities of the ITI/diploma technicians working in the electronics and mechanical industries and for the LED assembly services.

A Memorandum of Understanding (MoU) was signed between CSIR-CEERI and Vigyan Bharti, Rajasthan (ViBha, Rajasthan), at DSIR supported CRTDH, CSIR-CEERI Facility (Incubation-cum-Innovation Hub) on September 5, 2020. CSIR-CEERI and ViBha will interact with each other in the "I will also be Kalam" and "Vigyan Chetna Yatra Program" under this MoU.

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

The objective of the CRTDH at IIT Roorkee is to work towards development of micro-

wave 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 that may require testing of microwave absorbing materials that have potential for various applications in the commercial as well as defence space. The website for the CRTDH center *crtdh.iitr.ac.in* has been developed and deployed. The available facilities along with the upcoming facilities has been published on the website. Various facilities like Free Space Measurement for Transmission and reflection loss of EM wave in microwave region, Camouflage Net Testing – Reflection Loss & Transmission Loss, Antenna Characterization – Radiation Pattern, Gain Measurement & Return Loss and Material Characterization for their electrical properties are established. The CRTDH center at IIT Roorkee has successfully established a large database of advanced radar absorbing materials. The characterization and performance evaluation facility are also available with the hub. CRTDH center has also undertaken different project during the reported period.

With the meteoric rise of the stealth solutions required in the defence and military applications, there is a need to provide lightweight, novel solutions for the development of radar absorbing materials (RAMs). IIT –Roorkee has demonstrated the cost-effective use of waste computer printed circuit boards for the absorption of microwaves. The project on "E-waste based Stealth Solution" is viable due to the abundant availability of E-waste, low density, easy handling, and cost-effectiveness. The permittivity and permeability values of the RAMs produced from E-waste are measured. The center also worked on "Development of Ultra-Thin Camouflage Net using Frequency Selective Surfaces". Preliminary results based on the studies of frequency selective surface (FSS) structure printed using resistive ink on a low dielectric fabric has been compiled. The characterizations have been made in frequency range from 2-18 GHz. The simulated results have shown effective reflection losses in 7.5-8.5 GHz and 12.8-16.5 GHz.

IIT Roorkee in association with CRTDH for New Materials/Stealth Applications and Department of Applied Mechanics, Motilal Nehru National Institute of Technology Allahabad, Prayagraj organized the VAM-MAM-2020 conference for the fourth consecutive year. The 4th conference on "Prof. Vijaya Aggarwal Memorial National Conference on Microwave Absorbing Materials (VAM-MAM-2020)" was held in online mode on 23rd-24th August, 2020. The focus of the conference was to provide the scientific world an insight in the research progress of microwave absorbing materials and techniques for the defence applications. The key aspects of the conference were "microwave absorbing materials" and "stealth & communication applications". The conference provided for exchange of knowledge amongst the academicians, industry and scientists from the Defence sector.

IIT Roorkee's concept entitled "E-waste based Radar Absorbing Material for Stealth Applications" received first prize at the competition organized by Information Technology Development Agency (ITDA), Uttarakhand. The event was an E-waste Artifacts Design Competition at a national level for students of universities/colleges, designers, industry partners and creative thinkers. The objective of the event was to find creative ideas that may produce next-generation methodologies and products. The research facilities of CRTDH center at IIT Roorkee have been used for the project that made an entry for first prize. The proposed concept was an E-waste based solution from the desktops and personal computers for realizing stealthy unmanned

aerial vehicles (UAVs), radomes, and camouflage nets needed for defence applications. Thus, a cost-effective use of waste computer printed circuit boards for the absorption of microwaves was demonstrated.

1.3.4 CRTDH at Indian Institute of Technology Gandhinagar, Gandhinagar, Gujarat

Dyes and dye intermediates is one of the core chemical industries in India and 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, the IIT Gandhinagar has endeavoured 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 CRTDH Hub will soon start the scale up a few processes such as Bio-coagulation followed by adsorption, Coagulation followed by catalytic Fenton at least in 500 L scale. The centre is also in the process of scaling up batch to continuous process in 50 L scale. Any such success will be helpful for many of the industry members. In addition, several industry members are using the CRTDH facility to characterize their products, raw materials and very few industries are engaged through the project mode. The Industry members are willing to donate a Skid mounted 1 kL STP to DSIR-IITGN-CRTDH for which the negotiations are in process and the installation was expected in October 2020. This will enable the CRTDH centre to evaluate the use of treated sewage water in process plants. Similarly, one of the industry members from Hyderabad donated an ozonator for STP water treatment. The CRTDH centre is working on the scale up of the ozonation process and the Pilot plant construction completed. The centre has sensitized one MSME through licencing mode. A patent has been filed for development of catalyst which is giving > 90% COD reduction for textile effluent. Scale up is done upto 20 L. Further scale up is planned in coming months upto 1000 L. Few industries have been helped in collaborative mode, viz. for one member industry, CRTDH helped them to optimize their products for various STP water in different Scale 1 L to 20 MLD.

The CRTDH Hub conducted one-day training workshop on the Use of High Performance Thin Layer Chromatography (HPTLC) for Industrial Product Analysis on February 19, 2020. 14 people from Industry (9 Industries) joined from Vapi, Vadodara and Ahmedabad. The centre also conducted cluster-wise meet through one-day "Industry Interactions with DSIR-IITGN-CRTDH @VAPI" in the Vapi Industrial estate on February 29, 2020. There were 44 industry people from 36 industries. In addition, 14 students from Gujarat Cleaner Production Center (GCPC) and 5 people from CETP, Vapi were present in the Industrial meet. The CRTDH in the fourth year of its operation has interacted with 141 industries for so far till September 28, 2020.

1.4 CRTDHs scheme in third phase (2018-19)

In the third phase, during 2018-19, the department approved setting up of five new hubs in various sectors. These hubs are currently engaged in activities like procurement of equipment, and 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.

1.4.1 CRTDH at Indian Institute of Technology Kharagpur, Kharagpur

The focus of CRTDH set up at IIT Kharagpur is to develop a research and innovation hub for healthcare system through which entrepreneurs, startups and MSEs can get support and facilities to carry out their research and development activities. The hub aims to develop novel portable devices that can be deployed at rural healthcare centres, for affordable quick and reliable diagnosis; taking the above products from bench to bedside (rural health kiosks); and provide training and consultancy to the MSE for skill development and augmenting technical knowledge.

The institute allocated an earmarked space for the pilot plant at Dr. BC Roy Institute of Medical Sciences & research (upcoming Super-Specialty Hospital at IIT Kharagpur) and additional space at the Diamond Jubilee building at IIT Kharagpur. The CRTDH team has identified an initial list of Ten (10) technologies being worked up on by the team (till prototype stage) that could be offered to MSMEs for technology transfer. These technologies include a paper-based device for colorimetric detection of blood hemoglobin level, a generic paper based device for simultaneous detection of multiple diseases using a single drop of blood, a CD-based microfluidic device for disease detection using colorimetric techniques, a diagnostic device for noninvasive evaluation of oral/skin cancer or pre-cancer using thermal imaging etc. Currently, the institute is setting up the pilot plant facility for CD based devices, design engineering centre, bio safety labs in the allocated space at Diamond Jubilee at IIT Kharagpur. The team has procured various medical devices and trained rural health assistants prior to starting clinical validation study across rural locations in Kolkata. The team conducted clinical validation study on paper-based device for colorimetric detection of plasma glucose using mobile based app (as opposed to current POC devices which tests blood sugar and therefore is of less clinical value) at Salboni Super-Specialty Hospital located in a remote rural area about an hour from IIT Kharagpur.

Considering the current COVID19 pandemic, the institute has further included a couple of devices and a comprehensive Health Management Information System (HMIS) to the list. CRTDH is currently working on two devices on COVID-19. One is paper-based colorimetric test kit for low cost rapid detection of Corona virus named 'COVIRAP' and the other one is 'COVICUBE'. COVIRAP is a disease agnostic device which can be used for detecting Corona Virus which has a potential to detect other viruses in case of future pandemic. It can be used at rural areas with minimum infrastructure at a very low cost which is affordable for people living in rural hinterlands. COVIRAP has got the approval from ICMR and we are currently setting up pilot plant for the same at our CRTDH facility.

'COVICUBE' is a device which can simultaneously measure respiration rate, Oxygen saturation, breathing rate, Temperature and ECG. COVICUBE can be very effective for early screening of COVID-19 patient and constant monitoring of the patient at the hospital as well.

Under CRTDH, institute has done several field trails at different villages in West Bengal and trained 20 Health Workers for early screening of COVID-19. Currently IIT-Kgp is developing comprehensive disease agnostic e-healthcare software with HMIS system and adaptive AI-ML (Artificial Intelligence & Machine Learning) driven algorithm for risk assessment, screening, impact analysis and predictive modelling for COVID-19 or any pandemic in future. More than a thousand liters of sanitizers and more than one thousand masks were produced by the in-

stitute in the last five months. In addition, suitable training was imparted to health assistants to make CDC approved cotton mask and sanitizer following WHO guidelines. As per the objective, institute has trained 20 rural youths (majorly women) working as Frontline Health Worker at remote villages in West Bengal on paper-based Plasma Sugar Hemoglobin devices and COVICUBE. Several Webinars. Three companies have been incubated in the facility, which are availing the infrastructure set up at CRTDH. Meetings with MSMEs were organized for technology transfer and showcased various technologies developed such as (i) Paper based devices for measurement of plasma glucose; (ii) Paper based devices for measurement of hemoglobin; (iii) CoviCube- for simultaneous and real time measurement of different vitals important for SARS-CoV-2 monitoring and screening; (iv) COVIRAP- for low cost rapid detection of SARS-CoV-2 and beyond; (v) 'Uday'- a comprehensive software ecosystem for primary healthcare out of which two technologies viz(i) Paper based devices for measurement of plasma glucose; (ii) Paper based devices for measurement of hemoglobin have been transferred.

Setting up Pilot plant for Paper-based device and training of COVICUBE

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

The objective of the CRTDH set up at CSIR-IITR is to meet the R&D requirements of MSMEs regarding the clean air/water and effluent management sector to develop indigenous & effective solutions for environmental monitoring, water treatment, and effluent management. Currently, two facilities viz., instrumentation laboratory and analytical facility are established for the use of testing services and training programs. Under CRTDH, IITR has procured various capital equipment as per the project plan and purchase procedure is still underway. Major facility developed at CRTDH includes Anaerobic workstation, 3D Printing Portable Fine Dust Aerosol Spectrometer, Cirrus Sound Level Meter etc.

Prototyping and devices for water treatment, paper mill and textile mill effluent treatment and air quality monitoring & management has been initiated. The paper mill effluent treatment studies were carried out using consortium of five ligninolytic bacteria such as *Bacillis cereus*, *Bacillus aryabhattai, Bacillus wiedmannii*, *Bacillus paramycoides and Serratia* on a laboratory scale bioreactor with minimum inputs (0.25% yeast extract). The validation of paper mill effluent treatment technology is being carried out in collaboration with M/s Yash Paper Mill, at Yash Pakka Ltd, Ayodhya. The MoU has been signed between CSIR-IITR and M/s Yash Pakka Ltd. Moreover, various technologies such as "Oneer" (an electronic device for the disinfection of drinking water); Water Analysis Kit; Lab scale Reactor for Bioremediation of Paper & Pulp Industry Waste water; Indoor Air Quality Monitoring Device (Sense Air); Remediation and Reclamation of Hexachlorocyclohexane (HCH) using Microbial Bioremediation Technology etc have been showcased.

Oneer, Lab scale Reactor for Bioremediation of Paper & Pulp Industry Waste water and water analysis kit

So far CRTDH has incubated two companies which are graduated from the facility. This includes (i) H2O Mantra Private Limited, Ghaziabad (Uttar Pradesh) which worked on R&D for the assessment and certification of existing Iron, Arsenic & Fluoride removal water treatment products/technologies and other technologies related to the water treatment and (ii) Telemachus High Pvt. Ltd, Mumbai (Maharashtra) which availed the facility for sewage treatment and industry affluent treatment for optimization and customization. In addition, 10 companies in and around Lucknow have used the facilities developed at CRTDH and additional 15 innovators/companies have been sensitized. IITR has organized several seminars/ workshops to create awareness about the CRTDH facility.

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

The focus of CRTDH at CDRI is to set up and operate a Pharmaceutical Formulation Development and National Clinical Trial Batch Production Facility that will develop (via Quality by Design (QbD)) industrially-scalable process-cum-product technology packages for 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. The setting up of infrastructure and facilities has commenced. A few equipment for setting up test item preparation and analytical areas under CRTDH

have been purchased. GLP certification of both the above areas has also been achieved. Equipment required for conducting accelerated stability and photostability testing of medicinal preparations has also been procured and made fully operational during the year. Installation and commissioning of manufacturing facility are also in progress.

The CRTDH team has also started effective engagement with MSMEs/start-ups. In September 2019, a technical workshop was held at the CRTDH where CDSCO and UP Drug Manufacturing Association along with around 156 MSME members were participated and sensitized. During the period of COVID-19, CDRI has started sensitizing stakeholders via virtual meetings which includes meetings with M/s. Modern Laboratories, Indore; M/s Auriga Research, Manesar, and M/s Aizant Drug Research Solutions Pvt. Ltd, Hyderabad. Out of which, collaboration with M/s Aizant Drug Research Solutions Pvt. Ltd, Hyderabad is underway.

1.4.4 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 MPPT, UPS, Charge controllers etc. The Center has created a Brochure/Pamphlet for CRTDH and Website for CRTDH: https://crtdh.csio.res.in/. The renovation work for the hub was initiated by Prof. R. K Sinha, Director, CSIR CSIO. Currently, the hub has installed solar inverter test facility consisting of grid array simulator, solar array simulator, RLC load and measuring instruments and is in the process of creation of standard operating protocols for inverter testing. Procurement of other capital equipment's as per the project plan are placed and purchase procedure is underway. As a part of incubation requirement of CRTDH, the hub had approached Ministry of SME under Entrepreneurship and Managerial Scheme to support industries with seed funding. MSME after examining the facilities of CRTDH & CSIO, approved CSIO Chennai Centre as Host Centre for Incubation and approved two companies for incubation out of 100 ideas from startups & students.

In parallel, this hub with the motive serve as a platform for collaboration among stakeholders conducts continuous expert panel meeting from local R&D institutes, industries Academia (IITs, state funded universities) and MSME institutes. This hub has so far organized four major events and around 30 industrial participants have drawn benefits from this Hub. Besides this, center concentrates on skill development pertaining to renewable energy and calibration and has trained more than 50 people in this sector. During the pandemic, the CRTDH team at CSIO had given advisory on design, operation and testing of UVC based electronic disinfection systems for surface and room disinfection for efficient reduction of SARS CoV-2 virus.

1.3.5 CRTDH at CSIR- Institute of Minerals & Materials Technology (IMMT), Bhubaneshwar

The foundation stone of the CRTDH building along with the Incubator office space was laid by the Director General of CSIR on 01.02.2019. This project is being implemented

in two stages for a total period of 5 years (Stage-I is for first 2 years and stage-II is for last 3 years). The purpose of the CRTDH at IMMT, Bhubaneshwar is to provide R&D and knowledge based support to MSMEs and innovation driven start-ups in the State in the area of "New materials & Chemical Processes". 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.

During the first stage of the project major emphasis as planned was to develop the requisite infrastructure, procure equipment and sensitize the MSMEs about the IMMT-CRTDH. Industrial shed for providing incubation facilities to Start-ups measuring around 7000 sqft is under construction – to be completed by end of FY 2020-2021.Capital equipment purchase process for Stage-1 is almost completed. Mobilization of MSMEs under different major categories along with necessary R&D support is under progress. CSIR- IMMT Bhubaneshwar provided 10 know-hows related to fighting against COVID-19 like sanitizers, liquid soap, and disinfection kits etc. to around 14 MSMEs.

In addition to the above work, 2 MSMEs have been provided know-how through licensing mode that have been commercialized. Rest of the MSMEs is being developed in Collaborative mode so far. Over the last one and half year, the revenue of total Rs 40.01 lakhs has been generated by engaging with industries/start-ups, and also providing the testing/analysis services to MSMEs.

A workshop to promote awareness about the CRTDH initiative was organized at CSIR-IMMT on 22 August 2020. It was attended by more than 80 MSME participants from various sectors. After the exercise, the intervention areas have been clearly defined and taken up for around 15 innovations for translation into innovative products.

The centre has provided 10 know-hows related to fighting against COVID-19 like sanitizers, liquid soap, and disinfection kits etc. to around 14 MSMEs. IMMT, Bhubaneshwar is working with a vision to take this CRTDH scheme forward in this region and establish supporting linkages with all stakeholders.

1.2 Call for Proposals and Webinar for Popularization of the Scheme:

DSIR invited proposals from eligible organisations for setting up of CRTDH under five sectors, viz, Electronics/Renewable Energy, Affordable Health, Environmental Interventions, Low Cost Machining and New Materials/Chemical Process, during May to July, 2020. DSIR organized a webinar on "Funding schemes of DSIR" on 22nd July, 2020, in association with PHDCCI.

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

1 A2K+ Studies

2 A2K+ Events

3 Technology Development and Utlization Programme for Women (TDUPW).

4 Technology Development and Demonstration Programme (TDDP)

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

1.0 A2K+ STUDIES

The objectives of A2K+ Studies program is to support studies in 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, 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.

1.1 During the period under report, following studies are ongoing:

1.1.1 Effective Grain storage for better livelihoods of Indian Farmers for food and nutritional security in the new millennium by Indian Institute of Food Processing Technology (IIFPT)

The study has been supported with objectives (i) to determine safe storage guidelines based on moisture, temperature and quality of pulses for tropical weather conditions, with special emphasis on the coastal regions of Tamil Nadu; (ii) to design and develop eco-friendly safe storage structures with provisions for physically eliminating insect pests to store pulses for small scale enterprises, retailers, rural livelihoods, pulse growers, millers and farmer producer organizations; (iii) to disseminate the technology to small and medium enterprises and to pulse growers in the coastal regions of Cauvery Delta. The study found out that (i) multi layered bags were effective for storing pulses for more than six months without altering the quality parameters and the usage of chemicals and pesticides, (ii) developed insect traps to mechanically eliminate insects during storage of pulses. Electronic stack probe trap with UV-LED strip was used for attracting insects from the stack and (iii) two in one trap was designed to control and monitor pulses. This trap could collect insects more effectively. Usage of natural insect repellents in addition to light is also possible to attract more number of insects in short span. This study is in progress.

1.1.2 Formulating a suggestive model for India for facilitating university- industry linkages in research by PHD Chamber of Commerce & Industry (PHDCCI), New Delhi

The study on formulating a suggestive model for India for facilitating university- industry linkages in research was aimed to prepare a model for India for an enabling environment to facilitate university-industry linkages for research in India. The study objectives includes (i) To assess the problems in the Protection and Utilization of Public-Funded Intellectual Property (PUPFIP) Bill and to suggest changes in it; (ii) To suggest a model for India on lines of Bayh Dole Act of USA for building a strong and thriving innovation ecosystem in the country. As the Protection and Utilization of Public-Funded Intellectual Property (PUPFIP) Bill was withdrawn from the Parliament, India does not have legislation in place to facilitate University-Industry Linkages in Research. PUPFIP is on the lines of Bayh-Dole Act in US, which led to great benefit for the country and many other countries have benefited by adopting a similar legislation. The proposed study has carefully pinpointed suggestions and recommendations from the Universities and Indus-

tries pan India in order to develop a model /framework for policy on the lines of Bayh Dole Act for commercialization of publicly funded research in India. With due considerations to the concerns and apprehensions of both University and Industry, study suggested that the preparation of the model for India on lines of Bayh Dole Act of USA would help build a strong and thriving innovation ecosystem in the country.

1.1.3 Role of Branding in Enhancing Competitive Growth for MSME Sector by All India Management Association (AIMA), New Delhi

The study was supported to AIMA to (i) assess the role of branding in growth of MSME sector; (ii) explore the key branding strategies for MSMEs in India; (iii) assess the acceptability of branding for MSMEs in India; (iv) suggest the way forward for MSMEs to create their brand. It was found that branding is well acceptable by MSMEs in India, since it leads increase in revenue and support in expansion of market. It is revealed that majority of the MSME's considered that branding provides a competitive edge to the business. Further, it was found that increase in return on investment, sales growth, expansion of market was considered as criteria's for the increase in competitive growth of MSME. But MSMEs also feel that there are certain enablers and hurdles which make impact on acceptability of branding like availability of funds, time management, awareness about branding and schemes like Limited Liability Partnership and Comparison with MNC branding act as enabler which support MSMEs to build their brand strategy.

In sum, this study provides an insight to MSMEs about branding their products and services within modest budgets and will help MSMEs in becoming successful in the current challenging economic environment. The study will help MSMEs to understand their business strength, USPs (Unique selling propositions) & skills for leveraging their strengths and will guide SMEs in establishing a brand for their products. Study would help in increasing the acceptability of the MSME products globally which would lead to enhancement of export earnings.

1.1.4 Qualitative study of technologies designed using Artificial Intelligence for improving healthcare services in the Indian context by Centre for Development of Advanced Computing (C-DAC), Mohali

The qualitative study supported to C-DAC, Mohali looked into technologies designed using Artificial Intelligence for improving healthcare services in the Indian context. The specific objectives of the study were to (i) identify technologies in the area of Healthcare based on Artificial Intelligence; (ii) facilitate collaboration amongst industries and startups working in Artificial Intelligence- Health to improve healthcare services in India. As Artificial Intelligence area is an emerging area and it could be deployed to improve healthcare services as well as to bridge the healthcare divide in urban and rural areas, the study focused on the aspects of Artificial Intelligence applicability in Healthcare. With AI and associated machine learning algorithms, technology can be used to assist healthcare practitioners in (i) diagnosing the disease quicker, (ii) forecast the spread of the disease, and (iii) design customized treatment plans for patients, even for those situated remotely. This study identified and provided details on the technologies being developed by academic institutions and R&D labs. The outcome of the study would be useful for various R&D labs, industrial organizations including start-ups, which can adopt and build upon the identified technologies and roll out to the Indian populace.

1.1.5 Feasibility study on commercial scale coating on copper alloys, using radio-frequency plasma technology by Institute of Advanced Study in Science & Technology (IASST), Guwahati

The supported work studies the feasibility of commercial scale coating on copper alloys, using radio-frequency plasma technology. The main objectives is to (i) study the techno-commercial status of surface protection of bell metal and brass in the main production centers of India; (ii) find the proper mechanism for transferring the surface coating technology, developed. Brass & Bell metal, which are the largest art metal exported from India, would further get an edge in the international markets due to deployment of plasma coating and this study would create ready reckoner for developing commercially viable facilities for plasma coating on copper alloy products. It was found that plasma coating technology developed by IASST is commercially feasible for high value decorative items and other Pooja items, door handle etc. This study has paved the way for commercially viable Plasma Coating on copper alloys, either via private enterprises or via Common Facilitation Centers at manufacturing clusters.

1.1.6 Demand, opportunities and challenges for development and deployment of Ultra Machining Technology in India by Central Manufacturing Technology Institute (CMTI), Bangalore

The study is supported to CMTI, Bangalore with main objective to find out emerging requirements of Ultra Precision Machining Technology, gaps & challenges in development and deployment of indigenous technology, in the Indian market scenario. The study aims to (i) explore the demands of assimilation for Ultra Precision Machining Technologies; (ii) identify the technology gaps (Machine & machining technologies, process developments, measurements) in Ultra Precision Technologies; (iii) identify indigenous development works required; (iv) study the challenges in development and deployment of indigenous technology for Ultra Precision Machining Technology. The study has been extended due to COVID-19 pandemic and it is ongoing.

1.1.7 Developing a framework for Commercialization of technologies developed at public funded research institutions by CSIR-Central Scientific Instruments Organisation (CSIR-CSIO), Chandigarh

The supported study would look into developing a framework for Commercialization of technologies developed at public funded research institutions. The specific objectives of the study is to (i) find the status of commercialization of technologies developed at CSIR-CSIO; (ii) identify lacuna in the commercialization process; (iii) develop a framework to strengthen commercialization process. The study will be focus for technologies transferred in the past three years by CSIR-CSIO and it will be cover Chandigarh, Punjab and Haryana regions for technologies related to in the areas of biomedical instrumentation, agri-instrumentation (post-harvest and pre-harvest), waste-to-wealth etc. The study will provide an understanding of the factors that play a key role in the commercialization process.

1.1.8 Inventorization of microbe based technologies developed in National Agricultural Research System (NARS) for catalyzing their effective translation from lab to land by ICAR-National Bureau of Agriculturally Important Microorganisms (NBAIM), Mau Nath Bhanjan, UP

The study supported to NBAIM was focused

on the inventorization of microbe based technologies developed in National Agricultural Research System (NARS) for catalyzing their effective translation from lab to land. The study objectives were to (i) document and develop user-friendly database for microbe based technologies developed/ available at different ICAR institutes and State Agricultural Universities (SAUs); (ii) evaluate selected potential technologies for commercialization; (iii) identify key issues in commercialization of microbe based technologies; (iv)prepare a status report/policy paper for catalyzing the commercialization of microbe based technologies. During the period of study, NBAIM presented on the collection of technologies and creation of a database containing all relevant information on microbe based technologies available in different NARS institutes/universities. NBAIM also organized a workshop to discuss/identify key issues in commercialization of microbe based technologies and tried to work out possible solutions to maximize the commercialization of the technologies. Policy paper written during this study also highlights recommendations on research and development and regulatory and policy issues for commercial success and effective farmers' outreach of biofertilizers and biopesticides. The study concluded that a strong collaboration between industry and R&D institutes is urgently required along with few policy modifications to ensure their successful commercialization and adoption by farming community.

1.1.9 Technology forecasting and projecting market trends for agricultural machinery manufacturing Sector for India by ICAR-Central Institute of Agricultural Engineering (ICAR-CIAE), Bhopal

The supported study in technology forecasting and projecting market trends for agricultural machinery manufacturing sector for India would assess (i) present status of agricultural machinery manufacturing industries in India; and (ii) forecast the potential demand for agricultural machinery manufacturing sector. The survey was conducted in 5 states (Punjab, Tamil Nadu, Chhattisgarh, Odisha and Gujarat) from different zones of India (North, South, Central, Eastern and Western) using a questionnaire. The study showed that the farm machinery manufacturing sector plays a vital role in production and promotion of the agricultural implements in India. The analysis indicated that medium manufacturers had about 50 percent share of the total population while Small and large manufacturers contributed 25 percent each. Large and medium agricultural implements manufacturers are focusing more on tractor operated implements like combine harvesters, rotavators, potato cultivation implements, paddy cultivation implements, maize threshers, laser land leveller, reapers and combine, based on the demand of the country. General implements like threshers, trolleys, seed drill, mouldboard plough, disc harrow, weeders and manual equipment based on local need is being manufactured by all categories of manufacturers. In general the forecasted data suggested that the demand of implements in all the surveyed states is increasing but some common machines used by the state since long time showed negative trend (e.g. cono weeder and laser land leveller in Tamil Nadu, potato digger, chaff cuter and reaper in Punjab, pedal thresher, cono weeder and hand winnower in Odisha, rotavator, potato planter and potato digger in Gujrat). This study is in progress.

1.1.10 Access to Energy Efficiency Technology Information for Indian Industries by The Energy and Resources Institute (TERI), New Delhi

The study entitled "Access to Energy

Efficiency Technology Information for Indian Industries" was supported to TERI. This study would identify, collect, collate and disseminate information on energy efficient technologies in the sector Iron & Steel and Pulp & Paper, their services, use and energy consumption to Indian industries. The study aims to provide information on a host of parameters which could be used to assess the performance and make comparisons using latest information and communication technologies. During the course of study, a web portal was designed to provide all the necessary information related to the energy efficient technology to the stakeholders. As an outcome, this study would benefit the Indian industry and plant professionals/research labs, researchers, academia, government and other stakeholders to identify and know of the best available energy efficient technologies and practices that improve energy efficiency and reduce CO_2 emissions.

1.1.11 The Role of Standards in Diffusion of Emerging Technologies: Internet of Things (IoT) by Indian Council for Research on International Economic Relations (ICRIER), New Delhi

The supported study on Role of Standards in Diffusion of Emerging Technologies: Internet of Things (IoT) was set to analyze the complex process of standardization of an emerging technology, viz, the 'Internet of Things', and specifically, understand the role of Standard Setting Organizations (SSO) and the industry in setting and conforming to standards. The study provided policy suggestions for designing an efficient ecosystem, which will allow the Industry, SSOs and the State to better coordinate and collaborate towards enabling an IoT environment. It has also explore the features of an efficient architecture of standards and SSOs that promote conformity, competition and efficiency of the IoT industry. Based on the study following observations were made -

- Despite having the third largest start-up ecosystem, Indian startups fail to contribute to standard development despite the nascent presence of Centre of Excellences (CoE). Participation of startups in the standardization process will help kickstart innovation
- India is currently a follower and not a contributor to the IoT Standards ecosystem. However, the case study indicates that stakeholders understand the exigency of standardization for IoT.
- Standardization efforts in India ware led by countries of foreign origin and very little input from Indian origin MNCs
- Case studies indicate that the uptake of Industrial IoT will be faster than Consumer IoT in India
- Most Indian organizations have adopted global standards that may not cater to local needs. Industry collaboration, experiences from global engagements and learnings from other countries can help India develop an innovation – driven approach to IoT.

1.1.12 Emerging requirement of Nano coating in the fields of Automotive, Aerospace, Machine tool, Healthcare & sanitization sectors in the Country and the means to achieve it by Central Manufacturing Technology Institute (CMTI), Bangalore.

The supported study in the Emerging requirement of Nano coating in the fields of Automotive, Aerospace, Machine tool, Healthcare & sanitization sectors in the Country would look into one of the technologies which has a potential to increase per capita revenue of capital goods sector is by addressing the Nano coating technologies. The intended study would (i) understand the requirement of MSME in different sectors in Nano coatings. (ii) understand the problems

faced due to existing coating techniques and address the issues faced by interaction with industries. (iii). understand the technologies required for addressing various problems of coating by industries in country and find the availability of such facilities in public domain.

1.1.13 Alternative materials for improving response and damping properties of machine tool structure by Central Manufacturing Technology Institute (CMTI), Bangalore.

The study entitled "Alternative materials for improving response and damping properties of machine tool structure" was supported to CMTI, Bangalore. The aim of the study is to find out emerging requirements for alternate materials for machine tool structure & bed. It also aims to identify technological gaps & challenges in development and deployment of indigenous technology, in the Indian market scenario. This study would assess to (i) explore the demands of alternate damping materials for machine tool structure & beds. (ii) identify the technology gaps (fabrication methods, material properties & characteristics). (iii) identify indigenous development works required.

1.1.14 To assess the commercialization status of the technologies from Govt. funded national institutions by Amity University, Noida

The proposed study is intent to assess the commercialization status of the technologies from Public funded institutions of India. The study would look at the design of effective technology transfer process for Indian academic / technical institutes. The study aims to address (i) state of the commercialization of patented technologies from public funded research institutes, (ii) incubation level of maturity of technologies in IITs and NITs, (iii) the type of technologies, which have received joint development support from industry (BIRAC, DST, DBT, etc.), (iv) the status of patenting facility in the institutions, (v) Launching of product or services in the market, based on the technology developed by public funded institutions and (vi) to assess critical elements of a successful technology transfer and commercialization process, of a research organization. Study intends to cover selected (sample size) public funded higher educational institutions and national labs of India and investigate, if there are basic technological transfer needs which need to be fostered, that eventually may lead to sophisticated technology development within India.

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

An important and useful project entitled "Speeding up the Lab to Market Journey: Repurposing Drugs for COVID-19" for the government and scientific community during this pandemic has been supported to Entrepreneurship Development Center. The objectives of the study have been outlined as – (i) to track and collect information on technology development efforts on repurposing of drugs in India and abroad ; (ii) to 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) to 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 and to "connect dots" and identify useful collaborations) ; (iv) to leverage the office of PSA to facilitate the journey to market and use by doctors; (v) to contribute to getting practical solutions in use for COVID-19. The project is still ongo-

ing and following outcomes are expected out of this study -

i. Well researched, holistic and thorough reports on drug candidates (LEADS)

ii. Compilation of information on key risks like IP, manufacturing etc and anticipate potential bottlenecks.

iii. Suggest ways to fast track drug's journey to market.

iv. An ADVISORY GROUP to provide opinions on each leads/option
   - Advisory Group of Experts
   - Regular meetings to review leads and form opinions, prioritization
   - Action points

v. An innovation TRANSLATION NETWORK
   - Nationwide network of key stakeholders
   - Connects and requests
   - Inputs on journey to market for each lead

1.1.16 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 has been supported to Rabindranath Tagore University, Raisen, MP 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. The study expected to draw out a picture of the technology transfer and commercialization of the public funded research institutes in MP. The study will also highlight the major technical requirement of the regional industrial clusters. In addition, study will identify the challenges and problems of both industry and academia regarding technology commercialization.

1.1.17 Studies on Technology & Innovation Management by CSIR-Institute of Himalayan Bioresorce Technology (IHBT), Palampur

The project on the topic "studies on technology and innovation management" was supported to IHBT, Palampur. This project aims 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 will also focus on two case studies (success/ failure) for linkages amongst academia, R&D and Industry. Possible outcomes out 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.

1.1.18 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" has been supported to Symbiosis School of Media and Communication, Bangalore. The objectives of the study are – (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 shall provide 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

1.2 **Call for Proposals and Webinar for Popularization of the Scheme:** DSIR invited proposals from eligible organisations under "Studies" programme during September to November, 2020, on 18 topics.

The current crisis of COVID-19 has created multiple challenges for everyone. The COVID-19 situation has made it impossible to conduct in-person meetings or presentations. As a result, the popularity of webinars increased considerably and several activities shifted to online platforms. DSIR organized a webinar on "Funding schemes of DSIR" on 22nd July, 2020, in association with PHDCCI.

2: ACCESS TO KNOWLEDGE FOR TECHNOLOGY DEVELOPMENT AND DISSEMINATION (A2K+) – EVENTS

The Access to Knowledge for Technology Development and Dissemination (A2K+) – Events programme of DSIR 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.

Grant was released towards successful organization of The 12th International Conference on Plasma Science and Applications (ICPSA 2019) which was hosted by the Department of Physics, University of Lucknow, India from 11th to 14th November, 2019. The theme of ICPSA – 2019 was 'Plasma in the Service of Mankind'.

Grant was released towards successful organization of International conference on Next Generation Libraries-2019 (NGL-2019) on New Trends & Technologies, Collaboration & Community Engagement, Future Librarianship, Library Spaces & Services during December 12-14, 2019 at National Institute of Technology, Rourkela, India.

3: 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 Technical Advisory committee (TAC) which recommends projects for funding under the scheme "Technology Development and utilization Programme for Women (TDUPW)" was reconstituted in July, 2020, on expiry of the tenure of the earlier TAC. One meeting of the TAC has been convened since then.

1.1 Projects Supported Under TDUPW Programme: The following projects were in progress:

3.1.1 Technical Skill Training in the field of Assembly of Scientific Instruments and their quality control undertaken by Instrument Design Development & Facilities Centre (IDDC), Ambala Cantt, Haryana

The objectives of the project are promoting adoption of new assembly & quality techniques of instrumentation by women; awareness creation and training of women in the field of science and its applications; application of science in the area of scientific instrument assembly by women entrepreneurs and application of Quality Measurement Techniques to independently initiate the part – assembly of science instrument for revenue generation and induce entrepreneurial skills in women to set up their own small scale enterprises. The location of the training conducted were at IDDC Ambala Cantt. and Mool Chand Govt. ITI, Ambala Cantt. Girls were trained on optical and mechanical components, fabrication technique to manufacture the requisite components, quality assurance technique and tools, use of Jigs & fixtures in assembly and study of instrument standards. Hands-on training on measuring instrument (e.g. Bore Gauge, Universal Dial Gauge Comparator etc,), use of Jigs and fixture to hold subassembly for quality and final assembly of complete instrument, test methods etc. were provided to the participants. The beneficiaries were taken for industrial visit related to manufacturing firms to acquaint beneficiaries with industry requirement and fabrication techniques / process. Total 150 women trainees have been successfully trained. The training was conducted in 06 batches of 25 women participants each. After, the training, the women participants have become empowered and they are now capable of getting employment in local industry as also they can set their own small businesses. For placement of the trained girl candidates, various meetings with local industry owners / representatives were convened. 14 girls have been employed in the local industries such as M/s V.K. Electronics, Ambala Cantt,; M/s Geeta Optical, Ambala Cantt.; M/s Sun Tech Engineers, Ambala Cantt.; M/s Himanshu Milling Works, Ambala Cantt.; M/s J.K. Optics, New Preet Nagar, Ambala Cantt.; M/s Sun Tech Engineers, Vashisht Nagar, Ambala Cantt.;

M/s Verma Enterprises, Rampur, Sershari, Azad Nagar, Ambala Cantt. and M/s Licon Optics, Azad Nagar, Ambala Cantt..

3.1.2 Women empowerment and skill development through technological intervention in cooking stove undertaken by Department of Energy, Tezpur University, Napaam, Sonitpur, Assam

The objectives of the project are to educate and create awareness regarding the use of improved cook stove (ICS); to provide technical training on construction of improved cook stove to 100 women; to impart hands-on training on construction of improved cook stove to the women/women groups using locally available materials and an improved metallic stove for possible entrepreneurial activity and to facilitate the women groups to develop a business model to enable them to construct ICS on a commercial scale and sell ICS to prospective buyers and train other women/women groups. The methodology adopted under the project includes selection of a suitable site/ village(s), conduct survey of households, hands-on training and demonstration on construction of ICS and train them to take it up as a business activity. During the Phase I of the project, two villages. i.e. Amola Pam Gaon and Borguri gaon which are located in Tezpur Circle of Sonitpur district, Assam were selected. After completion of the survey of these villages, about 101 women participants were selected for training. The training included classroom training to impart the preliminary knowledge on improved cook stoves, their benefits as well as construction. The women participants were then trained to undertake the cook stove construction as an entrepreneurship activity. In this course they have built improved cook stoves at various locations.

Hands-on-training on improved cook stove

Hands-on-training on improved cook stove

3.1.3 Adding Value to Fish: A Potential Livelihood Option for Rural Women of Odisha undertaken by ICAR-Central Institute for Women In agriculture, Bhubaneshwar

The objectives of the project are to build the capacity of fisherwomen of Puri district of Odisha in the preparation of value added products and by products from fish and fish wastes; to enhance entrepreneurial skills of the fisherwomen in managing their business and to assess the consumer preference of value added fish products and byproducts and development of innovative products based on consumer preference. Adoption of fish processing as a source of livelihood will improve the economic status of women. 20 women SHG's from 2 blocks of Puri District, Astaranga and Puri Sadar were selected for implementation of the project. The socio-economic profile of 203 rural women was assessed with the help of a questionnaire. The only form of value added fish product available in Odisha is dry fish. Hence, a variety of value added products like prawn pickle, fish pickle, prawn chutney powder, hygienic dry fish, fish papad and prawn sev were developed. 32 training programs (612 rural women) were conducted on and off campus including capacity building programmes. Skill training was given on hygienic preparation of value added fish products and entrepreneurship management training for developing marketing skill of SHGs. 40 Master trainers were selected depending upon their interest and enthusiasm in taking up

the production of these products. Management training of beneficiaries on business enterprise development was also imparted, to educate master trainers about marketing strategy and marketing. Trainings include marketing orientation technique, methods, advertising, promotion (marketing communication) distribution and product management, which will facilitate beneficiaries to set up successful enterprises. For strengthening the market linkages, and meeting the quality standards in the competitive markets, discussions with "Mission Shakti", FishFed and retain fish supply chain "Falcon Chilka Fresh" were conducted. A group of 12 master trainers was selected from the Kanamana Village, Astaranga for enterprise development. The group has been provided with necessary utensils and packaging materials to start the production of value added fish products. They have ventured into online marketing taking into consideration the pandemic situation. They were facilitated in obtaining Trade license under the trade name "Fishlikes" from Bhubaneswar Municipal Corporation. They have started displaying their products through the marketing website bikayi.com under the trade name Fishlikes and through a facebook page. Market linkage was strengthened for the rural women SHGs by linking them with Falcon Chilka Fresh Retail outlets in Bhubaneswar. ICAR-CIWA launched the first marketing of value added fish products prepared by the SHGs at the Falcon Fresh Fish outlet. The sales of prawn pickles has gained momentum and the women are gaining a profit of Rs 130-150/kg of the pickle. Under the project, a technical bulletin, one research paper, one popular article and 10 extension folders have been published.

3.1.4 Empowerment of women through silk and cocoon based handicrafts (Wealth from Sericulture Waste) undertaken by Department of Biosciences and Sericulture, Sri Padmavati Mahila Visvavidyalayam, 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 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, conveyance facility available to reach the venue and where necessary local resources were available to conduct the training programmes. The three locations i.e. i) Govinda Nagar, Tirupati (Tirupati Division), ii) V. Kota (Kuppam Division) and iii) Penumuru (Chittoor Division) were selected to conduct the training programmes. Seven training programs were conducted, at various places of Chittoor district and 191 women were trained. 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. 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 reference to the trainees

3.1.5 Skill up-gradation of women potters in fabricating fine terracotta pottery products in Tirunelveli District, Tamilnadu

The project aims to upgrade the existing status of the rural women potters and train them in advanced technology of clay body formation, methods of fabrication, firing techniques by utilizing affordable mechanical devises evolved through a series of experiments. The overall effort is to equip the women potters with adequate technical skill and to help them in availing financial assistance to make them successful entrepreneur in the pottery trade. Diversified red clay pottery products are having very good market not only in local area but also in other states. Various products adopted by the women includes decorative items, utensils etc. 100 women beneficiaries were trained on pottery technologies and fabrication of fine terracotta pottery products in four batched (25 Nos women in each batch) in four villages Mavadi, Melacheval, Subramaniyapuram, Kattalai of Kalakad Block, Dist. Tirunelveli, Tamil Nadu. 50 trainees were trained in the upgraded pottery products fabrication technologies. Various new designs of the consumer oriented products were introduced in the market and permanent market outlets created and strengthened the existing channels. 28 individual entrepreneurs units and one common production unit was established.

3.1.6 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

The main objectives of the project are to build capacity of 742 tribal women farmers so that they can earn a better livelihood through food processing. Cluster of 20 Villages in Naswadi block of Chhota Udepur District of Gujarat were selected based on the survey conducted in the project area. 268 women were trained on various aspects during Phase I i.e. imparted training to 23 women on dal mill operation; 20 women on processing unit operation; 20 women on marketing & account management; 171 women on FPG management; 24 women on FPG leadership & enterprise development for leaders; 10 women FPC Board of Directors on compliances within stipulated time period. 40 women have set up small enterprises. They are marketing their product, instant meal mix – Khichadi and promoting their business at platforms like IRMA, IIM (A), Saras Mela, local haats etc. In the second Phase, the objectives are to provide the training to 488 women through 9 types of training covering 25 batches (i.e. Training of women on dal mill -18, Training of women on masala mill operation-18, Training of women on processing of custard apple-18, Training of women on processing of Tomato-18, Training of women on grading, sorting and cutting of vegetables for vegetable selling business, Training of women on packing -18, Training of women on marketing, accounts management and digital literacy-40, training of women on FPG management -320 and training of women on leadership and enterprise development-20). Till Octobor 2020, 258 women have been trained on under FPG management (women trained 240) and processing of custard apple (women trained -18). After the training, women are engaged in processing of the custard apple pulp and 10 women have started production of custard apple pulp and marketing it to ice cream vendors, individuals etc.

3.1.7 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.* Imparting the training to the rural women in remote villages of Rajasthan focuses on capacity building for application of biofertilizers specifically to the farmers who grow Sonamukhi (*Cassia angustifolia*) and Isabgol (*Plantago ovata*).

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 production of bio-inoculants was done at Amity University, Noida and delivered to AFRI, Jodhpur for training to identify women farmers. First training program has been conducted for 12 women farmers of Osian Tehsil at the Forest nursery, Osian. The PI from Amity University, Noida joined the training through the virtual meeting platform Google meet and interacted with the women farmers. To initiate, a token sample of 100 g of bio-inoculant was given to all the participants.

Imparting training to rural women farmers on application of bio-inoculants

3.1.8 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 district 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. Nearly 50 percent of the annual production of coconut in the district of Puri is harvested as tender coconut for their high demands among the devotees coming throughout the country round the year to visit Lord Jagannath. So far, four number of training cum demonstration programmes have been conducted covering 102 women beneficiaries and 8 number of local SHGs. Ten master trainers have already been trained to disseminate the technology effectively among the other women beneficiaries. 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 and developing skills among the women beneficiaries regarding the use of a low cost charring drum for carbonization

of biomass. The activities have been initiated to establish linkages with (i) Mahila Samities (ii) Pollution Control Board of the state (iii) Coconut Development Board of the state and (iv) Local Krishi Vigyan Kendra for wide dissemination of technology. The training to the other women identified is in under process.

Training of women Bio-coal Preparation from Waste Green Coconut Shell

3.1.9 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, District Chandrapur, Maharashtra

The objectives of the project are 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. 10 SHGs have been identified for the cultivation cum training and baseline survey has been started to select the women beneficiaries. Quality seed has been purchased from the CSIR Palampur and saplings are being developed from the purchased seed. Initial work on the nursery development is in progress.

3.1.10 Skill Satellite Centres :

The main aim of this component of TDUPW programme is to set up Skill Satellite Centres to enhance the quality of life of women by imparting knowledge and skills. Women thrive when their community truly values women's work both at home as well as in the public sphere and therefore, this initiative of DSIR is committed to working towards gender parity and making women's work visible at all levels of development. DSIR will support proposals for setting up "Skill Satellite Centres" in close vicinity of rural/tribal or other needy groups of women, which would be different from the usual vocational training centres for women, established by various other organisations. In addition to the skills training, all the women enrolled with the satellite centres will also go through a short duration literacy curriculum. In addition to training on specific technical subjects, training will also be given on financial literacy and enterprise development. This will ensure that after completion of the training, they are not only financially independent but can also face social challenges more effectively. The programme has been launched and the Department is getting proposals for setting up Skill Satellite Centres for women. For popularization / promote the Skill Satellite Centres, two webinar have been conducted with corporate foundations and women institute. About 100 participants from various foundations and institutions had participated in the webinar and discussed in detail about the eligibility for receiving funds and the process followed in disbursing the funds, in order to facilitate the participants in understanding the scheme in details. The Skill Satellite Centres are expected to help the local women uplift their socio-economic status significantly.

3.1.11 Webinars for Popularization of the Scheme:

The dawn of 2020 saw the rise of the infamous, Coronavirus. Webinars have become the

new normal and have given us a safe way to keep our professional engagements going and socially distance at the same time. They are a great way to manage our professional activities while maintaining social distancing. DSIR conducted six webinars since July, 2020 to create awareness amongst its stakeholders, about the scheme "Technology Development and Utilization Programme for Women (TDUPW)". A large numbers of participants attended the webinars

4: Technology Development and Demonstration Programme (TDDP)

The Department has been providing partial financial support to research, development, design and engineering (RDDE) projects proposed by industry in the following areas:

(a) Development of a new or improved product resulting in prototype development and ending with demonstration in commercial environment.

(b) Development of a new or improved process resulting in establishment of process know-how, development of process equipment and demonstration of yield, efficacy etc on a pilot plant.

(c) Absorption and up-gradation of imported technology.

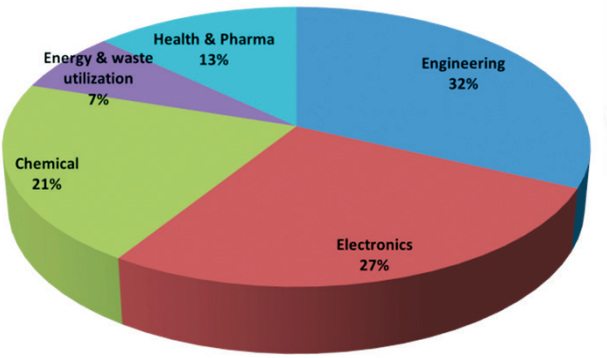
(d) Priority technology development projects of PSUs in consultation with and co-financing from economic ministries. Under this, consortium projects for development of technologies of common interests for group of industries or associations to be undertaken by industrial units, national laboratories, user industries in important focused areas such as Electronics and Communications, Railways, Drugs, Chemicals and Fertilizers etc.

(e) Development and demonstration of technologies for common use by industry clusters.

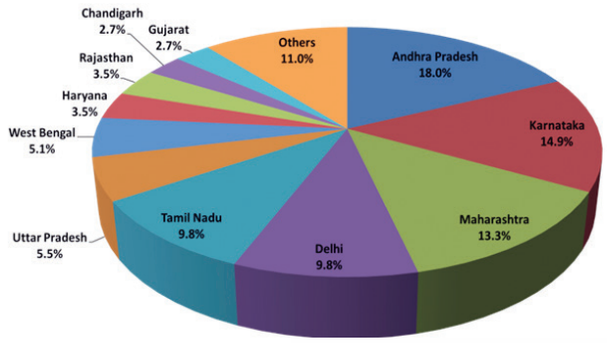
(f) Development and demonstration of technologies for government's flagship and mission mode projects.

The partial financial support by DSIR in the above areas primarily covers prototype development and pilot plant work, testing and evaluation of products from such R&D, user trials, etc. Bulk of the cost of the project is met from the proposer industry's resources.

The Technology Development and Demonstration Programme (TDDP) started in 1992, and the department has supported 254 R&D projects of Industrial units with a total project cost of Rs. 750.60 crores in which DSIR support is Rs. 280.40 crores. The projects cover a number of industry sectors and the share of these industry sectors in the project supported are: 32% engineering; 27% electronics; 21% Chemical; 7% energy and waste utilization and 13% Health & Pharma. The projects supported have been spread over 22 states of the country and the share of top five states in the number of projects supported is: Andhra Pradesh 18%, Karnataka 15%, Maharashtra 13%, Delhi 10% and Tamil Nadu 10%.



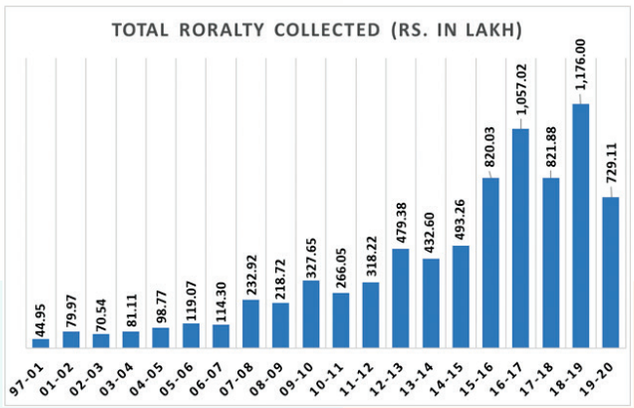
Sector-wise TDDP Project supported



State-wise TDDP Project supported

102 technologies developed under the scheme have been commercialized (**Annexure 7**) and the department has received a cumulative royalty of Rs.79.82 crore during the period 1997-2020.

During the current financial year, progress of last three on-going projects was monitored.



Year-wise royalty received from the commercialized products/processes developed under TDDP projects.

ASIAN & PACIFIC CENTRE
FOR
TRANSFER OF TECHNOLOGY (APCTT).

ASIAN & PACIFIC CENTRE FOR TRANSFER OF TECHNOLOGY (APCTT).

1. INTRODUCTION

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.

The Centre has been fostering inclusive partnerships between governments, research and development institutions, private sector and civil society for transfer, dissemination and diffusion of environmentally sound technologies between countries in the Asia-Pacific region.

The Centre supports development of partnerships and creation of enabling environment for innovation and technology transfer. The activities of the Centre not only contributes towards the Sustainable Development Goal (SDG) 9 (Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation) and SDG 17 (Strengthen the means of implementation and revitalize the global partnership for sustainable development), but also supports the other SDGs through specific technologies related to them.

2. SUMMARY OF CAPACITY BUILDING ACTIVITIES IN 2020

i. APCTT's primary focus areas in 2020 were as follows:

ii. Strengthening and promoting sound national innovation systems to harness technology innovations for sustainable development;

iii. Capacity building support to develop, transfer, commercialize and adopt new and emerging technologies that have the transformative potential to achieve the Sustainable Development Goals;

iv. Enhancing knowledge and exchange of best practices on science, technology and innovation policy, promotion of new and emerging technology innovations, technology transfer and commercialization, intellectual property management and technology licensing, strategies to address the challenges of COVID-19 pandemic;

v. Production of periodicals and publications on science, technology and innovation policy, technology transfer and commercialization, intellectual property management, new and emerging technologies and other related areas; and

vi. Facilitation of regional cooperation and networking in science, technology and innovation, and cross-border technology transfer.

vii. The Centre delivered and actively contributed to 7 demand-driven capacity building activities in 5 member States (China, Indonesia, Japan, Thailand and Uzbekistan) in close collaboration with 27 partner institutions (**Annexure 8**). The activities included international conferences and regional capacity building workshops. The Centre reached out to about 707 target participants comprising representatives from science, technology and innovation policy makers, and representatives from technology promotion agencies, technology transfer intermediaries, academia, research and development institutions, small and medium enterprises, startups and financial institutions.

viii. The Centre mobilized participation of experts from the Asia-Pacific member States namely Australia, Bhutan, China,

India, Indonesia, Islamic Republic of Iran, Japan, Lao People's Democratic Republic, Malaysia, Maldives, Myanmar, Philippines, Republic of Korea, Sri Lanka, Singapore, Thailand, Timor-Leste, Turkmenistan, Uzbekistan and Viet Nam. The experts shared their domain knowledge, experiences and best practices with the target participants. The Centre's also facilitated participation of experts from Botswana, Ireland, Poland, Switzerland, Trinidad and Tobago, the United States of America, Association of Southeast Asian Nations, from other United Nations Organizations such as the United Nations Educational, Scientific and Cultural Organization and the World Intellectual Property Organization.

ix. APCTT's online periodical 'Asia-Pacific Tech Monitor' delivered latest information on: technology trends and developments; science, technology and innovation policies; technology market; technology transfer and commercialization; intellectual property management; and new and emerging technologies including the fourth industrial revolution technologies (**Annexure 9**).

x. The Centre contributed to strengthening the capabilities of stakeholders from countries with special needs such as Bangladesh, Bhutan, Lao People's Democratic Republic, Maldives, Myanmar and Timor-Leste.

xi. The Centre expanded the outreach of its capacity building activities to Central Asian countries such as Turkmenistan and Uzbekistan.

3. DETAILS OF ACTIVITIES CARRIED OUT BY THE CENTRE IN 2020

i. Strengthening of national innovation systems: APCTT provided capacity building support to strengthen national innovations systems of the member countries. Following are the key activities carried out and/or contributed by the Centre:

ii. Expert Dialogue on Science Engineering Technology Innovation Priorities and Implementation Means – Asia-Pacific Online Consultation, 1 September 2020, Indonesia (virtual event): The Centre supported the event organized by the Regional Science Bureau for Asia and the Pacific, the United Nations Educational, Scientific and Cultural Organization, Jakarta, Indonesia. The regional dialogue brought inputs and insights from related experts in Asia and the Pacific to reach a regional consensus on the role of science, engineering, technology and innovation for delivering the Sustainable Development Goals. Eleven experts from Australia, China, Indonesia, Japan, Malaysia, Myanmar, Pakistan and Sri Lanka shared experiences, key challenges and the lessons learnt. They provided suggestions on how to overcome the challenges as well as areas for international collaboration and networking to advance achieving Sustainable Development Goals in the region. The Centre shared perspectives on the role of Sustainable Development Goals-ready technologies and innovations for the Asia-Pacific region. The regional dialogue was attended by 63 participants from Afghanistan, Australia, China, India, Indonesia, Islamic Republic of Iran, Japan, Malaysia, Myanmar, Pakistan and Singapore, Sri Lanka and Viet Nam.

iii. International Conference on Circular Economy and Technology Transfer for Small and Medium Sized Enterprises,

23 September 2020, Bangkok, Thailand (hybrid event): The Centre organized this conference jointly with the Ministry of Higher Education, Science, Research and Innovation, Thailand and the Thailand Institute of Scientific and Technological Research. The conference was held in conjunction with Association of South East Asian Nations Sustainable Energy Week, 23-27 September 2020, Bangkok, Thailand. The conference deliberated on: circular and bio-circular-green economy concepts; bio-circular-green economy policies and practices; bio-circular-green innovations and best practices for small and medium enterprises; bio-circular-green technologies for sustainable development, commercialization and adoption; and areas for regional cooperation. Experts from India, Malaysia, Thailand, Viet Nam and ESCAP shared their perspectives and experiences, case studies and best practices. The conference enhanced knowledge and understanding of 70 participants from 13 member States, namely China, India, Indonesia, Lao People's Democratic Republic, Malaysia, Maldives, Myanmar, Philippines, Singapore, Thailand, Timor-Leste, Turkmenistan and Viet Nam. The participants comprised government officials, scientists, private sector representatives, technology intermediaries, small and medium enterprises and other relevant stakeholders. The experts shared their perspectives and experiences on bio-circular-green model for sustainability, climate change mitigation and adaptation and the ways to support small and medium enterprises in taking up inclusive bio-circular-green technologies in the Association of Southeast Asian Nations region.

iv. **Regional Workshop on New Paradigms of Innovation and Technology to Address the Challenges of COVID-19 Pandemic, 3 November 2020, Tashkent, Uzbekistan (virtual event):** The Centre organized this regional workshop jointly with Ministry of Innovative Development, Republic of Uzbekistan. Policy-makers and experts from China, India, Ireland, Japan, Philippines, the Republic of Korea and Uzbekistan discussed strategies to use technologies, including emerging fourth industrial revolution technologies, to address the challenges during- and post-COVID scenarios. The experts highlighted the various challenges of COVID-19 in the areas of healthcare, business, production, education and research and development. In order to complement the knowledge with real experience, the regional workshop was held on the first day of the virtual InnoWeek.uz 2020 expo, part of the International Week of Innovative Ideas (3-8 November 2020) organized by the Ministry of Innovative Development, Uzbekistan. The workshop contributed to enhancing the knowledge, skill and capabilities of 86 participants from 10 member States, namely China, India, Indonesia, Japan, Pakistan, Philippines, Republic of Korea, Sri Lanka, Thailand and Uzbekistan. The participants included government officials, research scientists, private sector representatives, technology intermediaries, small and medium enterprises and other relevant stakeholders involved in innovation and technology transfer.

v. **International Forum for Sustainable Asia and the Pacific 2020, 10 November 2020, Hayama, Japan (virtual event):** The Centre contributed to this event organized by the Institute for Global

Environmental Strategies, Japan. The forum deliberated on the model of 'co-innovation' and its potential role in facilitating the cross-border transfer of technologies, including transfer of Japanese technologies to other countries in Asia. The forum discussed about co-innovation as a collaborative and iterative approach to jointly innovate, manufacture and scale up technologies. Nine experts from India, Japan, Asian Development Bank and Institute for Global Environmental Strategies shared their viewpoints and case studies with the participants. The Centre shared regional perspectives on low carbon technology collaborations in Asia to foster technology transfer and co-innovation.

vi. **International Conference on Emerging Technologies to Combat the COVID-19 Pandemic, 1 December 2020, Guangzhou, China (hybrid event):** The Centre organized the international conference jointly with the Ministry of Science and Technology, People's Republic of China and in collaboration with the Guangzhou University, China. The conference provided a platform to deliberate on the role of science, technology and innovation (STI), and to share national, regional and global best practices on the use of emerging technologies to address the challenges of COVID-19. The conference facilitated increased understanding of participants on collaborative research and innovation, and international and regional technology cooperation related to emerging technologies. The conference had a strong focus on strategies to use fourth industrial revolution (4IR) technologies to address the challenges in the areas of healthcare, business, production, education and research and development, during- and post- COVID scenarios. One of the key items of the international conference was the launch of the new website of Asia-Pacific Regional Innovation Knowledge Network for 4th Industrial Revolution Technologies (APRIKNET-4IR). This knowledge network was created as an outcome of past APCTT event. The conference enhanced the knowledge and understanding of about 120 participants including senior Government officials and experts from Bhutan, Bangladesh, China, India, Indonesia, Ireland, Islamic Republic of Iran, Japan, Malaysia, Nepal, Pakistan, Philippines, Republic of Korea, Singapore, Sri Lanka, Switzerland, Thailand and Uzbekistan.

4. Support technology transfer capacity building

The Centre organized the following capacity-building activities:

i. **Regional Workshop on Technology Transfer – Renewable Energy Technologies for Climate Change Mitigation, 24-25 September 2020, Bangkok, Thailand (hybrid event):** The Centre organized this regional workshop jointly with Ministry of Higher Education, Science, Research and Innovation, Thailand and the Thailand Institute of Scientific and Technological Research. The workshop discussed policies and strategies, institutional and financial mechanisms, and innovative business models for renewable energy technology transfer, adoption and deployment. Experts from India, Japan, Republic of Korea, Thailand, ESCAP and the United Nations Educational, Scientific and Cultural Organization shared experiences and relevant case studies from across the Asia-Pacific region. The workshop witnessed participation of 83

representatives from 14 member States, namely Bhutan, China, India, Indonesia, Islamic Republic of Iran, Japan, Lao People's Democratic Republic, Myanmar, Philippines, Republic of Korea, Thailand, Timor-Leste, Trinidad and Tobago, and Turkmenistan. The participants comprised policy makers, government officials, scientists, private sector representatives, technology intermediaries and other stakeholders from the domain of renewable energy (including bio-energy) and climate change related aspects, from the Association of Southeast Asian Nations and other Asia-Pacific countries. As a concrete outcome in this area, the Centre supported the establishment of the Association of Southeast Asian Nations Network of Excellence Centre of Biomass Conversion Technology in cooperation with Thailand Institute of Scientific and Technological Research, Thailand.

ii. **International Workshop on Intellectual Property Management and Technology Transfer, 19 November 2020, Indonesia (virtual event)**: The Centre organized this international workshop jointly with Indonesian Institute of Science. The workshop deliberated on: policy framework on intellectual property and technology transfer – global and national perspectives; intellectual property management tools, strategies and best practices; and collaborative research to enhance technology transfer through Science and Technology Parks. Experts from India, Indonesia, Japan, Malaysia, Republic of Korea, Thailand and the World Intellectual Property Organization shared their viewpoints and experiences related to intellectual property management, technology transfer and licensing. Case studies and best practices were also shared by the speakers. The workshop enhanced knowledge, understanding and skill of 176 participants from 12 member and associate member States, namely Bhutan, Hong Kong Special Administrative Region of the People's Republic of China, India, Indonesia, Japan, Malaysia, Pakistan, Republic of Korea, Singapore, Thailand, Uzbekistan and the United States of America. Experts from Botswana, Ireland and Poland also participated in the workshop. The participants comprised policy makers, representatives from government agencies, academia, research and development institutions, technology-based enterprises and other relevant stakeholders.

5. Providing technology intelligence through publications

i. The Centre disseminated information on recent technological trends and developments through its periodicals and publications. The Centre's publication has been used widely by the policymakers, institutions, and technology transfer intermediaries and other experts. The online periodical Asia-Pacific Tech Monitor (www.techmonitor.net) features articles on the latest technology trends and developments, technology policies, technology market, innovation management, technology transfer and new products and processes.

ii. The Centre published 4 issues of Tech Monitor focusing on special themes such as technology-based start-ups, sustainable ocean economy, intellectual property management, and technologies to control the COVID-19 pandemic. The Tech Monitor issues featured 16 articles

contributed by 31 authors and experts from Bangladesh, China, India, Malaysia, Philippines, Republic of Korea, Thailand and the Asian Development Bank. 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 50 selected technology offers and requests from the technology database of the Centre.

iii. The Centre shared its online Asia-Pacific Tech Monitor with readers from the member countries and outside the region as well. The web-version of the Tech Monitor was distributed to 1489 key stakeholders and e-subscribers from the member countries. The Centre also disseminated the e-periodicals through social media platforms such as Facebook.

iv. The Centre developed a publication and training manuals on intellectual property management and technology licensing. The publication was part of the United Nations Development Account project activities titled 'South-South Cooperation for Science, Technology and Innovation Policies in the Asia-Pacific Region'. The publication and the training manuals cover key topics such as: identification and protection of intellectual property assets, intellectual property strategy and management tools, intellectual property commercialization, technology transfer, enforcement strategy and dispute resolution, and intellectual property policy options and recommendations for research and development organizations. The target users of the publication and the training manual are policy makers, managers of technology licensing and transfer offices, and the private sector enterprises. The publication is currently in the press for printing.

v. The Centre is currently developing a guidebook on 'Innovation and technology transfer for clean energy in Asia and the Pacific'. The guidebook focuses on policies, strategies, business models and regional cooperation for innovation and transfer of clean energy technologies in the Asia-Pacific region. The guidebook covers chapters on: introduction to need for transition to clean energy and importance of technology transfer and innovation in the Asia-Pacific; investigation of technology transfer and innovation - case studies pertaining to clean energy; leveraging available public resources for policymakers; and conclusions and recommendations to support clean energy technology transfer. The target users of the guidebook are policy makers and clean energy practitioners.

6. Support to inter-governmental meetings of ESCAP

i. **Seventy Sixth Commission Session of ESCAP, 21 May 2020, Bangkok, Thailand:** The Centre provided substantive support and submitted the report on the fifteenth session of its Governing Council, held in Malaysia. The Centre organized the election of the Governing Council for the period of 2020-2022. The following are the outcomes of the 76th Commission session on the Centre's work programme:

ii. The Commission endorsed the report of the Governing Council of the Asian and Pacific Centre for Transfer of Technology on its fifteenth session (ESCAP/76/20) (Decision 76/3).

iii. The Commission noted the information provided by the secretariat on the overview of partnerships, extrabudgetary contributions and capacity development (ESCAP/76/27) and expressed its appreciation for the contributions to the Centre pledged by members and associate members for 2020 (Decision 76/12). They are: China - RMB 190000, India - $870000, Macao, China - $5000, Republic of Korea - $24630 and Thailand - $15000.

iv. In addition to the host country, India, the Commission elected the following members and associate members to the Governing Council of the Asian and Pacific Centre for Transfer of Technology for the period 2020 to 2023: Bangladesh, China, Indonesia, Islamic Republic of Iran, Nepal, Pakistan, Republic of Korea, Sri Lanka, Thailand and Uzbekistan.

v. **Session of the Committee on Information and Communications Technology, Science, Technology and Innovation of ESCAP, 19-20 August 2020, Bangkok, Thailand:** The Centre provided substantive support and reported the outcomes of its activities to the Committee. The Committee made the following recommendation related to the Centre:

vi. The Committee acknowledged that the support provided by the Asian and Pacific Centre for Transfer of Technology in the period 2018–2020 strengthened the capacities of member States in critical areas of science, technology and innovation. The Committee recommended that the Centre continue to facilitate knowledge-sharing and provide demand-driven capacity-building support with regard to enabling science, technology and innovation strategies to advance sustainable development. The priority areas of focus for the Centre's continued work include technology transfer and commercialization, intellectual property management and technology-based entrepreneurship and start-ups, with a special focus on fourth industrial revolution technologies, renewable energy, agriculture, water, and climate change mitigation and adaptation technologies. In addition, the Committee underlined the need to continue strengthening the institutional and human capacities of the Centre and recommended that member States consider providing or enhancing extrabudgetary financial support to the Centre and financing new technical cooperation projects to ensure the variety and sustainability of its capacity-building, research and technical assistance work. (ESCAP/CICTSTI//2020/7) (Recommendation 13)

7. Cooperation with United Nations organizations, international organizations and other partners

The Centre jointly delivered activities/ worked closely with United Nations agencies and international organizations including Regional Science Bureau for Asia and the Pacific of the United Nations Educational, Scientific and Cultural Organization, Indonesia; World Intellectual Property Organization, Geneva, Switzerland; Private Financing Advisory Network; Energy Division, Environment and Development Division and Trade Investment and Innovation Division of ESCAP; Institute for Global Environmental Strategies, Japan; World Resources Institute; Green Climate Fund; while implementing capacity-building activities in the member States.

8. Resource mobilization activities

The details of resource mobilization for institutional support to the Centre are provided below.

i. **Host country contribution:** The Government of India, as the host of the Centre, provides office premises for the Centre and an annual contribution for institutional support to the Centre. The annual contribution is used for the emoluments of project and administrative support staff, utility services, the editing and printing of the Centre's periodicals, maintenance costs and other expenses of the Centre. As a result of efforts to implement Resolution 71/1 to make all regional institutes of ESCAP primarily funded from extrabudgetary resources, the DSIR has enhanced its institutional support from $400,000 in the financial year 2019-2020 to $870,000 in the financial year 2020-2021. This enhanced funding provides for the critical operating requirements of the Centre, including salaries and allowances of internationally and locally recruited personnel, and other expenses of the Centre. As of 30 November 2020, APCTT had received institutional support fund of $659,038 out of pledged contribution of $870,000 from the Government of India (DSIR). This financial contribution received in cash is in addition to in-kind support received towards office premises such as those for building repairs, renovation work and municipal taxes.

ii. **Contributions from other member States:** The Centre received contributions from Bangladesh, China, Indonesia, Islamic Republic of Iran, Macao Province of China, Malaysia, Pakistan, Philippines, Republic of Korea, Sri Lanka, Thailand, Uzbekistan and Viet Nam, at various levels ranging from $5,000 to $30,340 in 2019 and 2020.

iii. **In-kind contribution from member States**: The Centre successfully secured in-kind support and contributions from member States (namely China, Indonesia, Thailand and Uzbekistan) for organizing activities in hybrid and virtual modes in 2020.

9. Digital Outreach

In 2020, the Centre redesigned and enhanced its institutional website and technology databases in alignment with the current focus of work programmes and activities. The Centre continued to extend its outreach to stakeholders, policy makers and institutions through digital tools including Facebook (facebook.com/UNAPCTT). The Centre coordinated with Strategic Communications and Advocacy Section of ESCAP to disseminate information about its activities and outputs through ESCAP newsletters, press releases and twitter updates.

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 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 2020-2021 for the implementation of IT Action Plan.

1.1 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: Up gradation, extension and maintenance of the 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.

1.2 Implementation of e-office in the DSIR.

Department has successfully implemented office automation solution in the form of E-office. E-office is one of the key IT projects of National Informatics Centre (NIC) aimed at improving internal efficiencies ian 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.

1.3 DSIR Website

The DSIR Website (Bilingual) has been made compliant to the Guildelines for Indian Government of Websites (GIGW). The website has been regularly updated and has been visited more than 3,03,904 times since 6th August, 2018.

The new website for DSIR with integration of Content Management Framework

(CMF), the migration of the current to new website is coordinated by NIC, CMF team and the Department of Scientific & Industrial Research is in its final phase of development. The website development & content migration has been completed and is at staging URL (http://164.100.166.67).

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	Smt. Kamini Mishra, Scientist 'F' Department of Scientific and Industrial Research Room No 20, TIFAC Building, Technology Bhawan, New Mehrauli Road, New Delhi-110016	Tel: 26529753, 26590455 ksm[at]nic[dot]in
Transparency Officer	Dr Prabhat Kumar Dutta, Scientist 'F' Department of Scientific and Industrial Research Room No. 43, TIFAC Building, Technology Bhawan, New Mehrauli Road, New Delhi-110016	Tel: 26534823, 26590394 Fax: 26960629 pkdutta[at] nic[dot]in
Nodal Officer and Central Public Information Officer	Shri Vimal Kumar Varun, Scientist 'F' Department of Scientific and Industrial Research 14-B, Administrative Block, Technology Bhawan, New Mehrauli Road, New Delhi-110016	Tel: 26590416 TeleFax: 26516078 vkv[at]nic[dot]in
Interim Nodal Officer and Central Public Information Officer	Dr. Suman Mazumdar, Scientist 'D' Department of Scientific and Industrial Research Room No. 17, Hall -B, S&T Block II, Technology Bhawan, New Mehrauli Road, New Delhi-110016	Tel: 26590206 suman.dsir[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 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.

http://www.dsir.gov.in/#files/rti-dsir.html

http://www.dsir.gov.in/dsirhindi/#files/rti-dsir.html

DSIR has received **122** RTI applications during 01/01/2020 to 31/12/2020 and **116** RTI requests were disposed off on RTI Request & Appeal Management Information System at *https://rtinonline.gov.in/RTIMIS*. During 01/01/2020 to 31/12/2020 **10** RTI applications were registered as first appeal.

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.

AUTONOMOUS BODIES

1: COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

2: CONSULTANCY DEVELOPMENT CENTRE (CDC)

1. COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH (CSIR)

MAJOR COVID-19 CONTRIBUTIONS

The SARS-CoV-2 outbreak in India and the world has posed a tremendous challenge to the human race, which necessitates urgent S&T driven interventions. CSIR, with its strong network of 38 laboratories across India and multifarious portfolio of technologies and interventions, has deployed its might to tackle the outbreak. To do so, CSIR has set up five interdisciplinary verticals and is working in close synergy with other government departments, and with Industry, MSMEs, and others for scale-up, delivery, and implementation on the ground.

CSIR's Five Verticals to Combat COVID19

Considering the complexity and diversity of problems posed by the coronavirus epidemic, which require interventions in several areas and multi-pronged strategy, CSIR has set up five technology verticals for addressing the emerging situation due to pandemic. These verticals are need-based and span multiple research labs and disciplines and draw upon the strength of scientists, students, and harness it for the fight against COVID-19. Besides, CSIR is also working on promoting rural employment and providing ready to eat food to migrants and other outreach programs.

CSIR, being aware that the task is formidable and requires coordination and cooperation, is working in close synergy with other government departments, ministries, and agencies on the one hand and on the other with Industry, MSMEs and others for scale-up, delivery, and implementation.

Digital and Molecular Surveillance

Rapid and Economical Diagnostics

New Drugs / Repurposing of Drugs

Hospital Assistive Devices and PPEs

Supply Chain and Logistics Support

Digital and Molecular Surveillance

Isolation and social distancing being key measures in containing the Corona outbreak, the goal is to trace patients digitally and establish virus transmission chains and mitigate transmission, which is addressed in the Digital Surveillance sub-vertical. Molecular surveillance involves the identification of the strain of the virus and its sequence, which are critical towards understanding the molecular epidemiology. The information generated will assist in the accurate diagnosis, development of suitable vaccines and drugs, and doses suitable for the Indian population.

Molecular Surveillance

Large dataset of the sequencing of viral genomes in India is the need of the hour to understand the virus dynamics such as its spread & mutation frequency and the impact on the severity of the disease and implications for the vaccine, drug, and diagnostic development. CSIR laboratories have undertaken sequencing of SARS-CoV-2 to find the type of strains present in India and to understand if the virus undergoes genetic changes while it is spreading in the country. The information will help gauge the severity of disease in various geographical regions, host

response to the infection, develop an ELISA detection test, and ultimately develop a vaccine against coronavirus. Several CSIR labs have sequenced the SARS-CoV-2 genome samples from Indian isolates, and more than 2000 have been sequenced so far. Sequence analysis reveals that there are many haplotypes in circulation; there is one distinct to Indian population I/A3i clade. Now A2a/G clade, the globally predominant clade is the major clade in all states. Vaccines/drugs targeting the epitopes of A2a/G clade are likely to work equally well in India too.

Many resources have been developed for analysis:

IndiCoV: A comprehensive resource for SARS-CoV genomes and variants from India. The resource provides a searchable interface for genomes, genomic variants and variant annotations for the SARS-CoV-2 isolates from India.

GEAR-19: A resource developed by CSIR-CCMB to track the genomic evolution of SARS-CoV-2

PhyloVis - Phylogenetic analysis of SARS-CoV-2 genomes from India and the COVID-19 Genomepedia: An integrative & searchable resource of SARS-nCoV-2 genomes is other resource.

Sewage based surveillance:

CSIR-CCMB developed the protocol for estimating the extent of SARS-CoV-2 population in large areas via checking for the virus in sewage samples collected from large parts of a city in sewage treatment plants. Considering the fact that wastewater-based epidemiology (WBE) approach can be a tool to minimise the disease spread, surveillance of selected urban cluster with the drainage network has been selected and wastewater samples from in and around Tarnaka nallahs have been collected (from October 2020) and analysed by CSIR-IICT and CSIR-CCMB, for the presence of SARS-CoV-2 viral genome. This can be applicable to the other urban communities for SARS-CoV-2 genome detection. Along with this a comprehensive surveillance of major municipal corporations of Andhra Pradesh State has also been started in November first week, and the work related to this is under progress. CSIR-NEERI is also involved in a major way in the surveillance and carrying it out in different parts of India along with CSIR-CCMB.

Testing for COVID-19 in wastewater as a community surveillance measure at CSIR-IICT in collaboration with CSIR-CCMB.

Sample collection for monitoring of drains and STP in Kolkata for Covid-19 detection study jointly done by CSIR-NEERI & CSIR-CCMB

Digital Surveillance Platform

Digital Surveillance is a vital step that involves the collection of data of confirmed cases, suspected cases, probable cases, contact cases through contact tracing (that may include asymptomatic as well). The data so generated is closely analysed to interpret the spread of the disease and facilitate the government to take necessary action on a timely basis and mitigate community-level transmission of SARS-CoV-2.

CSIR is working with Intel India and International Institute of Information Technology (IIIT), Hyderabad to help achieve faster and less expensive COVID-19 testing and coronavirus genome sequencing to understand the epidemiology and AI-based risk stratification for patients with comorbidities. As part of the initiative, Intel India is developing an end-to-end system that consists of multiple applications, testing devices, data collection/ aggregation gateways, a data exchange SDK, and an AI model-hub platform. CSIR constituent labs such as CSIR-IGIB, CSIR-CCMB, CSIR-IMTECH, CSIR-IIP, CSIR-CLRI and others will work with various hospitals and diagnostic chains in carrying out comprehensive diagnostics. IIIT-Hyderabad will develop risk stratification algorithms that can help in drug and vaccine discovery for long term preparedness to combat the epidemic.

The community-level screening was carried out at Kolar, Karnataka by CSIR-IGIB. The team has set up a model for community surveillance. This was done in collaboration with NIMHANS, THSTI (DBT), and TATA Sons. The pilot study was done, and 1000 random samples that included 200 healthcare workers from a database of 1 million people were screened by a mix of RT-PCR assays and Rapid Antibody test and proper ELISA. This model was run successfully and can be replicated in different cities pan India.

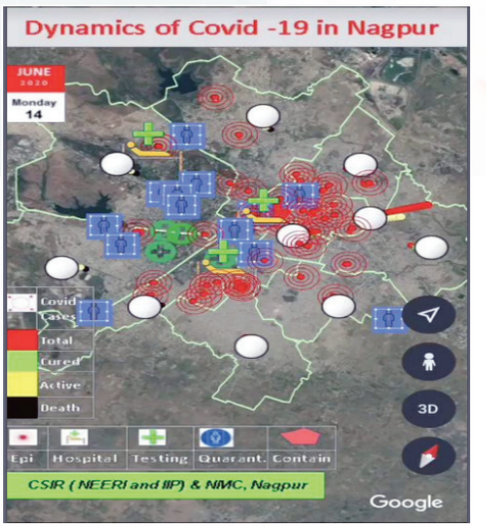
AI tool for Covid-19 detection from X-Rays: CSIR has initiated efforts to reduce the time taken for diagnosis using Artificial Intelligence tools. Efficient deep learning Artificial Intelligence models have been developed by CSIR-IGIB for early diagnosis of COVID-19 through pattern recognition of chest X-rays and CT scans in partnership with industry.

3D View of Covid Data:

CSIR-IIP and CSIR-NEERI jointly developed Google Earth enabled 3D handy digital surveillance service which was launched on World Environment Day (June 5th, 2020) with services for Maharashtra, India and World Covid-19 data in a more realistic and dynamic way. The most unique feature of the link has been a 3D view of the Covid data comparison (i.e. Total Vs Active Vs Cured Vs Death cases). Users can visualise the case counts just by clicking on the 3D bars. Implementing further improvisation in this service, CSIR-NEERI and CSIR-IIP in cooperation with Nagpur Municipal Corporation launched one of its kind of micro-level model for Covid-19 digital surveillance.

Air surveillance:

Given that there is ambiguity regarding the airborne transmission of SARS-CoV-2, work is on to test the presence of SARS-CoV-2 in the air which has been undertaken by CSIR labs, CSIR-CCMB and CSIR-IMTECH. Early studies indicate that while samples from ICU, are positive for the virus, further studies involving surveillance with COVID patients sitting in a confined room and samples taken at various distances and time point are ongoing. Extensive studies are needed to validate the early observations as this will have large implications in the Covid-19 mitigation efforts.



Serological Surveillance:

Several CSIR labs are participating in CSIR Phenome India Project led by CSIR-IGIB which is a long-term longitudinal observational cohort study of health outcomes within its employees with an aim to develop risk prediction tools and play an important role towards establishing precision health and medicine for the Indian population. In this regard, the Covid19 serological tests have been conducted across CSIR labs in the country spearheaded by CSIR-IGIB. The serological survey across the CSIR labs located in varied regions and representing a wide diversity of population provides insight into the spread of the disease in different settings, different categories of people. Also, long term studies will provide insights into the duration and magnitude of the antibody response in antibody-positive patients. The first round of testing has been done on > 10,000 persons. The second round of sero-surveillance on the positive patients is underway.

Rapid and Economical Diagnosis

The key to flattening the curve of growth in Coronavirus cases is to the detection of the infected at the earliest and isolating them. A combination of digital and molecular surveillance with rapid diagnosis is the need of the hour. Hence there is a critical need to expand the diagnostic scale in the country multifold. CSIR labs are well equipped with the technology and know-how of Coronavirus diagnostic tests and also possess expertise in developing newer and rapid diagnostics.

Diagnostic Testing of Coronavirus Samples

CSIR is deeply involved in the testing of human samples for the presence of coronavirus infection using the RT-PCR test. Several of its laboratories are engaged in the work, and 13 CSIR labs across the country are testing, and as of early December, more than 6.5 lakh samples have been tested with CSIR-IITR and CSIR-CDRI having tested more than 1.5 and 1.0 lakh respectively. CSIR labs have also engaged in training of Human Resources for testing and have helped many hospitals and research institutes in carrying out RT-PCR. CSIR-CCMB is the only non-ICMR but ICMR-approved validation centre that is approved to test the different kits that are being used in COVID-19 testing

Handheld device Truenat developed under CSIR-NMITLI has been approved for testing of the coronavirus at the country level. It can capture data from the installed machines and feed the central database for surveillance purposes. About 1000 devices are being used across the country for coronavirus testing. The cost per test is about Rs.1200 as against Rs.4500/test of RT-PCR test.

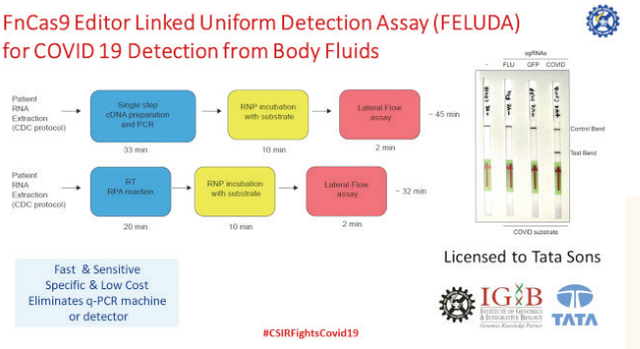
Dry-Swab-Direct-RTPCR Diagnostic:

The simple and fast method of Dry Swab-Direct RT-PCR, developed by CSIRs constituent lab CCMB, Hyderabad, for scaling up of SARS-CoV-2 detection has now been approved by ICMR based on their independent validation. This method is a simple variation of the existing gold standard RT-PCR method and can easily scale up the testing by 2 to 3 fold with no new investment of resources and makes diagnosis test simpler, faster and cheaper. Compared to conventional RT-PCR method, in the improved method, the swab is collected and transported in a dry state (Dry Swab), and the step of RNA isolation is omitted, and RT-PCR (Direct RT-PCR) is carried out directly. The advantage of this improved method is twofold. Firstly, RNA isolation is a major bottleneck in terms of human resources, time and money and the Dry-Swab-Direct-RT-PCR method circumvent this step. Secondly, dry swab without the liquid VTM is easy to transport and handle in the BSL2 facility and decreases the risk of viral infection. Significantly, CSIR-CCMB has demonstrated that Dry Swab-Direct RT-PCR

is comparable in sensitivity and specificity to the gold standard RT-PCR method. Further, it has been independently validated by CDFD (an autonomous institute under DBT), CSIR-NEERI (a CSIR lab at Nagpur) and IISER-Berhampur and several other private and government hospitals and institutes. After evaluating this method and finding an overall concordance of 96.9%, ICMR has issued an advisory for the use of CSIR-CCMB dry swab method, considering its lesser cost and quick turn-around time.

CRISPR/ Cas based paper diagnostic test FELUDA

A CRISPR/ Cas-based paper diagnostic test has been developed by CSIR. The FELUDA methodology has been developed in CSIR-IGIB for detecting single nucleotide variants in RNA or DNA or more broadly detecting any DNA or RNA fragment, without the need for sequencing. The principle of discrimination is derived from the natural property of the enzyme being used for the invention, *Francisella novicida* Cas9 (FnCas9) which shows a very low binding affinity to mismatched substrates. For COVID-19 detection, RNA is isolated from body fluids containing the inactivated virus, converted to DNA, and further amplified to increase the number of copies. The amplification is done using custom generated primers resulting in DNA products labelled with biotin ligand. Upon incubation of a CRISPR complex (labelled with a Fluorescein amidite group) with these DNA products, the Cas9 protein interacts with the biotin-labelled DNA only if there is a CoV-2 sequence present. The complex formed is then applied on a paper strip whose chemistry is defined by the production of the test line where the Cas9: DNA complex gets deposited giving rise to a visible band. The presence of this line shows that the patient sample is positive for COVID-19. This technology can be adopted for other diseases too. CSIR has licensed this technology to TATA Sons. The kit has been approved by DCGI, and TATA has launched this as TATA MD CHECK and is currently being rolled out.



Development of RT-LAMP assay for Molecular Diagnosis of COVID-19

CSIR-IIIM and Reliance Industries Limited have together developed a Reverse Transcription Loop-Mediated Isothermal Amplification (RT-LAMP) assay for much cheaper diagnosis of COVID-19. RT-LAMP assays include conversion of viral RNA to cDNA, followed by target DNA amplification using a set of four to six primers, at isothermal conditions. Larger validation of the RT-LAMP assay kit is underway.

Next-Generation Sequencing (NGS) based surveillance and diagnostics

CSIR labs have developed many platforms for sequencing based surveillance and diagnostics. Next-generation sequencing (NGS) allows for analysing a large number of viral sequences from infected patients, presenting novel prospects for studying the structure of viral populations and understanding virus evolution and epidemiology. Of these using the Illumina sequencing platform, CSIR-IGIB has been the first to globally validate the COVIDSeq assay on clinical samples. This method allows for sequencing for detection and also genetic epidemiology. It has a scalable configuration for 300, 1500, 3000 samples and can provide results of few thousands of

samples in 12 hours on the Illumina NovaSeq 6000, leading to the concept of Mega lab which can be deployed at airports or sporting events or red zones where a large number of samples needed to be tested at one go. CSIR-IGIB is working with the Kerala Government to track the viral strains using this method.

CSIR-CCMB has also developed a protocol for sequencing based diagnostics with Syngene as a partner which can also test thousands of samples at one go. In addition to this, a nanopore-based platform has also been tested and protocol developed by CSIR-IGIB, which will aid in testing at low resource settings. This method has the advantage of Affordability, Low-resource, Speed and Sensitivity and can be used to sequence the whole genome or amplicon-based detection.

Advance Virology Lab for the Covid-19 testing facility has been established by CSIR-National Botanical Research Institute, Lucknow

A newly developed "Advance Virology Lab." where the Covid-19 testing facility has been established by CSIR-National Botanical Research Institute, Lucknow, was inaugurated on 27th June 2020 by Mr. RK Tiwari, Chief Secretary, Government of UP and Prof. MLB Bhatt, VC, KGMU, Lucknow. Prof. SK Barik, Director, informed that the facility conforms to the guidelines of ICMR, WHO and Ministry of Health & Family Welfare, Government of India. It is a BSL3 level facility with Negative Pressure which makes it a very safe Covid testing facility. The facility will add up to the testing capacity of Uttar Pradesh. Prof. Barik mentioned that as requested by Government of India and Government of Uttar Pradesh, NBRI took up the initiative for developing the testing facility in the wake of Coronavirus pandemic as a service to the people of Uttar Pradesh.

Development of Repurposed Drugs/New Drugs and Vaccine

The main focus of this vertical is on enabling quick access to drugs against coronavirus for Indian patients as soon as they are developed in India or globally. CSIR is exploring all possible options ranging from repurposed drugs to new drugs to phytopharmaceuticals and AYUSH products and biological therapeutics, including vaccines.

Towards that CSIR is working on the synthesis of the top 'potential' repurposed drugs for carrying out clinical trials etc. For this CSIR has tied up with top pharmaceutical Industries such as Cipla and CSIR has well-established credentials in the synthesis of drugs, having worked closely with industry and being the fountainhead of processes for generic drugs for which India is globally renowned.

Repurposed Drugs: Based on the global

therapeutic pipeline, CSIR has identified the top 25 drugs/drug candidates that have the potential to be beneficial in the treatment of Covid-19. This is a dynamic list given that the global therapeutic landscape is changing with several ongoing clinical trials whose results are likely to impact the outcomes.

Of the drugs/drug candidates shortlisted, CSIR has prioritized drugs for establishing optimal synthetic processes for those drugs for which there is a higher potential of them getting approved and which are not commercially available in India. Developing the synthetic process of these top drugs/ drug candidates will enhance the chances of the drugs getting introduced in India by an Industry, once favourable outcomes are obtained in clinical trials. Many CSIR labs across India such as CSIR-IICT, CSIR-CDRI, CSIR-NCL, CSIR-IICB, CSIR-IIIM, CSIR-NIIST, CSIR-NEIST, and others are involved in this strategy.

Key Drugs/Drug Candidates under Development at CSIR

i. **Favipiravir:** A cost-effective process of Favipiravir for the treatment of COVID-19 patients has been developed by CSIR-IICT. An off-patent anti-viral drug, Favipiravir, originally discovered by Fuji Pharma in Japan, has shown promise in clinical trials for the treatment of COVID-19 patients, especially in mild and moderate cases. CSIR-IICT developed a cost-effective process using locally available chemicals to synthesise this Active Pharmaceutical Ingredient (API) and transferred the technology to Cipla. Cipla scaled up the process in their manufacturing facility and after receiving permission from DCGI (Drug Controller General of India) launched the product in India as CIPLENZA and the introduction of this lead to affordable pricing of favipiravir in the country.

ii. **Remdesivir:** CSIR-IICT developed the process for the key intermediates and APIs of Remdesivir another promising repurposed drug for Covid19. CSIR-IICT also developed processes for Arbidol, Baloxavir, Chloroquine/ Hydroxychloroquine and is working with industries such as Mylan, Laxai Life Sciences and CIPLA

iii. **CSIR-IICT and Mylan Laboratories Limited** are in partnership to address unmet patient needs amidst the evolving COVID-19 pandemic. Under the partnership, CSIR-IICT and Mylan are collaborating to identify potential therapies for COVID-19. A series of clinical trials will be conducted towards new and innovative solutions to manage COVID-19 pandemic in India as part of this collaboration. Application for phase III of Combination clinical trials was examined by DCGI, and it asked to do Phase II Clinical trial.

iv. **CSIR-IICT and LAXAI pharma** are undertaking multiple clinical trials of repurposed drugs, and the application of combination drugs was examined by DCGI. DCGI has recommended phase 2 clinical trial of colchicine for use in Covid19 patients.

v. **Umifenovir:** Umifenovir (brand name Arbidol) is an antiviral drug, which has been used for the treatment of influenza infection in Russia and China. Umifenovir is being investigated as a potential treatment and prophylactic agent for COVID-19 caused by SARS-CoV2 infections. CSIR-CDRI has developed an improved synthesis of Umifenovir on a multi-gram scale, and this technology has been transferred to an industrial partner. CSIR-CDRI after obtaining DCGI permission for conducting Phase III, Randomized, Double-blind, Pla-

cebo-controlled trial of Efficacy, Safety and Tolerability of Antiviral drug Umifenovir vs Standard care of therapy in non-severe COVID-19 patients has initiated the trial at King George's Medical University, Ram Manohar Lohia Institute of Medical Sciences, Eras Lucknow Medical College and Hospital, Lucknow. So far 60 COVID-19 patients recruited for the trials.

Reducing import dependency of APIs and drug intermediates:

CSIR labs are also working to reduce dependency on APIs and drug intermediates from other countries. Given the worldwide lockdown and apprehending shortage of supplies, CSIR-NCL, CSIR-IICT and many CSIR labs are working towards self-sufficiency in the drug supply chain for India by developing indigenous processes and platform technology to produce important key starting materials (KSMs)/drug intermediates and active pharmaceutical ingredients (APIs) in the country

Repurposing Anti-dengue Phytopharma formulation AQCH:

Collaborative work of CSIR-IIM with ICGEB and Sun Pharmaceuticals, a *Cocculus hirsutus* based phytopharmaceutical AQCH was developed for the treatment of dengue which had completed phase I trials. The drug has shown anti-SARS-CoV-2 effects in-vitro studies conducted in collaboration with ICGEB and Sun Pharmaceuticals. Currently, Phase-II Clinical trials on AQCH by Sun Pharma on Covid-19 patients is in progress. This is the First-ever approval in India in phytopharmaceutical route and Clinical trials on at 12 centers and involves 210 patients.

Sespivac (Mycobacterium W) for Covid-19:

CSIR and Cadila Pharmaceuticals are conducting clinical trials to evaluate the efficacy of an existing gram-negative sepsis drug, called Sepisvac for COVID19 patients. The drug contains heat-killed Mycobacterium (Mw) and is found to be extremely safe in patients, and no systemic side effects are associated with its use. Sepsivac has been clinically developed and approved for gram-negative sepsis, a severe infection. The drug has been shown to reduce the mortality of critically ill patients by more than half. It also leads to faster recovery of organ dysfunction seen in this condition. It is now approved for marketing in India and is available commercially as Sepsivac® from Cadila Pharmaceuticals Ltd. The drug now is being tested in three different trials to combat Covid-19.

On critically ill Covid19 patients: The Phase II clinical trial to evaluate the safety and efficacy of Mw on critically ill patients suffering from COVID 19 infection was conducted by CSIR and Cadila. The randomized, blinded, two arms, active comparator-controlled clinical trial was to evaluate the efficacy of the drug for reducing mortality (deaths) in critically ill COVID-19 patients. The trial was conducted at AIIMS-New Delhi, AIIMS-Bhopal, AIIMS-Raipur and PGI, Chandigarh. The drug has cleared Phase-II Clinical Trial successfully and is presently in Phase-III Clinical Trial.

The other two trials are phase III trial: a randomized, double-blind, two-arm, controlled clinical trial to compare the Efficacy and Safety of Mycobacterium w (Mw) administered along with Standard of care versus Placebo administered along with Standard of care, in adult, COVID 19 positive patients hospitalized but not critically ill; A Randomized, Double-blind, two-arm, Placebo-Controlled Clinical Trial to Evaluate the Efficacy and Safety of Mycobacterium w in preventing COVID-19 in subjects at risk of getting infected with COVID-19. The latter trial aims to see if Mw can protect the close contacts of

COVID-19 patients and health care staff by boosting their innate response and thereby preventing them from acquiring the disease.

Plasma Therapy:

A Phase 2 clinical trial for testing convalescent plasma therapy in Covid19 patients was undertaken by CSIR –IICB in West Bengal, in collaboration with the Department of Health & Family Welfare, Govt. of West Bengal. The study was undertaken by a team of scientists from CSIR-IICB, Kolkata, which was done in Infectious Disease & Beleghata General Hospital (ID & BG) in Kolkata. The study revealed that while among all the patients in this cohort the relative benefit of plasma therapy was not significant, it was found that moderate acute respiratory distress syndrome (ARDS) patients up to 67 years of age were significantly benefited from plasma therapy, in terms of reduction in mortality and early remissions. This suggests that precise targeting of severe COVID-19 patients is necessary for reaping the clinical benefits of convalescent plasma therapy.

The single centre open label phase II randomised control trial was done to assess the pathogen and host-intrinsic factors influencing clinical and immunological benefits of passive immunization using convalescent plasma therapy (CPT), in addition to standard of care (SOC) therapy in severe COVID-19 patients. Severe COVID-19 patients with evidence for moderate ARDS were recruited and randomised into two parallel arms of SOC and CPT, N=40 in each arm. Patients were followed up for 30 days' post-admission to assess the primary outcomes of all-cause mortality and immunological correlates for clinical benefits.

Ayurveda based botanical drugs

For the prophylaxis and management of COVID-19 in the population with mild to moderate disease, CSIR and Ministry of AYUSH have joined hands to validate some of the traditional AYUSH formulations for their safety and efficacy through scientific evidence. In this effort, CSIR-IIIM Jammu and CCRAS New Delhi signed an MoU on May 20, 2020. Under this agreement, CSIR-IIIM is validating following formulations through clinical trials in human subjects:

- *Withania somnifera* (Ashwagandha) for prophylaxis against SARS-CoV-2 infection.
- Ayurvedic formulation of *Tinospora cordifolia* + *Piper longum* (Guduchi + Pippali) as an Adjunct to Standard of Care for the management of mild to moderate COVID-19.
- Ayurvedic formulation of *Glycyrrhiza glabra* (Yashtimadhu) as an Adjunct to Standard of Care for the management of mild to moderate COVID-19.
- Ayurvedic Formulation AYUSH-64 as an Adjunct Treatment to Standard of Care for the management of Mild to Moderate COVID-19 Patients.
- A prospective clinical study to assess the role of Vasa Ghana (*Adhatoda Vasica*), Guduchi Ghana (*Tinospora Cordifolia*) and Vasa-Guduchi Ghana in therapeu-c management of symptoms in Covid19 posi-ve cases: a randomized, open label three armed study

Development of Drug-target based Assay platforms and screening against COVID 19

Identifying lead drug candidates either through drug repurposing or by the identification of new chemical entities requires the establishment of Drug-target based Assay platforms and screening against COVID 19. Presently, among the participating laboratories (CSIR-CDRI, CSIR-IICT, CSIR-NCL, CSIR-IMTech, and CSIR-IICB), purified targets like m-pro, PL-pro, RNA-dependent

RNA polymerase, and Spike-ACE2 are available. The purification of the proteins and assays are being standardized across the laboratories. The participant laboratories are further establishing platforms to address host-pathogen interaction and immune-modulatory functions, in addition to other targets, to screen new compounds & approved drugs to accelerate the development of therapeutics against COVID-19. Thousands of compounds are being screened using the assay systems for the development of new antiviral chemical entities as well as for drug repurposing as anti-virals and host-pathogen interactions, including immunomodulation.

Human Monoclonal Antibodies for COVID-19 Therapy:

Hyderabad based Bharat Biotech International Ltd., leads a CSIR-NMITLI supported project to develop human antibodies for COVID-19 therapy. CSIR has sanctioned a project led by Bharat Biotech International Ltd, to develop human monoclonal antibodies as therapy for COVID-19 infections. The project brings together both academia - National Centre for Cell Science (NCCS), Pune, and Indian Institute of Technology, Indore and industry - PredOmix Technologies Pvt. Ltd, Gurgaon and Bharat Biotech International Ltd., Hyderabad in a collaborative model for a public cause. The present project is to develop an alternate therapeutic regimen by generating highly effective and specific human monoclonal antibodies that are capable of neutralizing the SARS-CoV2 virus.

Vaccines for Covid-19:

CSIR and Aurobindo Pharma have signed an agreement for the development of several novel COVID-19 vaccines. CSIR-CCMB Hyderabad, CSIR-IMTECH, Chandigarh and CSIR-IICB, Kolkata are developing vaccine candidates using different technology platforms. Aurobindo Pharma will undertake clinical development and commercialization of the vaccines.

Antibody production in horses:

CSIR-CCMB has entered into MoU with the University of Hyderabad and Vins Bioproducts Ltd to enable the development of antisera against SARS-CoV-using inactivated virus in horses which is amenable for large-scale production. Antisera is the blood serum containing antibodies which can be used for passive immunity, and the work is in progress

Corona Viral Cultures and Cell lines for Screening Assays and Testing

To take forward new drug discovery, a critical step is the establishment of viral cultures and assays for testing. CSIR-CCMB and CSIR-IMTECH have set up viral culture facilities to enable testing and screening of drugs, devices etc.

CSIR-CCMB has entered into a collaboration with Eyestem Research Private Limited. The research team will use the human lung epithelial cell culture system provided by Eyestem as part of its anti-viral screening (ACS) platform. Eyestem's cell culture system expresses the ACE2 receptor and other genes which are essential determinants.

Drug Discovery HACKATHON (DDH2020)

DDH2020 is a joint initiative of AICTE, CSIR and supported by Office of Principal Scientific Advisor, Govt. of India, NIC and MyGov. DDH2020 vision and mission are to establish 'Open innovation Model' for in silico drug discovery against Covid-19 virus and will cover the various processes in drug discovery, including but not limited to, in silico screening of molecules, lead optimization and identification of drug-able non-toxic targets. The targets/tools/lead molecules identified through the process of DDH2020 will be further taken forward for synthesis,

followed by subsequent steps in the routine drug discovery program. Currently, India has more than 15 lakhs students & faculty in the field of computer sciences, pharmaceutical sciences, and biotechnology spread across 3000+ colleges and universities. We also have a large number of scientists working in research organizations, industries, and startups in the field of machine learning, artificial intelligence, drug discovery, in silico chemistry, and big data analytics which can contribute to this endeavour. This wide network of researchers will go a long way to address pandemic and outbreak situations across the world.

Hospital Assistive Devices and PPEs

A major challenge during the corona pandemic globally has been the severe shortage of ventilators and oxygen enrichment devices given that COVID19 patients develop severe respiratory problems. Another critical requirement in this pandemic has been the need for personal protective equipment (PPEs) to the caregivers such as Doctors, nurses, and paramedical staff given the infectious nature of the virus. Several CSIR laboratories including CSIR-NAL, CSIR-CEERI, CSIR-CMERI, CSIR-CECRI, and CSIR-CSIO are working actively in the development of ventilators, PPEs and other hospital assistive devices. For the scale-up of these CSIR has tied up with PSUs such as BHEL and BEL. Under this vertical, CSIR has developed: Ventilators, Oxygen Enrichment Unit, Pedal-operated Water Dispensing Taps, Electrostatic Disinfector, Face Shields and Personal Protective Equipment, etc.

SwasthVayu: Bi-Level Positive Airway Pressure (BiPAP) System Portable Ventilator:

CSIR-NAL developed a low cost indigenized, non-Invasive bi-level positive airway pressure ventilator device named as "SwasthVayu". It is a microcontroller-based closed-loop adaptive control system with a built-in biocompatible "3D printed manifold & coupler" with HEPA filter (Highly Efficient Particulate Air Filter) in inhalation & Exhalation circuits. Developed in 36 days, it is a cost-effective device, easy to use in Makeshift hospitals, wards, dispensary and has three modes of operation, continuous, timed and spontaneous. It has successfully passed stringent electrical safety, performance, calibration, bio-compatibility tests at NABL accredited laboratory and certified. It is registered with the Central Drug Standard Control Organization (CDSCO). It has undergone clinical trials at many hospitals, and CSIR-NAL is providing 1200 ventilators to the Delhi Government. Technology has been transferred to 7 Industries.

"BRAVO" Automated ICU Ventilator:

Bravo is an indigenously developed premium ICU ventilator by CSIR-CECRI, which has more than 95% of the parts sourced locally. The design has been done by Broadline Technologies Private Limited, Chennai and the 3D printing and medical coating done by CECRI, Karaikudi. NIPER, Govt. of India, helped for Clinical trials. Bravo can sense a patient's breath requirements and provide the required oxygen/air to the patient and has in-built alarms and warnings and can detect anyone parameter going out of range. Bravo also has an option to add other critical parameters such as pulse, oxygen saturation and ECG to serve as a comprehensive all in one Ventilator.

Oxygen Enrichment Unit (OEU) for Covid-19 Patients

CSIR-NCL has developed an Oxygen Enrichment Unit (OEU) based on Indigenous, innovative hollow-fibre membrane Technology. The unit intakes compressed air at 5 bar and offer oxygen-enriched air at 5-7 lpm with ~

35-40% oxygen content in it. OEU is certified by TUV Rheinland (India) Pvt Ltd. OEU is useful in the treatment of chronic lung diseases. It is being used for COVID patients with medium symptoms requiring supplemental oxygen at Dr. Naidu Hospital, Pune. It is portable, easy to operate, low maintenance (needed only for the compressor) and can serve in villages/remote areas where oxygen therapy is a costly affair. The technology is out-licensed to NCL's spin-off startup company, Genrich Membranes Pvt Ltd., who developed three variants of the unit: (1) Split unit: Compressor & membrane unit separate; (2) Compact, portable unit (3) Battery operated handy unit.

SwasthVayu

Oxygen Enrichment Unit

"BRAVO" Automated ICU Ventilator

Medical grade oxygen concentrator for hospital

In recent months there is also an escalation in demand for the medical-grade oxygen in the country for administering oxygen therapy to patients suffering from COVID-19. Availability of life saving, scalable, on-demand medical Oxygen plants is especially necessary for areas where logistics of oxygen supply is poor. For medical applications, high purity Oxygen is needed. As per Indian pharmacopoeia, medical oxygen should have O2 content 93±3%. There is huge scope for developing improved indigenous processes and devices with low energy intensity for the production of high purity oxygen meeting medical-grade specification with high recovery. CSIR-IIP has commissioned a 6 m3/h medical grade oxygen producing plant as per its own design which works based on the principle of adsorptive separation. The plant

is currently operational, and process performance stability is under study.

ElectroStatic Disinfection Unit: An electrostatic disinfection unit has been developed by CSIR-CSIO for a 360-degree area and uniform coverage, small droplet size, applicable for all fluid types. It has a single-headed nozzle with a tank capacity of 10/15 litres and battery usage hours[3] of 10-12 hours. The technology was transferred to BHEL, Rite water, M/s. Jhosna Corporation and M/s. Dashmesh Industries. Close to 200 units have been produced. Further, the unit ENCEESPRAY selected for Top COVID-19 Innovation Award with RITE Water Solution Pvt. Ltd, Nagpur, CSIR-CSIO and Univ. of Florida as partners by USISTEF.

Makeshift hospitals:

CSIR labs have developed makeshift hospitals to cater for care of Covid-19 patients. A 10-bed makeshift COVID-19 hospital and isolation centre was developed by CSIR-SERC, Chennai at the 4th Battalion Centre of the National Disaster Relief Force (NDRF) in Chennai. Hon'ble Union minister Dr Harsh Vardhan inaugurated the hospital. Further, CSIR-SERC has signed an agreement for licensing of technology – Portable lightweight foldable module for makeshift hospitals and other needs (PoliTal-M), with L&T, Mumbai. PoliTal-M is a lightweight foldable modular unit for fast deployment in the critical need of shelters, the total weight of the unit is around one ton, and it can be folded and transported easily. The fully folded modules can be taken to the site and erected after levelling the site, and each module can be installed within 30 mins. The size of the module is 6.0m x 3.0m x 2.8m height and the size can be customized as per the requirement from 3m to 6m length.

CSIR-CBRI, Roorkee, in collaboration with NDRF, Ministry of Home Affairs, developed a 10 bedded shift hospital for demonstration purpose as well as the use of NDRF, named as Karuna Bhawan. It would serve the purpose for disaster recovery stage including for use in a long pandemic or emergency situations. Currently, three makeshift hospitals are being made by CSIR-CBRI for the HP State Government.

Nasal-pharyngeal (NP) Swabs:

CSIR-NCL has developed NP swabs that can be used for Covid19 sample collection. They are made of sterile flocks material with nylon micro-fibre tip and flexible ABS shaft. They have a Breakpoint at which swab can be broken after sampling and put in a sample tube. They facilitated easy collection and release of cells into transport media-nylon microfibers attached vertically to shaft. It is an appropriately small size for paediatric, nasopharyngeal or urethral genital sample collection. They have been approved by ICMR, and the technology has been licensed

to Ms. Chembond Polymers and Materials Pvt. Ltd. (CPML), Mumbai. CPML has now started commercial manufacturing of these nasal swabs under the name, "KEMYLON SWABS". The company has established a facility to produce 1 lakh swabs/day.

Medical grade oxygen concentrator

Electro Static Disinfection Unit

Nasal-pharyngeal (NP) swab

PPE Coveralls

CSIR-NAL in a joint Venture with M/s. MAF Clothing Pvt Limited has developed the PPE Coveralls with Indigenous heat sealing tape and polypropylene materials. These are lightweight, breathable, jumpsuit type PPE coveralls using laminated non-woven fabric with features like the attached hood, seam-sealed, zipper front with sealed edges, soft elastic around the neck and long sleeves have been designed and developed indigenously for frontline health workers involved in containment zone of Covid-19. CSIR-NAL has prepared and implemented a strict Quality Assurance Plan, which includes inspection & qualification of raw materials, fabric cutting, sewing, seam sealing the fabric, labelling of coverall, folding and packing of the final product to ensure a foolproof quality requirement for coveralls. The developed coverall passes ASTM F1670 and ISO 16603 tests and has been tested and passed for blood penetration test as required for covid-19.

Production capacity at M/s. MAF Clothing is 5000 units per day (can be increased to 30,000 per day). More than one lakhs PPE Coveralls have been supplied so far.

Face masks and Face shield

3-D Face Shield by CSIR-CECRI: CSIR-CECRI has developed a 3-D printed face shield and is tying up with industry to scale up the mass production and has partnered with a company 3D Lycan, Bangalore for Face Shield. Certification as per the ANSI standard (Certified by CIPET, Chennai) is obtained.

Regular

Premium

Biopolymer Nanocoated Medical Grade Mask.

CSIR-NCL, Pune has developed a superior face mask that has better filtration efficiency than the available face masks in the market. The mask has been developed using patented bacterial nanocellulose technology along with nano-coating. The South India Textile Research Association (SITRA) has conducted tests on CSIR-NCL's sample face masks and has certified it. CSIR-NCL has licensed the biopolymer nano- coated technology to Pune-based MSME SETLAB INDIA. SETLAB plans to start production in the next few days with 5000 masks/day and will reach the target of one lakh masks per day.

UV sterilization units

Contactless Auto UV Disinfection Unit or Chamber for Touch Screens, Thumb or Finger Scanners and Keypads of Biometric Identification Devices and Other Devices or Systems developed by CSIR-CIMFR: The technology is used for contactless, automatic and chemical free disinfection of surfaces of biometric identification systems and other devices used by multiple users. UV-C germicidal lamp is used for disinfection of surfaces of biometric attendance systems (BAS) placed inside the Unit. The unit can be used for placing almost all sizes of available biometric attendance machines in the market. The disinfect unit for Biometric Attendance System is tested and certified by ICMR approved lab. The technology has been transferred to M/s Ashta Tech Automation Pvt. Ltd., Vimal Paints, Nagpur.

CSIR-CGCRI developed a programmable UV-C sterilization unit in order to disinfect several day to day office items. Ten such units have been fabricated and are in use at institute premises.

Multi-wavelength UV Source for Killing Pathogens in Real Time (MUKT – मुक्त):

MUKT-मुक्त is Plasma-UV based electronic easy-to-use pathogen inactivation system designed by CSIR-CEERI for its multi-purpose and diverse applications in Medical, Domestic, Food and Grocery. There are two versions of MUKT-मुक्त, namely MUKT-मुक्त Portable Version and MUKT-मुक्त Handheld Version. These systems are easy to operate with a normal AC power supply. The developed systems are a combination of indigenously developed mercury-free broadband UV lamps, and mercury based UV lamps. Multi-wavelength are being generated from dielectric barrier discharge based excimer lamp.

Touchless hand sanitiser/soap dispenser:

Various models for touch-free and leg operated soap and sanitiser dispensing systems have been designed, developed and installed at various locations by the CSIR laboratories, CSIR-CECRI, CSIR-CEERI, CSIR-CLRI, CSIR-CRRI, CSIR-CMERI, CSIR-IMMT. Foot-operated hand washing system (Hasta-Suraksha) developed by CSIR-IMMT. Hasta-Suraksha is a compact system, mechanically operated by foot and doesn't require any electricity and can be used at any convenient locations. This has a built-in mechanism for both water and liquid soap dispensing, controlled by foot through pedal and lever. It's a portable, low cost and maintenance-free system.

Sanitiser and soap solutions

In-house preparation of hand sanitiser as per WHO guidelines and specifications have been performed by various CSIR labs, CSIR-CEERI, CSIR-IIP, CSIR-IITR, CSIR-NML, CSIR-CLRI and CSIR-CFTRI and distributed to local shops, Electricity Supply Administration & Electricity Substations, hospitals, COVID-19 Isolation ward, State transport services, State Disaster Relief Force (SDRF), Subsidiary Intelligence Bureau, LPG bottling plant and Local Police Departments.

Sanitization, Disinfection and related Systems

i. **Electrochemical preparation of sodium hypochlorite (1.0 % NaOCl) disinfectant from common salt:** CSIR-CECRI developed the process for on-site preparation and production of sodium hypochlorite (1.0 % NaOCl) disinfectant from common salt, which is mainly used as a disinfectant (to combat COVID-19) in public places and hospitals to kill bacteria, fungi and virus. Technology transferred to M/s. RS Nanotechnologies, Sattur

ii. **Tractor mounted road sanitizing unit:** CSIR-CMERI developed a prototype for Tractor mounted road sanitizing unit having Span of 16 feet, Pump Spray Capacity of 30 Litre/min, Line Pressure of 10-15 bars, Tank Capacity of 2000-5000 litres, 6 Nos of Nozzles at the rear end and three on each side (Left and Right), Road Width Coverage of 16 feet on each run, Road Speed during Spray is 5-10 km/hr, Spray Mixture of Water and Sodium Hypochlorite Solution-6%.

iii. **Battery Powered Disinfection System:** CSIR-CMERI developed a Cordless machine that deactivates/kills pathogenic micro-organisms inside a chamber like rooms, halls, etc., Two nozzle spray system, Extended arm spray unit - length (full stretch): 250 cm, cost-effective, storage capacity: 20 Litres each tank, Battery back-up time in a single charge: 4 hours, Gross weight (empty tank): 25 Kg

iv. **Antiviral-coatings on fabrics***:* Coating of ZnO nanomaterials onto different fabric types using the CSIR-IICT developed methodology. To further explore the process for coating ZnO supplied by Tata Chemicals Ltd. and other metal oxide-based nanomaterials on fabric.

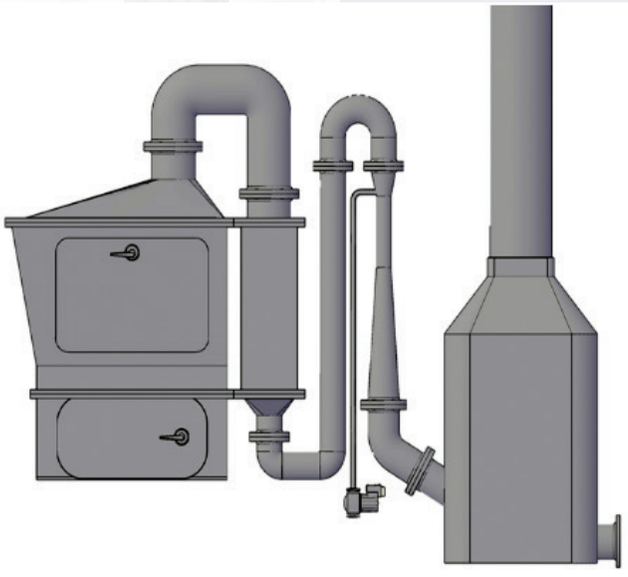
v. **Ozone Air Disinfection:** A new gadget was designed by CSIR-CFTRI for air disinfection in hospital settings like offices, schools, restaurants, hotels and buses, which is effective for controlling Covid-19 spread. The design was standardised for various process design parameters such as ozone concentration, exposure time, temperature, relative humidity, mixing requirements and functional relationship. The results were validated with indicative airborne pathogens as per WHO and USFDA guidelines. The technology has been transferred to Omniscient Treatment Technologies Pvt. Ltd., "Ozone House" Khare Town, Nagpur, India.

vi. **Sanitizing Bin (UV based):** Handling COVID medical wastes is the biggest challenge for sanitizing/health care workers nowadays due to the fastest community spreading of coronavirus. In contemplations of the present situation and taking care of public health, CSIR-IMMT has developed Sanitizing Bin for safe handling of medical/health care wastes generated from COVID-19. The specialized sanitizing bin with inbuilt Ultraviolet-C (UV-C) based disinfection can solve the purpose of safe collection, sanitizing and handling COVID medical wastes, which will lead to safe disposal/incineration. This bin can be placed in COVID isolation wards, hospitals/clinic and public places.

Production of sodium hypochlorite

Tractor mounted road sanitizing unit UV Sanitizing Bin

vii. **Development of Decentralized Waste Incinerator for combating COVID-19 Spread at CSIR-NEERI:** Waste Management has become a critical component to restrict the spread of coronavirus, which is highlighted by the recent release of the CPCB guidelines on Handling, Treatment and Disposal of Waste Generated during Treatment/ Diagnosis/ Quarantine of COVID-19 Patients. The compressive guidelines suggest the coronavirus related waste to be disposed in Centralised Bio-medical Waste Treatment Facilities (CBMWF) with multiple care at each step. This includes, containers/bins/ trolleys used for storage of COVID-19 waste should be disinfected daily, use of double-layered bags (using two bags) of collection, regular sanitization of workers, adequate PPEs and vehicle sanitization etc. Although, if properly implemented, such measures can curb the spread of the virus, however, lack in practicality in overcrowded hospitals and those not in major cities connected to CBMWTF and also lack of training of health workers and quarantine facility staff. The guideline has also made provisions for the use of captive facilities for waste disposal, thus encouraging decentralized waste management, also considering storage and risks. These captive facilities can help dispose of the COVID-19 waste immediately at the source.



viii. **Ozone decomposition in decontamination chamber "Chakr DeCoV":** Decontamination chamber was developed for disinfection of used PPE kits and N95 masks using ozone-based technology during this COVID pandemic situation.

The ozone concentration required to decontamination is very high than the permissible limit for humans in the atmosphere (<0.1 ppm). Hence the high concentrations of ozone should be decomposed in reasonably short duration to reduce the decontamination cycle time. CSIR-NCL has developed catalysts using Indigenous raw materials, which has worked very well for the decomposition of very high concentrations of ozone. CSIR-NCL has coated the catalyst on ceramic monolith for fixing in the chamber. The catalyst has helped reduce the time for ozone decomposition significantly. The time taken by the catalyst for the decomposition of ozone generated in large volume is 10 min and in a small chamber for a face mask is 3 min. This has reduced the decontamination cycle time in the product considerably, which helps to run higher decontamination cycles than expected.

ix. **360° Car Flusher:** A Vehicle Sanitizing Unit known as 360° Car Flusher has been developed by CSIR CMERI principally for sanitization of cars, trucks, buses etc. The sanitizing system can be used in long stretches of highways, vicinity of the market, shopping mall, office campus as well as residential complexes. The novelty of the System: Complete 360° washing –all four sides of the vehicle, IR Transmitter and IR Receiver Module, Powered by Electricity/Solar

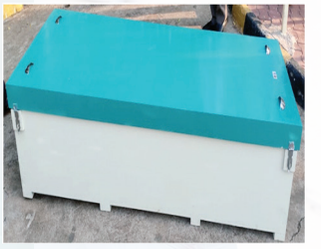
x. **Incubation Hood:** During COVID19 pandemic time, doctors require a transparent hood while carrying out treatment procedures such as intubation. These can also be used during any oral examination by dentists. Based on the need of doctors at AIIMS Bhubaneswar, Incubation hoods are designed and delivered by CSIR-IMMT. These are made by using acrylic sheets and cutting & fixing procedures in the carpentry section. The cutting can be done using laser cutters. Design can be modified by the special needs of different types of doctors while examining patients.

xi. **Insulated Coffin:** During COVID19 pandemic time, a requirement was felt by doctors to preserve the dead body for about 10-12 hours and for that a temporary thermally insulated coffin was required where the dead body can be kept. There was a space for keeping ice packs for cooling inside the coffin. Accordingly, a new coffin was designed by IMMT and fabricated by an external fabricator for this purpose. One piece is handed over to AIIMS Bhubaneswar for their evaluation.

Chakr DeCoV

360° Car Flusher

Incubation Hood



Insulated Coffin

Supply Chain & Logistics Support Systems

This objective of this vertical has been to Setting up a Rapid Supply Chain Information Platform; offering Regional Inventory Management Solutions where required by local government; Capturing and pre-empting issues in new CSIR launches and Connectivity with and best practices from collateral areas.

Pre-emptive identification of supply chain issues in new launches of CSIR products (Devices, PPE, kits, drugs, vaccines etc.) and services (testing, training) for COVID-19 management was one of the key goals of this vertical. The key task is to prepare a bill of materials for each key item category and to provide a document or link to the specifications. There may be more than one specification for a product category (e.g. home, mobile, and hospital ventilators). An Item master - a standard form capturing all details of the primary use item was prepared.

Setting up a Rapid Health Supply Chain Information Platform

Aarogyapath (आरोग्यप थ), a single stop solution for all the national healthcare needs has been developed as the National Healthcare Supply Chain Manageme nt System to address COVID-19 and an y future national pandemic.

https://www.aarogyapath.in, a CSIR National Healthcare Supply Chain Portal that aims to provide real-time availability of critical healthcare supplies, was launched.

AarogyaPath would serve manufacturers, suppliers and customers. This integrated public platform provides single-point availability of key healthcare goods can be helpful to customers in tackling a number of routinely experienced issues. These issues include dependence on limited suppliers, time-consuming processes to identify good quality products, limited access to suppliers who can supply standardized products at reasonable prices within desired timelines, lack of awareness about the latest product launches, etc. It also helps manufacturers and suppliers to reach a wide network of customers efficiently, overcoming gaps in connectivity between them and potential demand centres like nearby pathological laboratories, medical stores, hospitals, etc. It will also create opportunities for business expansion due to an expanded slate of buyers and visibility of new requirements for products. Over time, analytics from this platform is expected to generate early signals to manufacturers on overcapacity as well as on looming shortages. This would help to reduce wastage of resources due to inefficient forecasting and excess manufacturing, generate awareness about the demand for new technologies

Kisan Sabha App: Kisan Sabha App has been developed by CSIR-Central Road Research Institute (CSIR-CRRI), New Delhi to connect farmers to supply chain and freight transportation management system. This portal acts as a one-stop solution for farmers, transporters, and other entities engaged in the agriculture Industry. A detailed primary study was undertaken wherein 500+ farmers were interviewed and a 6-day long survey with dealers, transporters and farmers were conducted in Asia's biggest Azadpur Mandi to understand the various issues and gaps in the current environment. Based on this study and the current prevailing situation, the Kisan Sabha App was developed.

- The portal connects the farmers, transporters, Service providers (like pesticides/ fertilizer/ dealers, cold store and warehouse owner), mandi dealers, customers (like big retail outlets, online stores, institutional buyers), and other related entities for a timely and effective solution.
- The portal acts as a single stop for every entity related to agriculture, be they a farmer who needs better price for the crops or mandi dealer who wants to connect to more farmers or truckers who invariably go empty from the mandis.
- KisanSabha also works for people in the agriculture services sector such as

dealers of fertilizers/ pesticides, who can reach out to more farmers for their services.

- It would also prove to be useful for those associated with cold store(s) or godown(s). KisanSabha also provides a platform for people who want to buy directly from the farmers.
- Kisan Sabha has six major modules taking care of Farmers/Mandi Dealers/ Transporters/Mandi Board Members/ Service Providers/Consumers.
- Kishan sabha app has seen >60, 000 downloads

CSIR Outreach Programs

In addition to the development of products, technologies, and interventions and R&D, CSIR labs are also actively engaged in supporting the local communities by coming to their aid at this critical juncture by providing masks, sanitisers, and ready to eat food.

i. **Production and distribution of Face Masks and know-how transfer**

CSIR-NEIST is training people in the North East for facemask making and other activities. As a national initiative, Digital Training has been conducted by scientists of CSIR for Reusable cotton face mask to the rural public through lectures and videos, explaining the details of stitching face mask, for its wider reach to the unreached society. Such training has been offered by CSIR-CECRI to individuals from various districts of TN, with the aim of not only to produce reusable masks and distribute them at free-of-cost but also to create trained manpower and to deploy their skill sets widely around the state on emergency. CSIR-CMERI provided 43,000+ masks to different organizations by supporting 200 families. CSIR-CECRI's transferred technology of making reusable face masks and in first phase 5000 reusable cotton cloth Face Masks were distributed at the Textile city of Karur. CSIR-CSMCRI has provided 500 masks to the Gujarat Police and 500 membrane-based face-masks. Venture-centre CSIR-NCL to donate 1 lakh face shield masks – every shield is equipped with OHP & MDF sheets, an elastic band & also comes with three additional sheets. CSIR-CSMCRI has given 1200 membrane-based face masks to the Solid Waste Management Dept. of Bhavnagar Municipal Corporation. CSIR-Indian Institute of Chemical Technology (IICT) has joined hands with Cipla Foundation (CF) to make one lakh high-quality masks and distribute across Telangana.

ii. **Production and distribution of Hand Sanitizers:** CSIR delivered immediate relief by providing hand sanitisers, soaps and disinfectants to mitigate COVID-19**.** Early in the pandemic when there was a shortage of sanitisers, about 50,000 litres of hand sanitisers and disinfectants have been produced within the laboratories of the CSIR and distributed among more than 100,000 people belonging to various sections of the society. Besides, the laboratories also networked with the local administration to distribute sanitisers and disinfectants among personnel belonging to the police force, municipal corporations, electricity supply undertakings, medical colleges, hospitals, panchayats, and banks and several others.

iii. **Food Distribution**: Several Ready-to-eat (RTE) products have been developed by CSIR-IHBT and CSIR-CFTRI, which are available through licensee/s for scale-up and distribution to the COVID-19 affected persons. These

products include Herbal Khichdi and 'Dal Chawal Aloo Mix' developed by CSIR-IHBT and High protein biscuits; high protein rusks fortified mango bar; Nutra chikki with added Spirulina and cardamom flavoured water developed by CSIR-CFTRI are the key RTE products available for scale-up. CSIR-CFTRI has distributed 7 tonnes of high protein biscuits, 1 tonne of spirulina chikki, 10 tonnes of flavoured water, and 5 tonnes of fruit bars to reaching 31,278 migrant labourers in Bangalore/Delhi, hospital patients, doctors and police departments in two metropolia. CSIR-IMMT delivered 10,000 packets of ready-to-eat food (Khichidi), liquid soap, and sanitiser to Commissionerate Police, Bhubaneswar. CSIR-CIMFR staff club provided food to villagers – 740 meals (430 days 300 night), in Dhanbad district. CSIR-IHBT supplied ready-to-eat food boxes to the HP State Administration. CSIR-IIP employees distributed 350 homemade masks to the needy. The Institute has also been providing food to more than 300 poor people for almost one month. CSIR-CFTRI supplied one tonne each of high protein biscuits and high protein rusks to the Vasant Vihar, New Delhi for distribution to the people at the shelter homes managed by it. CSIR-IHBT also supplied Ready-to-Eat to CSIR-IMMT who handed over to the office of Asstt Labour Commissioner, Bhubaneswar for distribution to the migrants.

iv. **Dissemination regarding Covid-19:** CSIR-NISCAIR organised Covid-19 focused online Competitions for Drawing, essay writing and video making, weekly COVID-19 Bulletin, Urdu COVID-19 Compendium, E-Handbook on COVID-19 (Hindi), Public awareness posters, Special coverage on COVID-19 in issues of monthly science magazines Science Reporter and Vigyan Pragati. Science communication and dissemination directorate of CSIR HQ undertook dissemination of Covid precautions and various initiatives of CSIR for Covid-19 mitigation through social media, press releases, webinars, compendium and developed a portal for Covid related information https://covid19csir.urdip.res.in/ and https://www.iiim.res.in/cured/.

1.2 S&T ACHIEVEMENTS

1.2.1 Biological Sciences

Expression of transglycosylating alpha-glucosidase in P. pastoris under high cell density cultivation

A gene conferring novel α-glucosidase (AG) with high transglycosylation activity from *Aspergillus neoniger* (a non-niger strain belonging to section Nigri) was cloned and expressed in *Pichia pastoris*. Pre-determined open-loop exponential feeding strategies were evaluated for methanol dosage to improve the recombinant enzyme synthesis during high-cell density cultivation in 5 L bioreactor. The specific growth rate of 0.1 h-1 resulted in the highest enzyme activity of 182.3 mU/mL in the supernatant, whereas the activity of 3.8 U/g dry cell weight was obtained in the cell pellet. Thus, the obtained enzyme was utilized in the synthesis of a potential prebiotic molecule, isomaltooligosaccharides (IMOs), which can be used as a sweetener and bulk filler in the food industry.

Maternal high protein-diet programs impairment of offspring's bone mass through miR-24-1-5p mediated targeting of SMAD5 in osteoblasts

The environment and nutrition and nutrition experienced during in-utero development and early life can have a long-lasting influence on an organism's health. Maternal nutrition is crucial for the offspring's skeleton development and the onset of osteoporosis later in life. Here, we found that C57BL6 mice fed with HP delivered offspring with decreased skeletal mineralization at birth and reduced bone mass throughout their life due to a decline in their osteoblast maturation. These results will be a bit surprising for the general population because protein is considered a good **calorie** source for an individual. However, these results are in accordance with the previous literature and further the observation that a high protein diet during pregnancy results in the birth of low weight and smaller length offspring. A small RNA sequencing study revealed that miR-24-1-5p was highly upregulated in HP group osteoblasts. Target prediction and validation studies identified SMAD-5 as a direct target of miR-24-1-5p. Further, mimic and inhibitor studies showed a negative correlation between miR-24-1-5p expression and osteoblast function. Moreover, ex-vivo inhibition of miR-24-1-5p reversed the reduced maturation and SMAD-5 expression in the HP group osteoblasts. Together, we show that maternal HP diminishes the bone mass of the offspring and programs a decline in the maturation of osteoblast cells via increased expression of miR-24-1-5p.

Guidelines of CPCSEA for Reuse/Rehabilitation of Large Animals post experimentation:

CSIR-IITR contributed to the Guidelines of CPCSEA for reuse/ rehabilitation of large animals post experimentation released in October 2020. This effort was steered by the Department of Animal Husbandry and Dairying, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India. These guidelines have been prepared to operationalize the rules amended in 2006, Section 9 (cc) for Rehab and Reuse of large animals. These guidelines would be useful to the academia, industry and other stakeholders, whose research/manufacturing practices involve animals above the phylogenetic level of rodents and lagomorpha.

1.2.2 Chemical Sciences

Advice for optimization of blast design parameters for flattening of Ulwe Hill as part of the land development works for construction of Navi Mumbai International Airport (NMIA)

M/s City and Industrial Development Corporation (CIDCO) of Maharashtra Limited awarded a very important and challenging project to CSIR-CIMFR for designing, monitoring and supervision of controlled blasting for flattening of Ulwe Hill as a part of the land development work for the construction of Navi Mumbai International Airport (NMIA). The Ulwe Hill to be flattened was 91 m high, 2.5 km long and 1.2 km wide and the approximate volume of hard rock to be excavated for the flattening works was 3.5 crore cubic metre. There were more than ten villages located nearby the hill along with High Tension (HT) lines and towers passing through the hill cutting site. Control on blasting impacts in the form of ground vibration, flyrock, noise, dust etc. is required for the safety of the nearby habitats. Apart from control on blasting impacts to the nearby surrounding, the different fragment sizes viz. 300 mm, 400 mm, 500 mm & 600 mm are also required to obtain using specialised blast design. The design of controlled blasting, supervision, and continuous monitoring of the total blasting operations have been carried out by the Rock Excavation Engineering Research Group of CSIR-CIMFR since June 2017. The significant achievements are listed below:

- Nearly 60% of the hill cutting work has been completed successfully for Phase-I of the project.
- The Diversion Channel of 120 m wide and 3.2 km long was successfully completed before the arrival of monsoon in June 2019 creating huge relief for the adjoining flood-affected inhabitant areas.
- Ground vibrations, flyrock and noises were controlled successfully without imparting any damages to the nearby residential houses, schools and other important village structures.
- The desired fragmentation was achieved by changing the blast design parameters as per the fragmentation analysis results.
- Controlled blasting operations were carried out safely nearby the HT lines and towers without damaging and disrupting the electric transmission.
- A number of difficult cliffs/pillars formed during the past stone quarrying in the Ulwe Hill were safely and successfully demolished

Studies on Compatibility of mulberry silk fabric with cow nappa leather for product development

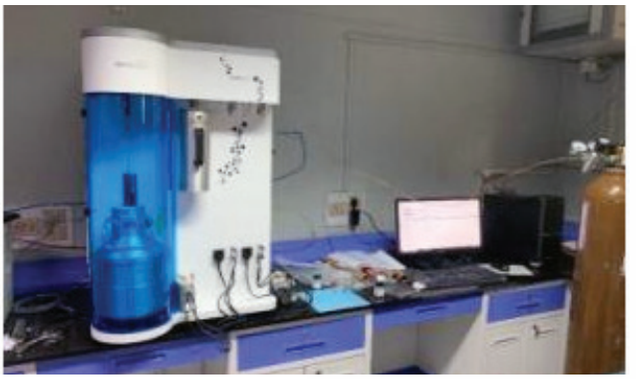
The present work describes the application of silk fabric for leather garments and goods to support the leather products industry in identifying alternate raw material. The results show that the quilted silk fabric has the potential to be combined with cow nappa leather to make products with improved strength and enhanced aesthetic appeal. The major findings of this study also prove that on treatment with artificial alkaline perspiration, leather and silk-based samples behave inversely, and this relation gives a clear direction to product designers and developers about the placement of leather and silk panels while making combination products. Apparently, this study helps the silk industry to attain the major share in the domestic and global market. The research findings are published in the *Indian Journal of Fiber and Textile Research* (IJFTR), Vol. 45, September 2020

Integrated advanced oxidation process for treatment of caustic wastewater discharged from petrochemical industries

The integrated advance oxidation process for the treatment of spent caustic wastewater (SCWW) was designed from the wastewater discharged from the petrochemical industry. The SCWW was characterized by COD 19,246–21,054 mg/L, sulphide 4280–5092 mg/L, and phenol compounds 2349–2716 mg/L. The SCWW is wastewater with poor biodegradable in nature which is indicated by the BOD/COD ratio of 0.196–0.216 mg/L. About 100% efficiency is achieved in removing sulphide in the integrated catalytic advanced oxidation process, 96.7% in removing phenol, 95.3% in removing COD and 99.2% in removing BOD.

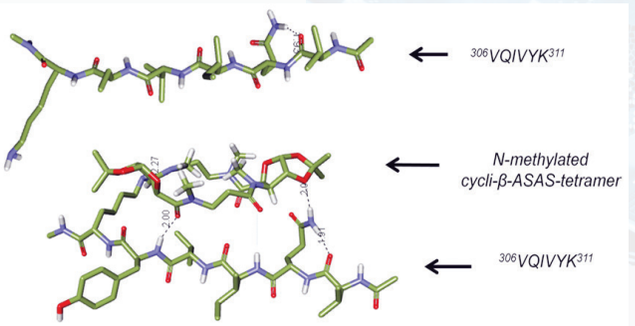
Development of catalysts for direct production of lower olefins from Syngas. Project funded by CHT (Min. of Petroleum & NG) with BPCL, CRD as a user industry with a cost of Rs 2.38 Crores/-

In this about 15 nos of Fe- and Co-based FT catalysts were synthesized towards FT to Olefefins route and about 25 nos of Cr- and Zr- based Zn materials integrated with SAPO-34 for OX-ZEO route for syngas to ethylene & propylene. These catalysts are under performance evaluation over syngas feedstock.



Design & Development of Novel Unnatural peptidic scaffolds as models for Amyloid type aggregation

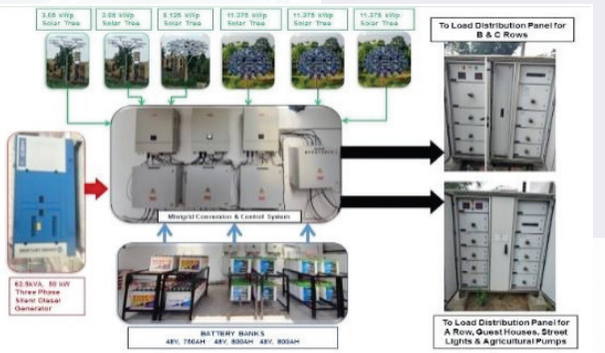
Unnatural peptidic oligomers, particularly, those comprised of cyclic beta- or gamma-amino acid residues have emerged as fascinating molecules as they exhibit discrete secondary structures (foldamers) akin to proteins, and are also found to serve as antagonists for specific protein-protein interactions]. Amongst them, Furanoid cis-beta-Sugar-Amino Acid (FSAA) based short oligomers exhibit robust helical conformations, which upon cyclization (N- and C terminals) switch to sheet-like structures, and then self-assemble into tubular stacking via intermolecular hydrogen-bonding. This type of conformational switching from helix/sheet to molecular self-assembly is parallel to the formation of amyloid fibrils and therefore, these molecules can serve as fibril models for understanding Alzheimer's and Parkinson's deceases at a molecular level, and may also be helpful in designing the corresponding inhibitors.



1.2.3 Engineering Sciences

Solar Biodiesel Hybrid Minigrid of 50kW Peak Capacity for CSIR-CMERI, Ludhiana Campus

CSIR-CMERI being an R&D lab of national importance is leading the way through the development of efficient energy harnessing techniques for Solar Photovoltaics(PV), Biomass, Biodiesel etc. In this project, a Solar Biodiesel Hybrid Minigrid at CSIR-CMERI, Ludhiana campus is installed. Initially, the load profile study is conducted to understand peak and average power and energy demands. Later an optimal mix of power sources and storage viz. Solar PV, Biodiesel and Lead acid battery is developed for the least net present cost of the system. Design of BOM to realize the above optimal mix is taken up and the components are installed.



Solar Biodiesel Hybrid Minigrid

High flow rate Fluoride & Iron removal filter

CSIR-CMERI for the very first time has come up with a dual solution (excess F- and Fe3+ mitigation from groundwater) having features of an integrated, low-cost, commonly available multi-adsorbent based community level (high flow rate) water purification system for effective and simultaneous removal of fluoride and iron (below WHO permissible limit) in an efficient manner from contaminated water. The technology has been transferred to M/s Capricans Aqua

Private Limited, Shibpur, Howrah.

UV-Covered Integrated Municipal Solid Waste Disposal System

Integrated & mechanized segregation system for bio-degradable & non-biodegradable waste. Eco-friendly disposal of plastic waste through electric ionization utilizing high-temperature plasma with zero level toxin emission. Large volume reduction, slag is 1/10th of the volume of processed solid waste. Decomposition of waste into Hydrogen-rich fuel gas and energy harvesting from generated gases through the generation of electricity. Utilization of Pyrolysis oil as fuel in the engine for energy harvesting. Generation of biogas from organic waste and utilization for household purpose. Utilization of Manure in agricultural and horticultural work. Conversion of agro-waste into briquette and utilization as fuel.

UV-Covered Integrated Municipal Solid Waste Disposal System

High flow rate Fluoride & Iron removal filter

Development and Testing of Prototype Pothole Repair Machine

Structural failure on the road surface due to moisture on the road and traffic passing over the affected area resulting in the formation of potholes. The potholes are usually repaired manually by pouring the repairing material into the potholes and then compacting the repairing material with a handheld roller rammer or a roller machine. CRRI has collaborated with M/s JCB India Limited and developed a prototype machine on Backhoe platform comprising a compaction assembly (plate compactor), a sweeper, an emulsion reservoir, a compressor unit and multiple air tanks and a bitumen mixing assembly. The demonstration was done at Pune, and the repaired pothole was monitored for six months. The large scale demonstration has also been conducted at CRRI campus in the presence of field engineers of different government departments. The machine is ready to launch in the market for wider application.

Design and development of "Mobile Cold Mixer cum Paver (MCMP)" to facilitate the onsite mixing and laying of bituminous material on a prepared granular/old surface

Indian Himalayan Region suffers from poor connectivity both with the rest of India and within the respective states of the region due to its geographical terrain. Hence, an adequate and long-lasting road network is very much necessary in Himalayan areas for the overall development of the region as well as fulfilling defence needs. Transportation of material and construction equipment in hilly areas is a huge challenge, considering the narrow and rough roads leading up to the site. To alleviate this problem, the need of the hour is to develop a cold bituminous mixer cum paver for construction of pavement using bitumen emulsion based road construction technology. To fulfil the need, funding was received from the Ministry of Environment, Forest and Climate Change

under the National Mission on Himalayan Studies (NMHS) Scheme. The Mobile Cold Mixer cum Paver (MCMP) has been designed and developed to facilitate the onsite mixing and laying of bituminous material on a prepared granular/old surface. This equipment contains storage units (aggregate, emulsion, water, filler and additive), mixing unit, spreader box and paving unit with PLC controller to proportionate the materials as per mix design and operation of mixing and paving system. This is designed to lay the pavement cold bituminous layer ranging a thickness of 20mm to 70mm and a width ranging from 1.5m to 3m.

Pothole Repair Machine

Mobile Cold Mixer cum Paver

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 consisting of particle size analysis, material density, settling characteristics of the limestone samples were carried out. In order to transport the limestone samples in vertically upward direction, the settling velocities of limestone 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 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.

Piezo-electric Poly Vinylindene Fluoride (PVDF) films

PVDF piezoelectric films are developed indigenously in the CSIR-National Aerospace Laboratories after optimizing various process parameters using indigenously designed machines. The technology has been transferred to M/S. Ajay Sensors & Instruments, Bangalore.

Vertical slurry transport system

PVDF films

Utilization of Distillery Bio-Compost Mixed Coal for Combustion in Brick Kiln Industry and thereof.

CSIR-NEERI has conducted a pilot-scale trial for the use of distillery bio-compost as a co-fuel in brick kiln industry in order to save the non-renewable energy sources viz. coal for future generation and also to achieve the goal of new and renewable energy. The characterization of bio-compost has indicated a calorific value of 1600 to 2000 Kcal/Kg of bio-compost and has been transferred to M/s Baba Kimmatkar Brick Klin Industry Ltd.

Production of hydrogen standard (CRM) in steel

Availability of certified reference material (CRM) for determination of hydrogen in steel by hot fusion technique is cumbersome in terms of both cost and time, as it is an imported product to India. CSIR-NML has been extensively working for the last five years and successfully developed an indigenous hydrogen standard (CRM) in steel under 4M theme projects. The uncertainty in the developed product has been protected better than the market available product by adopting suitable technique during the standard sample preparation process. Hydrogen standard is being extensively used in the steel industry both for civil (primarily for railways maritime navigation, core sector for components of oil and gas) and also for the strategic sector. Apart from steel plant it is also extensively used in power plants, aero industries, strategic units (AEC) dealing with steel components, national laboratories, institutes, BIS & other laboratories. The current available hydrogen CRM in Steel has been supplied by a foreign vendor at a cost varies from Rs. 20,000/- to Rs 40, 000/- for one pack/bottle (100 nos. of pin sample). On average, it can be assumed that the consumption of hydrogen standard in steel (plant) industries would be at least one bottle (100 pins) per month. Therefore, it can be further assumed that 50 to 80% of the developed product will be served within one or two years. At present, CSIR-NML has already launched the hydrogen standard in steel as an indigenous product for the Indian customers, and it is available to Indian users via., CRM window of CSIR-NML from July 2020.

Extraction of cobalt metal/ salt from black powder of Lithium batteries

Recuperation of critical metal, Co, Li, Mn, Cu, Al, Ni, plastic and graphite from end-of-life lithium cobalt batteries are gaining significance due to its constant escalating demand in commercial applications. Especially the presence of Co and Li in cathodic material enhances the importance of lithium cobalt batteries recycling which will not only fulfil the financial perspective but also have a concern regarding the environmental impacts. The technology has been transferred to UNQ IND PVT. LTD, Firozabad.

1.2.4 Information Sciences

Atmospheric opacity and water vapour trends over high altitude astronomical observatory at Hanle

Atmospheric opacity at 220GHZ over Indian Astronomical Observatory at Hanle is estimated using Radiometer data from 2006 to 2018 and compared with high temporal resolution GPS-PWV (Global Positioning System- Precipitable Water Vapor). The results indicate a linear correlation (figure) with a correlation coefficient of 0.8. The opacity at Hanle increased by 44% during this period due to the dynamics of the regional and global hydrological cycle. Water vapour at nine high-altitude astronomical observatories spatially spread across the globe using satellite and reanalysis data indicate increasing trends pointing to non-uniform dynamic hydrological cycles. This study was carried out to identify future sites for the establishment

of infrared and sub-millimetre astronomical facilities.

Implications of high GNSS rates in Kashmir Valley

Crustal deformation rates using Kashmir cGNSS (Continuous Global Navigation Satellite System) observation network (2008-2019) indicate oblique surface deformation of about 16mm/yr in Kashmir Valley and adjoining regions. Inverse modelling of surface crustal rates gives the slip of 16mm/yr at a depth of 15km (figure) along the 145km wide Main Himalayan Thrust (MHT). High geodetic strain rates observed to the north of Kashmir valley, and south of Zanskar ranges is consistent with the Northern edge of locked MHT mapped using seismic activity and inverse models. Since there was no earthquake since 1555, the total slip during the intervening 465 years is 7.6m which is capable of generating Mw 7.8 earthquake in Kashmir valley which is corroborated by the high scalar geodetic moment accumulation rate and micro-seismicity recorded in Kashmir valley.

Hydro-meteorological Impact on Malaria Diseases at Regional Scale in India

In this study, attempts are being made for assessing the combined effect of hydro-meteorological variables on malaria disease at the regional scale. It reveals that evaporation is one of the essential climatic variables in this context, which is jointly derived by hydrological and meteorological variables. To our best knowledge, there are very few studies which have been performed to analyse the relations between malaria and the ratio of precipitation (P) and actual evaporation (AET). This study analyses the impact of the ratio of P and actual AET on malaria diseases. The AET and P relationship with Plasmodium vivax (PV), Plasmodium falciparum (PF) is analysed. The sum of PV and PF is BSB indicator, and it shows the total number of people affected by malaria. The study has revealed that fraction P/AET is negatively correlated with PV, PB and BSB. In comparison to hydrological and meteorological variables like P, surface runoff, AET and AET/P, which are mostly positively correlated.

Truenat for Point of care Tuberculosis detection:

The Truenat platform from Molbio Diagnostics is the world's only commercial field usable, battery-operated PCR that can be deployed in resource-limited settings worldwide for rapid, sensitive, and accurate diagnosis of infectious diseases like Coronavirus, TB, Dengue, Chikungunya, H1N1, HCV, HPV, among other tests. The success of the Truelab Platform that does Nucleic Acid Amplification Testing (NAAT) of pathogens is a result of the farsightedness of CSIR in supporting start-ups. CSIR's NMITLI project, which started in 2005, helped in the development of the device involving Bigtec, Bangalore; IISc, Bangalore; and CSIR-IIIM, Jammu. The device was validated for hepatitis-B detection through CSIR-NMITLI Support. Later on, DBT, through the BIPP program, helped with early validation of select clinical parameters. ICMR's extensive testing of the platform and suggested modifications for use in the hands of minimally trained technicians has shaped the final product in the market today. This platform is one of India's most widely patented products, with patents in over 150 countries.

Seaweed Formulations for Productivity and Health of Dairy and Poultry Animals:

Under a CSIR-NMITLI Project, CSIR-CSMCRI has developed novel seaweed-based animal feed additive formulations to enhance the productivity of animals, improving the quality of animal products, and boosting immunity. The formulation was validated by the Indian Veterinary Research Institute (IVRI), Central Avian Research Institute (CARI), National Dairy Research Institute (NDRI), and Toxicity trials done at CSIR-Indian Institute of Toxicology Research (IITR). M/s Aquagri Pvt Processing Ltd was an industrial partner in the project.

The animal feed additive products have been engineered by blending selected cultivated seaweeds and naturally harvested seaweeds sustainably in pollution-free conditions. The novel way of cleaning and processing the seaweeds under rigorous quality conditions ensures maximum conservation of bio-actives in the product with high expected shelf life. The additives were proved to boost immunity and hence should reduce the use of antibiotics by imparting greater resistance to infection.

1.2.5 Physical Sciences

Design and simulations of Gallium Nitride nanowire FET

GaN NW FET is designed and optimized for digital logic and biosensing applications. The optimized device design offers an excellent Ion/Ioff ratio of 108 -109, suppressed off-state leakage in the range of 1015-1016, SS of 94.14 mV/Decade, and DIBL of 34.14 mV/V which reveals its suitability for the Switching and Biosensing applications. The design also reveals a novel approach of tuning from E-Mode (Normally-off) to D-Mode (Normally-on) by varying the thickness of the nanowire channel which has not been reported yet to the best of our knowledge anywhere.

Synthesis of Earthquake Hazard scenario in NW Himalaya by Investigating the multiscale Variations in structural and seismotectonic Assemblages (SHIVA)

A 3-layer model of the Indian lithosphere beneath the Ganga basin sediments and the Himalayan wedge and variations in Moho thickens towards the north, from ~38 km under the Indo-Gangetic plain to ~43 km in the upper/higher reaches are identified for the first time. The Seismic network-enabled identification and location of 500 events of ML 1.0-5.4 with focal depths varying from the surface down to 40 km depths, with a large concentration of seismicity at 5-20 km depths. The salient feature of the Magneto-Telluric model is the presence of a very high resistivity block between the North Almora Thrust (NAT) and the Munsiari Thrust (MT). A high velocity mafic lower crust below the study region is also inferred to be composed of garnet and pyroxene granulites. The Seismic tomography result reveals that the Main Himalayan Thrust (MHT) is a 10 km thick north-easterly shallow dipping (~1-2o) high-velocity zone (Vp: 6.3-7.2 km/s; Vs: 3.64-4.16 km/s), extending down to 20 km depth.

Safety and Security of Vital Installations:

Earthquake hazard assessment of Uttarakhand with special focus on risk assessment of vital installations in Uttarkashi district. Two important deliverables are proposed: 1. Earthquake hazard assessment of Uttarakhand focusing on acceleration and displacement spectra; 2. Risk assessment of vital installations (bridges, water tanks, hospitals) in Uttarkashi district. The progress made so far are 110 Broadband seismological stations and Accelerometers installed, 350 earthquakes located and seismicity maps prepared, Acceleration spectrum estimated at 10 locations for earthquakes magnitude 3.5-5.5.

The response of Ocean Surface Waves to the Co-occurrence of Boreal Summer Intra-Seasonal Oscillation and El Niño Southern Oscillation:

The change in wave climatology due to the combined effect of Boreal Summer Intra-Seasonal Oscillation (BSISO) and El Niño Southern Oscillation (ENSO) using 40 years of reanalysis data on the Asian Summer Monsoon Region (ASMR) is examined. The combination of each ENSO phase with each BSISO phase manifests noteworthy changes in wave characteristics. In El Niño-BSISO combined phase the advancement in the reversal of wind (north-easterly to monsoon enhanced south-westerly) and faster eastward propagation is observed than in the Neutral ENSO-BSISO phase, and as a result, significant wave height (Hs) increases to peak values over the coast of Sri Lanka, Maritime continent and South China Sea (SCS) and Western North Pacific (WNP). On the other hand, La Niña-BSISO combined activity suppresses both the north-easterly (phase 1 to 4) and south-westerly wind system (phase 5 to 8) in the North Indian Ocean (NIO) and thereby reducing the Hs anomaly than usual. In all the ENSO-BSISO combined phases, maximum wave height variability occurs at SCS owing to the combined action of NIO and WNP surface wind forcing. Strong positive mean wave periods (Tm) during the first 2 phases of Neutral ENSO-BSISO activity changes to a negative anomaly during the combination of La Niña and El Niño phases with BSISO. Similar mean wave period (Tm) patterns are visible in the El Niño-BSISO phase 8 and Neutral ENSO-BSISO phase 1 in NIO, indicating the advancement of wave characteristics due to the effect of El Niño-BSISO combined activity. High fluctuations in Tm over the NIO and WNP are observed during La Niña. The phase relationship of Hs with Tm and the significant height of wind-sea (Hsw) and swell (Hss) are assessed to understand the propagation of swells.

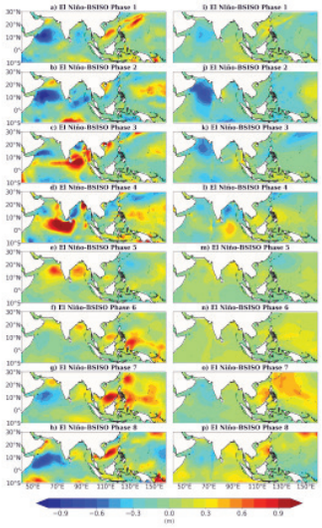
Spatial distribution of waves and wave-induced littoral drift along the nearshore regions of central west coast of India:

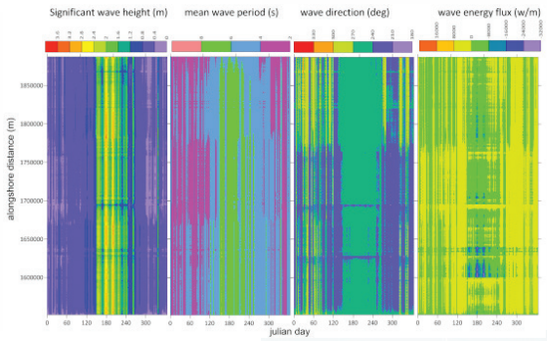
Using a wave transformation model, the nearshore wave characteristics and wave-induced littoral drift rates along the central west coast of India (CWCI) were investigated. The wave data collected at ~15 m water depth at three locations in the CWCI, which are ~ 130 km apart is used as an input. The model results were compared and validated with the measured wave data at 9 m and 5 m during the monsoon and non-monsoon period. On an annual scale, the significant wave height varies in the range of 0.8-1.2 m, the period in the range of 4-6 s, and the predominant direction is southwest-west (~230-270˚). The study also examines alongshore varying energy fluxes and littoral drift in the CWCI. In the breaker zone along CWCI, wave height varies up to 18% during non-monsoon, while the period and direction varies less than 10%, and during monsoon, these variations are less than 7%

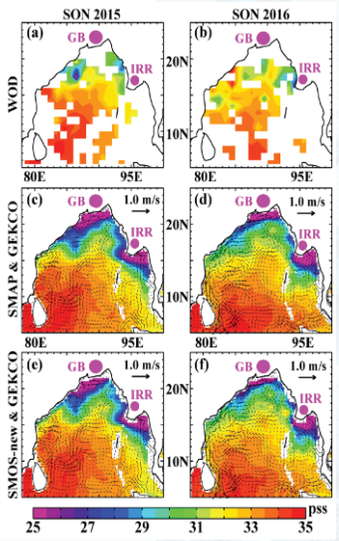
The response of the Indian Ocean to present and future climate (IOClim):

Monsoon rain and rivers bring large freshwater input to the Northern Bay of Bengal (BoB), yielding low Sea Surface Salinity (SSS) after the monsoon. The resulting sharp upper-ocean salinity stratification is thought to influence tropical cyclone intensity and biological productivity. The density of *in situ* data is far from sufficient to monitor the BoB SSS variability. The advent of satellite remotely-sensed SSS (SMOS, Aquarius, SMAP) offers a unique opportunity to provide synoptic maps of the SSS every ~8 days. In this study, we assess the performance of these satellites in BoB. Our results show that the newly available satellite retrievals are able to capture the SSS

variability in BoB reasonably well, and so can be confidently used to monitor the SSS variability and to study its mechanisms.







1. Ocean Surface Waves climatology to the Co-occurrence of BSISO and ENSO, 2. Spatial distribution of waves and wave-induced littoral drift, and 3. Indian Ocean response to present and future climate (IOClim)

1.3 TECHNOLOGIES FOR RURAL DEVELOPMENT

Popularization of Improved Samba Mahsuri, a bacterial blight resistant and diabetic friendly rice to increase farmers' income

During the Kharif season of 2020, Improved Samba Mahsuri seeds have been distributed to more than 3000 farmers in the states of Andhra Pradesh, Telangana, Uttar Pradesh, Karnataka, Tamil Nadu and Jharkhand. As per our estimate, currently, Improved Samba Mahsuri rice is being cultivated in about 2.0-2.5 lakh hectares area.

Low cost embedded technology for monitoring of RO Plants

Microcontroller based low cost embedded technology for monitoring of RO Plants has been developed and deployed across 25 villages in Shekhawati and nearby areas of Rajasthan. It supports online monitoring of critical parameters of water (TDS, pH, input and output water flow rate and tank level).

Solar biomass hybrid dryer for drying of fish

Developed by CSIR-CMERI, the solar biomass hybrid dryer for drying of fish is enhancing the income of over 100 fisherman families and providing direct employment to 50 people.

Waste Management

Bio-methanation for Biodegradable Waste technology is used for biogas production, which can achieve the goals of developing sustainable technology for waste management, producing renewable energy and reducing greenhouse gas emissions. The enriched methane gas can be used as fuel gas for cooking purpose in the kitchen and also in a fuel cell for generation of electricity. The spent slurry becomes excellent organic manure which is highly rich in Nitrogen,

Potassium and Phosphorus content. This manure can be used in cultivation after drying.

Development of Kisan Sabha App

In light of the latest announcement of Rs 1.6 Lakh crore package by the Finance Minister with a key focus on empowering the farmer and initiatives such as providing adequate choices to farmers to sell produce at attractive prices, better framework for e-trading of produce, agriculture marketing reforms to give farmers marketing choices, etc., the Kisan Sabha App developed and launched by CSIR in April 2020 is appropriately positioned to connect farmers to supply chain and freight transportation management system.

Kisan Sabha, developed by CSIR in partnership with Sarvodaya Infotech Private Limited, New Delhi, has six major modules, one each dedicated for farmers, mandi dealers, transporters, mandi board members, service providers and consumers, respectively. It caters to the farmers' requirements such as availability of transporters, seeds, fertilizers, equipment, etc. and connects with mandis. Key highlights are:

- It connects the farmers directly to transporters, Service providers (like pesticides/ fertilizer/ dealers, cold store and warehouse owners), mandi dealers, customers (like big retail outlets, online stores, institutional buyers) and other related entities.
- It gives the option to choose the best-rated mandi out of 4 nearby mandis. This will improve the income of farmers.
- Since farmers can directly connect, interference of middlemen is reduced. Margins can be added to farmers' income itself.
- Small and medium farmers can hire logistics as per their demand.
- Freight calculators are being provided, giving them options to choose the cheapest transport facility.
- Equipment is also being provided to farmers for their cultivation and other activities as service providers can also be directly contacted.
- Kisan Sabha also provides a platform for people who want to buy directly from farmers in bulk.
- Refrigerated trucks, cold storage facilities and warehouses are also part of Kisan Sabha.

Introduction of Asafoetida (Heeng) cultivation in the Indian Himalayan region

A historical shift in farming practices is in the offing with farmers of the remote Lahaul valley in Himachal Pradesh taking up cultivation of asafoetida (Heeng) to utilize vast expanses of wasteland in the cold desert conditions of the region. In their efforts, the farmers are being supported by scientists of the CSIR-IHBT, Palampur, who brought in seeds of asafoetida and developed its agrotechnology. Since asafoetida is a major condiment in Indian cuisines, team CSIR-IHBT made relentless efforts for introduction of this important crop in the country through proper channel and finally, the institute introduced six accessions of seeds from Iran through ICAR-National Bureau of Plant Genetic Resources (ICAR-NBPGR), New Delhi.

ICAR-NBPGR, through its correspondence with the Institute, confirmed that in the past thirty years, this has been the first attempt by CSIR-IHBT for introduction of asafoetida (Ferula asafoetida) seeds in the country. The Institute raised the plants of heeng at CeHAB, Ribling, Lahaul & Spiti, H.P. under the vigil of NBPGR. Consequently, MoU between CSIR-IHBT and State Department of

Agriculture, Himachal Pradesh was signed on June 6, 2020, for a joint collaboration for the cultivation of heeng in the State. A capacity-building program was organized for officers of the State Department of Agriculture from July 20 to 22, 2020 in which twelve officers from different districts of Himachal Pradesh participated.

The first seedling of asafoetida was planted by Dr. Sanjay Kumar, Director, CSIR-IHBT on 15th October 2020 at farmer's field in village Kwaring of Lahaul valley to mark the initiation of cultivation of asafoetida in India.

Setting up a network of distillation units

Essential oils are the main economic ingredient of the aromatic plants extracted by employing distillation units. To enable farmers to distil the oil from aromatic plants, distillation units were installed in villages' clusters. Installation of the distillation unit was a very vital component of the CSIR-Aroma Mission. It is the availability of such distillation facilities, which instils a sense of confidence in farmers about ensured returns from aromatic plants' cultivation. A total of 61 distillation units of different types and capacities were installed at different locations in India's 12 states. A network of distillation units was developed in the UT of Jammu & Kashmir, where distillation units were installed at different locations in 14 districts.

Promotion of cultivation and processing of aromatic crops and enhancing area of selected aromatic plants

More than 1850 ha area benefiting more than 2100 farmers have been bought under captive cultivation of selected aromatic crops at various locations throughout the country under CSIR-Aroma Mission by CSIR-IIIM, Jammu. Seven districts in Kashmir division viz., Bandipore, Baramulla, Budgam, Ganderbal, Kulgam, Kupwara, and Pulwama; Nine districts in Jammu division viz., Doda, Jammu, Kathua, Kishtwar, Rajouri, Ramban, Reasi, Samba and Udhampur; and two districts in Ladakh division viz., Kargil and Leh were covered under CSIR-Aroma Mission. CSIR-Aroma Mission, CSIR-IIIM has introduced selected aromatic crops to small and marginal farmers in remote border districts of J&K like Kupwara, Rajouri, Kargil, Jammu, Samba, and Kathua, where employment opportunities are limited. QPM of the selected aromatic plants worth > 10 crores of market price was distributed free of cost to the farmers throughout the country. It was estimated that these farmers produced > 12,500 kg essential oil worth > 3 crores by CSIR-Aroma Mission interventions of CSIR-IIIM, Jammu.

Saffron cultivation and production under the Mission Atmanirbhar

Saffron (Crocus sativus L.) a perennial herb belongs to Iris family Iridaceae and is the most expensive spice in the world known for its aroma and colour and used for flavouring and colouring and in medicinal, pharmaceutical industries. The colour, flavour and aroma of saffron are mainly due to crocin, picrocrocin and safranal, respectively. Due to very high crocin content and rich aroma, the Kashmir saffron is famous worldwide and commands a premium price over the saffron available from Spain or Iran. The leading saffron growing countries like Iran, Spain and Greece

with intensive production technologies are able to achieve higher production and productivity than our productivity and posing a great threat to our saffron industry as imports are increasing every year. Thus, there is a need to increase production by bringing more area under cultivation and double the average productivity by adopting intensive production system, efficient processing and marketing to make it globally competitive and remunerative to growers.

The total area under saffron cultivation in J&K is 3715 ha with production and productivity of 16 MT and 3.0 - 4.0 kg/ha, respectively. Saffron in J&K is primarily cultivated in four districts (Pulwama, Budgam, Srinagar, Kishtwar) with 86% saffron farming system in the heritage site of Pampore over 3200 hectares. Pampore being peri-urban is under threat of commercialization /colonization; therefore, extending saffron cultivation in new potential and non-traditional areas of J&K will provide more sustainability to the saffron cropping system. This will help to further improve overall saffron production of J&K keeping in view National demand of 100 M.T besides providing livelihood security to the marginally poor farmers of J&K. Owing to the importance of the crop for its national market demand and export potential the crop was successfully introduced and grown at the Field Station, Bonera of CSIR-IIIM in August 2020. Under the Mission Atmanirbhar India, the Institute envisages to further extend the crop on a commercial scale in different non-traditional areas of the Valley.

Improved Jaggery making plant

CSIR-IIP has implemented over 50 Jaggery making plants in the states of U.P. and Uttarakhand. The improved Jaggery making plant not only consumes less fuel but also emits less smoke. Currently, an improved Jaggery making plant is being installed and commissioned in the aspirational district of Nabrangapur in Odisha. This plant will help in improving the livelihood and standard of living of the rural masses of the state.

Rural entrepreneurship thorough food processing to contain the impact of COVID-19 due to reverse migration

The study identifies ways of generating income among rural people by selecting model villages affected by reverse migration. The study will utilize local produce of the affected villages like fruits and vegetables for skill development and entrepreneurship among migrants.

Preparation of Need based DPR Brass, utensils and Silver clusters of West Bengal

CSIR-NML has developed energy-efficient eco-friendly brass and bell metal melting furnace for brassware artisans and clusters. The technology has been transferred to various medium and micro-enterprises. CSIR-NML was awarded by the Directorate of MSME, Government of West Bengal to prepare a Detailed Project Report (DPR) for setting up Common Facility Centre (CFC) in (i) CFC for Brass and Bell Metal Utensils Cluster Kashipur, Purulia, West Bengal, (ii) CFC for Bell Metal cluster, Suklai, West Bengal, (iii) CFC for Bell and Brass Cluster, Lalbazar, Shyamnagar, Bankura West Bengal, (iv) CFC for Brass and Bell Metal Utensils Cluster, Khagra, Murshidabad, West Bengal and (v) CFC for Jafarnagar Silver Cluster, Nadia, West Bengal.

After discussion with GM/ Industrial

Development Officer (IDO) of District Industry Centre, artisans, and site survey, the intended DPR has been prepared which contains present art (survey data), SWOT analysis, a requirement of Common Facility Centre (CFC), technology intervention, details of CFC including proposed business model, cost analysis, impact on environment and health and civil estimation. The artisans, at present, collect the raw materials like scrap from "Mahajan'' and deliver finished goods to the same "Mahajan". In return, the artisans receive the "conversion charges'' from the "Mahajan". As the entire process is individual-centric, it was felt that the earnings of artisans can be improved substantially by proper technological intervention through the adoption of creation of common facility centre (CFC), efficient process and equipment without much affecting their traditional practices being followed till date.

CSIR Integrated Skill Training Initiative

CSIR-NML Jamshedpur organised various Societal Skill Training program in the area of (i) Soft skill for quality improvement, (ii) Entrepreneurship development on e-waste management, (iii) EDP on E-Waste Collection and Deconstruction, (iii) Industrial Training on Materials and Metallurgical Engineering, (iv) In-Plant Training on Deconstruction and Upcycling of E-Waste, (v) Manual Metal Arc Welding and Gas Cutting (MMAW), (vi) EDP on Innovative Product Prototyping for MSME (IPPM), (vii) Industrial Training on Materials and Metallurgical Engineering (ITMME), (viii) Chemical analysis for Metallurgical Samples (CAMS), (ix) Energy efficient furnace, (x) Fitter Training, (xi) Turner Training and (xii) Management Development Program on Export Marketing of Metal Craft - 1

The attendees are mostly Diploma/ITI students as well as job aspirants having technical qualification. Along with them, the training programmes were attended by undergraduate students and people having Matric Degree and non-Matric. The trainees are from West Bengal, Jharkhand, Bihar and Odisha District.

1.4 ACTIVITIES TOWARDS CONTRIBUTION TO GOI MISSIONS

Startup India

- CCMB's Atal Incubation Centre is supporting 41 startups and 5 fellows. All startups are registered under DIPP and benefits under the Startup India program. Additional programs under TIDE 2.0 of MeitY and social innovation program of BIRAC implemented to expand support to startups.
- CSIR-CFTRI inaugurated a "*Food Business Accelerator*" in August 2020 to augment its startup Innovation System in the Campus. The Centre is targeted to provide opportunities for prospective entrepreneurs and startups to be part of the Accelerator Facility for a period up to 1 year or so. These companies can explore the avenues for product development, Scale-up operations, packaging and shelf-life studies for commercialising their products. Expert mentoring sessions also will be available.
- *Indian Institute of Integrative Medicine-Technology Business Incubator* (IIIM-TBI) a company of CSIR-IIIM, Jammu is devoted to R&D activities, technology support and academic including Skill Training/HR) for the benefit of industrial biotechnology in the country.
- *Foundation for Aerospace Innovation, Research and Entrepreneurship* (FAIRE), a non-profit technology business incubator for aerospace & allied engineering is being set-up by NRDC & FISE at CSIR-NAL, Bengaluru. The facilities,

technologies, knowledge base, etc. from the CSIR-NAL will be brought in for commercial exploitation to the potential start-ups and MSMEs for the introduction of novel products and services.

Make in India

- Focus on development of indigenous COVID-19 kits & IVDs. Six startups have been supported for accelerated deployment of Covid-19 solutions. One startup has received ICMR approval for their VTM kit, and another test is awaiting approval. 2 startups are working on plant-based therapeutics; of them, one company has already launched a nutraceutical made with Cordyceps Militaris
- FIND foundation of Innovative New Diagnostics in India-HYDERABAD REAGENT CONSORTIUM-An initiative to aggregate the capacities of delivering quality Covid-19 diagnostic kits for the nation. CSIR-CCMB helps MSME and startups in this consortium by testing their products, providing technical assistance by suggesting modifications to improve product quality & by connecting them to other stakeholders in the value chain.
- CSIR has launched a Mission Mode Project entitled "*CSIR Innovation Centre for Next Generation Energy Storage Solutions* (ICeNGESS)" and is being implemented at CSIR-CECRI, Chennai Center. CECRI's premier research in new generation battery systems like lithium-ion, sodium-ion, lithium-sulphur and metal-air battery technologies, has taken a leap forward in its journey towards establishing a CSIR Innovation Centre for Next Generation Energy Storage Solutions at CSIR Madras Complex, Chennai
- CSIR-CEERI Developed MEMS piezo-resistive pressure sensor interfaced with a commercial IC for sensor output amplification, bias generation and temperature compensation.
- CSIR-CGCRI has received orders from NTPC for the supply of sensor systems for generators, and Refractory ramming mass for induction furnace in steelmaking has been subjected to final trials
- The process is being developed by CSIR- IICT to produce ultrapure (Semiconductor grade) Choline etchant to aid in Make in India program of Semi-conductors Limited, Mohali, a space research laboratory Developing bench-scale technology for the ammoxidation of ortho chloro toluene - M/s Shiva Pharmachem Ltd, Gujarat.
- IIP Efforts are on for the commercialization of a biogas upgradation process to pipeline quality biomethane. The process developed at CSIR-IIP has been tested at pilot scale, and a patent has been filed. A proposal has been recently sanctioned by CSIR for taking up detailed engineering of the process to the commercial-scale (2-4 TPD biomethane) for the licensing purpose.
- CSIR-NAL developed a low cost indigenized a bi-level positive airway pressure, Non-Invasive ventilator device named as "*SwasthVayu*" which is a microcontroller-based closed-loop adaptive control system with a built-in biocompatible. Successfully passed stringent electrical safety, performance, calibration, bio-compatibility tests at NABL accredited laboratory, Registered with the Central Drug Standard Control Organization (CDSCO)
- CSIR-NAL and MAF Clothing together

developed the PPE Coveralls with Indigenous heat sealing tape and polypropylene materials. Lightweight, breathable, jumpsuit type PPE coveralls using laminated non-woven fabric with features like an attached hood, seam-sealed, zipper front with sealed edges, soft elastic around the neck and long sleeves have been designed and developed indigenously for frontline health workers involved in containment zone of Covid-19

- CSIR-NML Piloted first Commercial Sodium Production in the country, Developed an alternate reduction process of Mn ore by using gaseous reductant, Developed a process for the conversion of non-coking coal to coke, Developed and fabricated canon liners for CIMFR, Developed process for Rare earth extraction from granulated blast furnace slag, Developed Mg alloys for a biodegradable implant, Al-based metallic foams production method and developed metal foam.

Development of Fast, Durable and Energy Efficient Mass Scheme:

In Mass Housing Scheme, CSIR-NEERI entrusted to provide eco-services 1. Rainwater Harvesting System (RWHS) and greywater treatment, 2. Design guideline/ specifications for air and water purification system and 3. Design guideline/ specification for sewage treatment to minimize resource consumption, waste produced using sustainable development and green building concept.

Skill India

CSIR - Summer Research Training programme (SRTP) was conducted at CSIR-CFTRI during August 2020. A total of 300 students were enrolled along with faculties affiliated with UGC / AICTE / Universities etc. The programme included assignments from mentors, lectures by scientists and eminent scholars in the country. CSIR-IIIM has participated in the online CSIR-SRTP-2020 training program organised by CSIR-NEIST from June 2020 to August 2020. 86 candidates were provided with online summer research training from CSIR-IIIM. On the completion of the programme, e-certificates were issued to the successful candidates.

CSIR-CRRI organized two Online Training Programmes during the period. First on "*Quality Control Aspects of Rigid Pavement and Flexible Pavement*" from September 24-26, 2020, sponsored by Syama Prasad Mookerjee Port Kolkata, West Bengal. The other program was on "*Quality Assurance and Quality Control Aspects of Flexible Pavement*" on October 05, 2020, sponsored by M/s United Supreme Pvt. Ltd., Lalitpur, Nepal and attended by 72 participants.

CSIR–Indian Institute of Toxicology Research launched the Add-on Course on "*Analytical Toxicology*" for students of Hindu College, University of Delhi, on July 31, 2020.

Currently (2020-2021) 7 students are being trained in the area of Patent Informatics under the *Post Graduate Diploma in Patinformatics* (PGDP) program offered at CSIR URDIP under the aegis of AcSIR.

Swachh Bharat

IIP performed Thermo-chemical valorisation of agricultural residues for the production of fuels/ chemicals which will help in providing value addition to the crop residues otherwise being burnt.

NISTAD's in-house project included benchmarking and Socio-Economic Impact analysis study of the CSIR Water Technologies, in this project, comprehensive analysis of available water technologies of CSIR will be evaluated based on a set of

matrix indicators for their socio-economic impact

Sashakt Bharat

CSIR-CEERI transferred 2.6W *Pulse Tuned Magnetron tube technology* with application in healthcare diagnostics, dual-energy, mobile, and fixed cargo screening machines used for security checks in border areas, and at airports & harbours.

Detailed design of two different types of Mob Control Vehicles (MCVs) has been made by CSIR-CMERI. (i) Medium (LPTA) Chassis based MCV and (ii) Heavy (Stallion) Chassis based MCV made. The design and development of the tractor based MCV was carried out and demonstrated to the CRPF-RAF at New Delhi.

The intensified process has been developed for Salicyclic acid using reactive crystallization and validated experimentally at CSIR-IICT, AI & ML techniques have been applied for product modelling and applied inefficient product design. Modelling and simulation have been carried out for solids blending operation under a collaborative project with an international client (Daiichi Sankyo Europe Gmbh).

Swasth Bharat

CSIR-IIIM, Jammu has received Investigational New Drug (IND) approval from New Drugs Division of CDSCO for a potent anti-cancer, new chemical entity (NCE) effective against pancreatic cancer after successful completion of preclinical development and IND submission. This will pave the way for CSIR- IIIM for conducting the clinical trial of this important drug candidate IIIM-290 in pancreatic cancer patients.

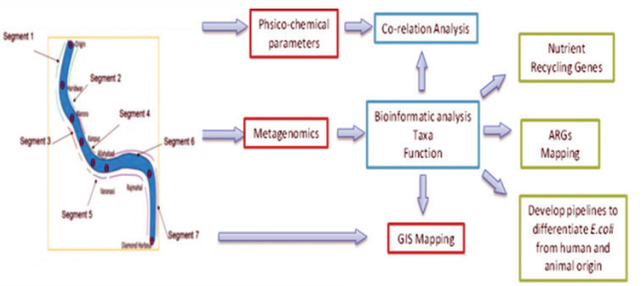
CMERI developed technologies for High flow rate Arsenic Removal Filter, High Flow rate Fluoride & Iron Removal Plant, Community level Fluoride, Arsenic & Iron Removal (FAIR) Plant, Domestic level Fluoride, Arsenic & Iron Removal (FAIR) Plant, Solar Based Intelligent Mask (IntelliMAST), 360 degrees Car Flusher, Dry Fogging Shoe Disinfector, Tractor mounted road sanitizing unit, Portable touch-free soap-cum-water dispensing System, Pneumatically operated mobile Indoor Disinfection Unit.

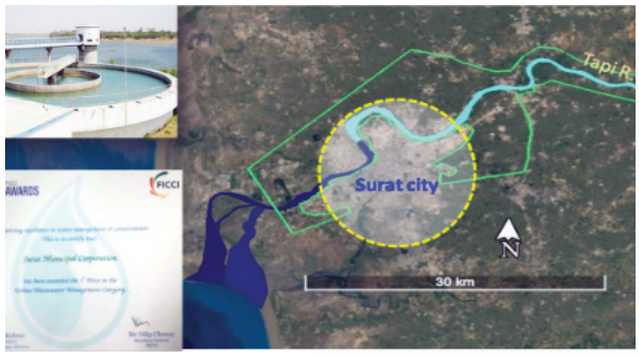
NISTAD in-house Project: Opportunities and Challenges for Vaccines Self-Reliance in India. In this project, the historical and current trends in vaccine demand and supply in India will be mapped, and opportunities for self-reliance through affordable domestic Production will be identified.

Namami Gange

CSIR-NEERI performed Mapping Microbial Diversity of the Ganges with Metagenomics

CSIR-NGRI carried out the AEM survey employing multi-moment SkyTEM312 at Ganga-Yamuna Doab, at Prayagraj for aquifer mapping with special reference to paleochannels. The study resulted in the mapping of a prominent resistive buried feature between Ganga and Yamuna rivers. This observed mega feature is inferred as the discovery of paleochannels, i.e. pathways of an ancient river that has near comparable dimension to the rivers Ganga and Yamuna.





Three Popular Science Magazines (Science Reporter, Vigyan Pragati & SKD) carrying information on various themes – women empowerment, youth/children encouragement, health, nutrition, education, sanitization, artificial intelligence, space & astronomy, wildlife & environment, technology, innovations, etc. which serve to fulfil several missions of Government of India including Swachh Bharat, Make in India, Namami Gange, Digital India, and Startup India.

2. CONSULTANCY DEVELOPMENT CENTRE

1. Introduction

The Consultancy Development Centre (CDC) was setup 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 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 organisations, Academic institutions and Consultancy companies. CDC has been getting an annual plan support from DSIR for carrying out schemes,projects and activities aimed largely at competency enhancement and capacity building of consultants in the country. Some of the major activities undertaken (including ongoing projects) during the year (FY 2019-2020) included

- Study on "Need based interventions for better marketability of Handicraft Clusters in Uttar Pradesh (Wooden crafts in Nagina and Zari/Zardozi crafts in Varanasi)", DC (Handicrafts), Ministry of Textiles
- Study on "Preparation of Strategic Roadmap for Metal Handicrafts Service Centre (MHSC), Moradabad", DC(Handicrafts), Ministry of Textiles
- Training and Consultancy Services for Implementation of ISO 9001: 2015 Quality Management System (QMS) at CSIR-IHBT Institute of Himalayan Bioresource Technology, Palampur.
- Training and Consultancy Services for Implementation of ISO 9001:2008 Quality Management System (QMS) at National Research Development Corporation (NRDC), Delhi.
- Consultancy Services for "Selection of Agency/SI regarding Implementation of Online Attendance Management System in various institutions of the Health Department" – Dept of Health & Family Welfare, Punjab Govt
- Consultancy services for Study on "DC-MSME schemes for MSME Sector – with focus on North Eastern Region including Sikkim"- O/o DC (MSME), Ministry of MSME, Govt. of India
- Consultancy Services for 'Selection of System Integrator (SI) for Design, Development, Implementation and support for OFSAMS Project at Dental Council of India and its various dental colleges.
- Service for ISO9001:2015 (Certificate to CSIR-CBRI) and NABL Accreditation to Fire Research Lab of CSIR-CBRI, Roorkee.
- Contents Development for Certificate Programme in Strategy Consulting.

2. Highlights of Performance

- During the year CDC undertook various activities keeping in view the mandate of promotion and development of consultancy covering capacity building and facilitation of client organisation in the selection of right consultants for their projects.
- Study on "Preparation of Strategic Roadmap for Metal Handicrafts Service Centre (MHSC), Moradabad", DC (Handicrafts), Ministry of Textiles .Draft Report submitted
- Training and Consultancy Services for Implementation of ISO 9001:2008 Quality Management System (QMS) at National

Research Development Corporation (NRDC) , Delhi. Project completed

- Consultancy Services for 'Selection of System Integrator (SI) for Design, Development, Implementation and support for OFSAMS Project at Dental Council of India and its various dental colleges. Project completed
- Contents Development for Certificate Programme in Strategy Consulting. Project completed

PUBLIC SECTOR ENTERPRISES

1: NATIONAL RESEARCH DEVELOPMENT CORPORATION (NRDC)

2: CENTRAL ELECTRONICS LIMITED (CEL)

1 NATIONAL RESEARCH DEVELOPMENT CORPORATION (NRDC)

Introduction

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 1800 patents.

Profit

The highlights of the performance and the financial result for the financial year ended on 31st March 2020 as per revised accounting policy are given below:

Performance Parameters	2019-20 (₹ in Lakhs)	2018-19 (₹ in Lakhs)
Gross Income	991.35	1112.86
Revenue from operations	931.17	1064.00
Other Income	60.18	48.86
Surplus Before Tax and extraordinary expenses	41.95	2.85
Extraordinary expenses	45.54	-
Profit/ (Loss) Before Tax	(3.59)	2.85
Profit/(Loss) After Tax	(17.27)	1.00
Paid up Share Capital	441.81	441.81
Reserves & Surplus	485.11	502.38
Net Worth	926.92	944.19

**The 75% Royalty share of DSIR i.e. ₹ 13,29,36,450 has not been shown in Revenue as per revised Accounting Standards.*

1. 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 34 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:

- NRDC and National Institute of Pharmaceutical Education and Research, (NIPER), Hyderabad
- Intellectual Property Facilitation Cell (IPFC), Director General of Quality Assurance, Deptt. of Defence Production,

Ministry of Defence, Govt. of India, CGO Complex, New Delhi.

- National Thermal Power Corporation, Gautam Budh Nagar, U.P.
- Tribal Cooperative Marketing Development Federation of India, New Delhi, NRDC and Birla Institute of Technology, Jharkhand
- Central Manufacturing Technology Institute, Tumkur Road, Bengaluru
- South India Textile Research Association, Coimbatore

MoA/MoU signed with institutes in foreign countries

i) New Jersey Economic Development Authority and Rawan University, USA Leads

ii) University of South Bohemia, Czeck Republic for Technical Cooperation and Technology Transfer

iii) National Centre for Scientific and Technological Research (CNRST), Morocco for setting up Technology Transfer and Demonstration Centre.

iv) Iran National Innovation Fund, Iran for Technical cooperation and Technology Transfer

v) Wevio Global Inc, South Korea for Technical Cooperation and Technology Transfer

Process Assigned

During the financial year 109 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, universities were:

B.V. Patel PERD Centre, Ahmedabad

- Low risk, patient friendly biodegradable polymeric microneedle based transdermal patch for delivery of bio-therapeutics/cosmetics.
- New use of 2-substituted amino-5-thiazolyl analogues against diabetes, obesity and autoimmune diseases.

Central Manufacturing Technology Institute (CMTI), Bengaluru

- Abrasive Flow Finishing Machine (AF-FM-150D)

Central Silk Technological Research Institute, (CSTRI) Bengaluru

- Development of new type of yarn (void silk) in reeling & spinning processes & its characterization
- Development of handloom silk sarees using spun silk

CSIR-CFTRI (Central Food Technological Research Institute), Mysuru

- Bioactive Molecular Rich Green Coffee Concentrate

CSIR-CCMB (Centre for Cellular and Molecular Biology), Hyderabad

- Improved Samba Mahsuri (RP BIO 226): A Bacterial Blight Disease Resistant and Low GI (Diabetic Friendly) Rice Variety

Major Technologies Licensed

As a result of Value addition, the Corporation managed to sign 19 license agreements with industry to undertake manufacturing during the year compared to 22 license agreements executed in the previous year. Some of the major processes/technologies licensed by the Corporation in the financial year were:

CSIR- NPL (National Physical Laboratory), Delhi

- Recycling of waste Plastic Bag into useful Tile

CSIR-SERC (Structural Engineering Research Centre), Chennai

- Geopolymer Block Technology

National Institute of Ocean Technology (NIOT), Chennai

- Remotely Operated Vehicle (ROV)
- Wave Powered Navigational Buoy

Vector Control Research Centre (VCRC), Pondicherry

- Bti based Mosquito Larvicide

Lumpsum Premia and Royalty

Corporation's consolidated Lumpsum Premia & Royalty income is Rs. 691.58 lakhs as compared to Rs. 910.69 lakhs in the previous year. The Royalty received was from both the NRDC licensees and PATSER projects.

2. Consultancy/Export of Projects and Services

The Corporation has been offering consultancy services in the following fields:

- Technological up-gradation for the SMEs – identify technological gaps, scouting for appropriate technology and partnering with R&D institute for developing the solution
- IP Consultancy services – Patent Data mining, Search and Analysis, Patent drafting, filing and prosecution, Patent landscaping, FTO analysis, IPR policy, Audit, Training.
- Project consultancy – undertaking and executing projects in India and abroad particularly in developing countries.
- Monitoring and mentoring of Start up companies- providing services for monitoring, mentoring of start up companies funded by IOCL
- The Consultancy fee earned in the Financial Year 2019-20 is Rs. 239.58 lakhs against the last year amount of Rs. 153.31 lakhs.

Export of Technologies and Services

The Corporation has been endeavouring extensively for export of technologies and services and securing projects for implementations. In addition, the lead generated earlier was also pursued for securing Turnkey projects.

A number of delegations visited the corporation to enter MOU for technical cooperation. Keeping in view of the above, it is expected that the Corporation may procure projects overseas and explore opportunities for export of technologies.

Export of Technologies- Leads Generated

The Corporation is also negotiating with various countries for export of technologies. Some of the technologies are mentioned below:

- Recycling of Waste Plastic into Tiles- South Africa, Nigeria
- Superabsorbent Hydrogel- Nigeria, South Africa
- Production of Sulphurless Sugar- South Africa
- Production of Fortified Sugar- South Africa

Foreign Delegations visited NRDC

1. Delegation of ASEAN-Member States Team visited NRDC office on 4th April, 2019 after attending Workshop on "Intellectual Property Rights and Technology Transfer" for ASEAN – Member States held from 1st April to 5th April, 2019 organised by NRDC.
2. Provost Dr. Hajela and his team from Rensselaer Polytechnic Institute (RPI),

a technical University situated in Troy, New York visited NRDC on 23rd May, 2019 for technical co-operation.

3. Mr. Ziba A. Ghorbani & his team, Technology Cooperation & Innovation Section, Embassy of the I.R. of Iran, visited NRDC on 13 June, 2019 for 'Identification of collaborative area in the field of technology, innovation and commercialization'.

4. A foreign delegation consisting of Mr Bart Fisher, Managing Director of the Law Office of Bart S. Fishar, Mr. John M. Albertine, Chairman, ALBERTINE Enterprises and Mr. Venkat Kumar Tangirala, President, International Operations, JJ&B Investment Banking from Washington visited NRDC on 23rd August, 2019 to carry out discussions on creation of a 1 billion USD technology fund in India. Mr. Bart Fisher desired to make NRDC as the nodal agency to handle the IPRs and carrying out due diligence upon the Indian companies utilising the fund.

5. Togo Delegation from Ministry of Higher Education, Togo visited NRDC on 27th August, 2019 to set up Skill Development & Incubation Centre at Togo.

6. NEJDA and Rowan University visited NRDC on 16th Sept., 2019 for discussions regarding signing of MoU between NRDC/NEJDA/Rowan University which was signed on 17th Sept., 2019 at, New Delhi.

3. PROMOTIONAL ACTIVITIES

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 awarding meritorious inventions, protection of IPs, evaluation of technologies, knowledge management and providing techno-commercial support to the new innovations/technologies etc. The activities carried out under this programme are summarized below.

3.1.1 NRDC National Meritorious Invention Awards of the Year 2019

The Corporation under its Programme for Inspiring Inventors and Innovators (PIII), with the support of DSIR Grants-in-aid, gives tax free awards annually for meritorious inventions. These awards are given to inventors, working in scientific and industrial fields with an objective to encourage inventive talent in the Country.

Applications for the year 2019 were invited under three different award categories i.e. National Innovation Award, National Societal Innovation Award and National Budding Innovators Award. A total of ten awards have been selected by the Prize Award Committee, two under National Innovation Award Category, three under National Societal Innovation Award Category and five under Budding Innovators Award Category in the fields of Coatings, Agriculture, Waste Management, Handloom, Medical Diagnostics and Hearing Aids.

The Cash Awards amounting to Rs. 24 Lakhs has been awarded to the 23 successful Awardees of the National Meritorious Invention Awards 2019 alongwith the Shields and Certificates.

The details of Meritorious Inventions Awards of the Year 2019 are as follows:

NATIONAL INNOVATION AWARD OF THE YEAR 2019

National Innovation Award 1: Hydroxyl Functional Acrylic Co-polymer from Derivatised Castor Oil for Coating Application

Shri Vrijesh Kumar Singh and Dr. Rajeev Kumar Jain of Asian Paints Limited, Thane Belapur Road, Navi Mumbai have been jointly awarded Rs. 5 Lakh (Rupees Five Lakh only) for the development of, "Hydroxyl Functional Acrylic Co-polymer from Derivatised Castor Oil for Coating Application ".

National Innovation Award 2: Zero Discharge Technology for Recovery of Potash Fertiliser, Water & other Value-added by-product(s) from Spent Wash (Distillery Effluent)

Shri Pratyush Maiti, Dr. Subarna Maiti and Dr. Soumya Haldar of CSIR-Central Salt and Marine Chemicals Research Institute, G. B. Marg, Bhavnagar (Gujarat) have been jointly awarded Rs. 5 Lakh (Rupees Five Lakh only) for the innovation, "Zero Discharge Technology for Recovery of Potash Fertiliser, Water & other Value-added by-Product(s) from Spent Wash (Distillery Effluent)".

NATIONAL SOCIETAL INNOVATION AWARD OF THE YEAR 2019

National Societal Innovation Award 1 for the development of, "Super Straw Management System - An Innovative Mechanized Solution for In-situ Recycling of Rice Residue in Rice Wheat System of India".

National Societal Innovation Award 2 for the innovation, "Alum from Aluminium Dross Rejects - A Journey from Lab to Land".

National Societal Innovation Award 3 for the innovation, "Low Weight Modified Jacquard for Handloom Weavers ".

NATIONAL BUDDING INNOVATORS AWARD OF THE YEAR 2019

National Budding Innovators Award 1 for the innovation, "A Full Duplex Microchip Receiver for 5G ".

National Budding Innovators Award 2 for the innovation, "An Underwater Vehicle ".

National Budding Innovators Award 3 for the innovation, "Novel Folding Mechanism for Rail Inspection (Autonomous)".

National Budding Innovators Award 4 for the innovation, "Design and Development of Point of Care Test and Optical Reader for Early Screening of Kidney Related Disorder".

National Budding Innovators Award 5 for the innovation, "Wearable Nasal Bone Conduction Hearing Aid Device".

3.1.2 INTELLECTUAL PROPERTY PROMOTION & FACILITATION

3.1.2.1 NRDC – Innovation Facilitation Centres (NRDC-IFCs)

The Corporation with the support of Department of Scientific & Industrial Research, Ministry of Science & Technology, Government of India under its Programme for Inspiring Inventors and Innovators (PIII) has set-up twelve Innovation Facilitation Centres in the premises of the Universities and Institutions engaged in innovative research & development in different regions of the country till financial year 2019-20.

The Corporation is promoting innovation related activities in the Universities, Autonomous Institutions & Academic Institutions across the country through these NRDC–Innovation Facilitation Centres (NRDC-IFCs).

The Corporation under PIII DSIR Grants-in-aid Programme has set-up twelve NRDC – Innovation Facilitation Centres in the premises of the Universities and Institutions, All India Institute of Medical Sciences, New Delhi; Amity University Uttar

Pradesh, Noida; NIT Silchar, Indian Institute of Engineering Science & Technology, Shibpur (IIESTS), Gujarat Technological University, Ahmadabad, Indian Institute of Technology Kanpur, National Institute of Pharmaceutical Education and Research (NIPER), Mohali; University of Hyderabad, Hyderabad & Indian Institute of Technology (BHU), Varanasi, Anna University, Chennai; Kavayitri Bahinabai Chaudhari North Maharashtra University, Umavi Nagar, Jalgaon and Tezpur University, Napaam, Sonitpur and signed MOUs with them. These Centres are implementing the programme effectively.

These centres are creating awareness on Innovation and IPR, including Capacity Building and Training. The Centres are also encouraging start-up projects and Entrepreneurship Development. The NRDC – Innovation Facilitation Centres are regularly organizing Seminars, Workshops and short term trainings on Innovation, Intellectual Property Rights and Technology Transfer in these Institutions and guided more than 2000 researchers, faculty and students for the effective management of Intellectual Property and technology transfer related issues to achieve the objectives of the NRDC-IFC Programme and encouraged the researchers, faculty and students to file Patent applications and Trademarks.

3.1.2.2MoMSME-NRDC Intellectual Property Facilitation Centre (IPFC), and WIPO-Technology Innovation Support Centre (TICS) Vishakhapatnam

NRDC-MoMSME-IPFC & TISC Visakhapatnam office has been established in Andhra Pradesh on 28thJanuary 2017 and 25th February 2018 respectively in Vishakhapatnam. IPFC is closely working with various stakeholders including MSMEs, academia, university, start-ups, R&D institutes and industries and PSUs in the region to identify potential innovations/ inventions which could be channelized into IPRs and value addition for commercialization's. The 3rdTechnology and Innovation Support Centre (TISC) by World Intellectual property Organization (WIPO) and Department of Industrial Policy and Promotion (DIPP), Govt of India was established in NRDC-IPFC at Visakhapatnam on 25th February 2018 during Partnership Summit which is attended and witnessed by then Hon'ble Minister of Commerce and Industry, Shri. Suresh Prabhu and other eminent dignitaries of both state and central government. NRDC-IPFC&TISC Visakhapatnam has provided its Intellectual Property Facilitation Services to various PSU's of Defense Ministry, Industries & Academia from its inception. It has promoted technological know-how of many technologies sourced from CSIR, NIOT and DRDO to various Start-ups, individual entrepreneurs, MSME's for licensing the technologies to them. Besides NRDC-IPFC&TISC Visakhapatnam is associating with DPIIT-CIPAM, WIPO, UNESO, Govt of AP, Ministry of MSME has been organizing various programs related to capacity building, awareness, training & workshop on intellectual property, technology management & transfer in various places.

The objective of NRDC-MoMSME-Intellectual Property Facilitation Centre (IPFC)&WIPO- Technology Innovation Support Centre (TISC) is to promote technological innovation, IP promotion, IP management and technology transfer in the region in view of growing industrialization and start-up ecosystem.NRDC–MoMSME-IPFC&TISC Visakhapatnam has developed wide network with scientific and industrial community in southern India. It is working effectively towards its roles and objectives in activities including technologies licensing, IP facilitation and capacity building and

awareness programs and participated in many exhibitions and technology promotional activities of multilateral organizations like WIPO and UNESCO and conducted various technologies entrepreneurship development programs. NRDC IPFC&TISC Visakhapatnam focused to make the centre self-sustainable and worked towards its vision readily. The activities carried out by NRDC-MoMSME-IPFC&TISC Visakhapatnam for the year 2019-20 are mentioned below.

S. No	Services Provided	FY 2019-20 (Till 31st March 2020)
1	Patent Services facilitated with due diligence (Novelty Search Reports generated + Patents Filed service + Advisory)	55
2	Technology Transfer to MSME/ Entrepreneurs/ Startups/ Industries & PSU's	10
3	Technologies Assigned	7
4	Trademark services facilitated & filed	29
5	Copy right services facilitated & filed	3
6	Industrial Design services facilitated & filed	2
7	Geographical Indication of Goods Initiated & services facilitated (under progress)	2
8	MoU/MoA Signed	19
9	IP Workshops Conducted	8
10	NRDC-IPFC&TISC-VSKP officials attended for IP promotional activities/awareness programs/ seminars/ exhibitions/ stalls/ EDP	48
11	No of MSMEs, Startups and industries visited NRDC office in APIS	200

Technologies Commercialization & IPR Consultancy Services

NRDC-MoMSME-IPFC & TISC has concluded 10 technology License agreement with various PSU's/start-ups/ entrepreneurs and MSME's in the year 2019-20. Some of the technologies are as below:

- Remotely operated Vehicle (ROV)
- Recycling of Plastic Waste into Useful Tiles
- Wave Powered Navigational Buoy
- Multiplex PCR Detection Kit for detecting virulent genes of Enterococcus faecal in water and seafood (MPCR)
- Geopolymer Blocks Technology
- Production of Lutein from Marine Microalgae

The NRDC-IPFC facilitated acquisition of the following technologies for commercialization

- Wave Powered Navigational Buoy (WPNB)
- Sae Surface Temperature Sensor (SSTS)
- Robo Boat Technology (RBT)
- Indian Tsunami Buoy System
- Met Ocean Buoy System

The centre has also provided IPR consultancy services including ordnance factories during the FY 2019-20.

- Gun Carriage factory, Jabalpur
- Ordnance Factory Project, Korwa
- Field Gun Factory, Kanpur Besides NRDC-MoMSME-IPFC & TISC Visakhapatnam is associated with UN WIPO, Govt of AP, Ministry of MSME, Govt of India organized various capacity building, awareness, training & workshop on Intellectual property, technology management & transfer in various places. It is also

targeting clustered based MSME in the region to create value addition in Entrepreneurship, Innovation and IP Facilitation. NRDC-MoMSME-IPFC&TISC has signed Memorandum of Agreements (MoA/MoU) with 19 Academic institutions and universities for mutual collaborations for IPR and Technology transfer services. The centre officials have organized and participated in 33 workshops, seminars and deliberated invited talks as resource persons and conducted 2 Entrepreneurs skill Development Programs (EDP). The officials attended for 21 trainings and exhibitions during FY 2019-20.

3.1.2.3 IP awareness & filing assistance

WIPO International Seminar

In a knowledge based economy today intellectual property is of utmost importance. Intellectual property is used to enhance growth and competitiveness. Various instruments of IP Rights are used to achieve economic, social and technological advancement for our country, keeping in mind the initiatives and drives of the Govt. of India for promoting the culture of innovation for emerging as a Global Intellectual Hub. The various labs operating both in the private and the Government sector have immense potential to enhance the R&D efforts in the country. This R&D when it leads to generation of IPR has to be protected at all costs as it ensures that India remains competitive in the globe.

The Corporation continued to provide financial, technical and legal support to protect inventions developed by various universities, R&D institutes, individuals, etc by filing patent applications in India in the year 2019-2020.

The various services provided and activities undertaken under this scheme are:

- **IP Protection** : During the year 2019-20, the Corporation in its pursuit of protection of inventions and technologies developed by scientists, researchers, etc has provided financial and technical assistance for filing of 60 patent applications in India. received from various universities, R&D institutes, etc. The Corporation has been prosecuting a number of patent applications filed in India and abroad. The efforts of the Corporation have resulted in the grant of 28 Patents (list attached herewith) in diverse fields like Chemical. Mechanical, Sericulture, Dairy, Food, Drugs, etc during the FY 2019-2020.

- **Patent Search Facility:** The Corporation has been catering to the requests received from various Universities, R&D Institutes and individual inventors etc for conducting the state of the art searches, the results of which are utilized for submitting research projects at university level so that the invention related to the R&D project should be novel and not a mere repetition of the R&D work already done. During the year 2019-20, 94 Prior Art Searches have been conducted by the Corporation.

- **IPR Seminars/ Advanced Workshop:** The Corporation has reached out to various universities and R&D institutions for creating awareness amongst scientific fraternity about the importance of protection of IP assets in the knowledge era by organizing the 10

awareness programmes on Intellectual Property Rights and delivering 93 lectures on IPR & Technology Transfer (TT).

- **Prior Art Search:** The Corporation has been catering to the requests received from various Universities, R&D institutes, individual inventors, start-ups etc. for conducting the state of the art patent searches. During the financial year 2019-20, 94 prior art searches have been conducted by the Corporation.

3.1.3 PROMOTION OF FLAGSHIP PROGRAMMES

3.1.3.1 Pilot Incubation Centre at NRDC

National Research Development Corporation (NRDC) New Delhi, established a Pilot Incubation Centre at NRDC in order to leverage the Start-up innovation ecosystem by utilising the vacant space into a new Incubation Centre, which can accommodate/ incubate about 9-10 start-ups.

After examining the applications of start-ups, NRDC had incubated following three start-ups.

a. The Corporation has physically incubated following two start-ups:

1. M/s Realsaber Technologies Pvt. Ltd., New Delhi
2. M/s Pratyaksha Agrotech Pvt Ltd, New Delhi

b. The Corporation has virtually incubated following one start-up:

1. M/s Klassical Biomechanics International LLP, Gurgaon

3.1.3.2 Promotion of Innovation in North-East & Rural Area

Details of EDP conducted in North East and Rural Areas (EDP-NERA) under Grant–in-Aid Scheme PIII of DSIR during financial year 2019-20

The Corporation with an objective to create employment opportunities and capacity building of development agencies for skill up-gradation through the application of innovative technologies in North East and Rural Areas carried out the Entrepreneurship Development Programmes during 2019-20 as listed in **Annexure 11.**

Some highlights of the EDP are as under:

1. EDP on "Fruit and Vegetable Processing" organised at Fruit Research Centre, Entkhedi, Bhopal, MP in association with M/s Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya (RVSKV), Gwalior, MP and about 30 women participants were benefited during this programme.
2. EDP on "Skill Training on Utilisation of paper waste for rural entrepreneurship" organised in association RELF, Jamshedpur at Bhutam Village, Purulia and about 36 participants were benefited during this programme.
3. EDP on "Coir Products from Tender Coconut Husk (Women empowerment from Waste to Wealth)" in association with Vasantha Lakshmi Charitable Trust and Reseach Centre, Nellore and 50 beneficiaries were benefited during this programme.
4. EDP on "Design and Technology Development workshop on Bamboo Craft" organised at Chandrapur, Maharashtra in association with Harshal Gramin Vikas Bahu. Sanstha (HGVBS), Chandrapur and about 30 women artisans were benefited during this programme.
5. EDP on Skill Development on Bamboo and Cane Products to Tribal Community

of Nagaland" organised at Dhansiripar Block of Dimapur, Nagaland in association with M/s People In Need Foundation (PINF and 30 artisans both men and women were benefited during this programme

6. EDP on "Honey, Tamarind, Mushroom, Mini Millets and Jack Fruit processing and value addition" to be organised at VIT, Vellore, TN. in association with M/s Centre for Sustainable Rural Development and Research Studies (CSRD&RS), Vellore Institute of Technology, Vellore, TN. During this programme about 200 candidates were benefited

3.2 PROGRAMME FOR DEVELOPMENT OF TECHNOLOGIES FOR COMMERCIALISATION (PDTC)

The programme aims to add value to the lab-scale technologies developed by the universities/research institutes/organizations, dissemination of the information and promotion of entrepreneurship development and appropriate innovative technologies in rural and north-east regions. Under this scheme the Corporation carried out various activities like Development of Innovation Portal, Value addition through preparation of Basic Engineering Design Package (BEDP), Market Surveys, and dissemination of information through exhibitions/ seminars/workshops etc., promotion of indigenous technologies abroad through showcasing of indigenous technologies. The various programmes undertaken in this scheme are:

3.2.1 TECHNOLOGY VALUE ADDITION

Technology upgradation for taking the Technology from Lab to Land provided to 49 technologies by conducting Market Surveys (MS), Basic Engineering Design Package (BEDP), Feasibility Reports (FR), Socio Economic Impact Assessment (SEIA), Techno-Commercial Support (TCS) and Priority Projects (PS) so as to take the technology from lab to industry.

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 laboratory scale technologies. The package provides information on the plant and equipment, raw material and the product, etc. which helps the entrepreneurs in decision making as well as implementation of the project. It requires a detailed study for working out the final process scheme, which can be obtained through series of simulation of the laboratory scale process and then incorporating required engineering input so that the process is workable. Once the BEDP is prepared based o the data the feasibility study and Detailed Project Report (DPR) can be prepared. With these reports it becomes easy for the entrepreneur to carry out detailed engineering for setting up the 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:

Sr. No	Name of Technology
1.	Adamantyl Substituted Quinolines as Anti Tubercular Compounds
2.	Nanoemulsion loaded gel for psoriasis management
3.	Phospholipid complex technology for improved metabolic stability and half-life of gemcitabine
4.	Sea Surface Temperature Sensor
5.	Azolla & moringa based animal feed pellets technology package (By Dr. Pillai)

Sr. No	Name of Technology
6.	Technology package on Value added products from Moringa (By Dr. Pillai)
7.	Process of Sugarcane Juice Clarification to Obtain Sulphurless Sugar
8.	Long-Lasting Nano-sanitiser with a Dispensing Antimicrobial Layer

3.2.1.2 Feasibility Reports

This activity has been started from financial year 2019-20. The preparation of Feasibility Report carried out by the Corporation is a very important value addition activity for laboratory scale technologies. The package provides information on the investment to be made on plant and equipment, raw material 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 the entrepreneurs to get loans from financial institutions by submitting the Feasibility Reports. Based on the data of Basic Engineering Design Package (BEDP) the Feasibility Report is prepared. 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 (2019-20), Feasibility Reports on the following technologies were conducted through professional empanelled consultants:

Sr. No	Name Of Technology
1.	Integrated Healthy & Nutritious bar manufacturing unit:
2.	Multiplex PCR Detection Kit – NIOT
3.	Process for Converting Sericulture Waste into Value Added Products
4.	Process of Sugarcane Juice Clarification to Obtain Sulphurless Sugar

3.2.1.3 Market Surveys

Market surveys are of considerable significance to the process of technology transfer. It makes the technology package more attractive to entrepreneurs. During the year 2019-20, market survey reports on the following technologies were conducted through professional empanelled consultants.

Sr. No	Name of Technology
1.	Adamantyl Substituted Quinolines as Anti Tubercular Compounds
2.	CNS effective thyrotropin-releasing hormone analogs
3.	Single Pot reaction/Process For The Production Of -Amino Acid Amides
4.	Nanoemulsion loaded gel for psoriasis management
5.	Phospholipid complex technology for improved metabolic stability and half-life of gemcitabine
6.	Novel agent for the treatment of organophosphate
7.	Ets-1 identifying Aptamer selection by using Cell-SELEX method
8.	Multiplex PCR Detection Kit – NIOT
9.	Wave Powered Navigational Buoy – NIOT
10.	Coconut water extraction equipment
11.	Preservation of sugarcane juice
12.	Water saving cost efficient reverse osmosis (ro) based water purification system
13.	Arsenic removal technology
14.	Value added food products from soyabean
15.	Health food products from millets
16.	C-Bot Coral Reef Monitoring and Surveillance Robot
17.	Process of Sugarcane Juice Clarification to Obtain Sulphurless Sugar
18.	Production of fortified amorphous sugar through co-crystallisation
19.	Novel Rakshak – PPE kit
20.	Abrasive Flow Finishing Machine
21.	Long-Lasting Nano-sanitiser with a Dispensing Antimicrobial Layer

3.2.1.4 Socio Economic Impact Assessment (SEIA) of Technologies Licensed by NRDC

NRDC since its inception has commercialised technologies to more than 5000 entrepreneurs. It was felt that the socio economic impact of the technologies/products licensed by NRDC on common man/ masses should be carried out for major technologies. Therefore, the activity has been started from current financial year 2019-20. The report is prepared based on the information of Licensee, production data and interaction with the end users of the product, their feedback, etc. The reports will help the Corporation in planning for marketing of its technologies in specific sector as per the feedback and demand of the end-users.

Socio Economic Impact Assessment (SEIA) reports on the following technologies were conducted through professional empanelled consultants.

Sr. No	Name of Technology
1.	Non-invasive kit for detection of Haemoglobin
2.	Ayush-82
3.	Ayush- SG (Herbal formulation for Rumatoid Arthritis)
4.	Herbal solution for Anti Arthritis
5.	POSHAN- A Multi-nutrient Formulation for Correcting the Nutrient Deficiencies in Mulberry
6.	ROT FIX- A broad spectrum environment friendly formulation for control of root rot disease in Mulberry
7.	Extraction of Azadirachtin from Neem Seed Kernels

3.2.1.5 Techno-Commercial Support to Scientists, Innovators and Students for Process Trial and Validation of Technologies

The activity provides necessary support to the scientist for overcoming minor issues like testing of the product, authentication and obtaining necessary approvals from statutory bodies, development of prototypes, preparation of Know-how document, demonstration of technology, etc.

The Techno-commercial support is being provided for the following purposes –

- Improvements in prototype to make it commercially acceptable
- Carrying out field trials / testing / analysis, further studies etc.
- Preparation of a pre-feasibility report
- Preparation of video about working of the invention.
- Preparation of comprehensive know-how document.
- Demonstration of the technology

During the year techno-commercial support was provided for the following 6 technologies:

1. Water saving cost efficient reverse osmosis (RO) based water purification system.
2. Smaller millet based break-fast cereals.
3. Field testing of pochonia chlamydosporia against nematodes
4. Field demonstration of biological control of thrips in small cardamom using granular formulations of Locanicilium Psalliotae
5. Specific supplements for Cancer patients.
6. Indigenous Johnin from native strain Indian Bison Type of Mycobacterium avium subsp. Paratuberculosis for the diagnosis of Johne's disease in domestic livestock as the field test.

3.2.1.6 Development Projects and Value Addition for Priority Projects

The Corporation undertakes the develop-

ment of selected technologies in the high-tech/thrust areas such as bio-technology, new materials for construction, waste utilisation, development of new drugs, futuristic pesticides, etc. The Corporation also gives thrust on the environment friendly technologies like Bio-pesticides, bio-fertilisers, etc., organic farming, Industrial based treatment, bio-remediation, etc.

During the year the following 3 technologies were provided support under the programme:

1. Pre commercialization trials and consumer acceptability studies of millet based breakfast
2. Development and standardization of technologies for extraction and value addition of Nettle Fibre
3. Development of Innovative Sanitary Napkins from Jute

3.2.2 DISSEMINATION OF INFORMATION ON SCIENCE AND TECHNOLOGY

3.2.2.1 Exhibitions and Publicity

Participation in exhibitions, seminars, workshops and entrepreneurship development programs are of vital importance for the creation of awareness about the activities of the Corporation and the role of the Corporation in technology transfer and technologies available with the Corporation for transfer. With this objective in view, the Corporation participated in 29 exhibitions in India organized by various agencies.

3.2.2.2 Publication of Magazines in NRDC for dissemination of information on Science and Technology

NRDC continued 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.

3.2.3 START-UP INDIA: SEED FUNDING OF MANUFACTURING START-UPS IN INCUBATION CENTRES

Considering fact of the emergence of innovation and start-up ecosystem in the country and in line with the Government of India flagship programmes like, Start-up India, Stand-up India and Make-in India, the Corporation proposed to hand hold such entrepreneurs, by way of equity to reduce the associated capital raising risk, and re-introduced Seed funding scheme in 2017-18. The Scheme aims to Promote and accelerate start-ups/aspiring entrepreneurs in the country who are incubating their ideas in any state/central government funded incubators and Promote fruitful utilization of research works carried out in the country by various public or private financed institutions or business houses or by any other person. The scheme is supported by Department of Scientific amd industrial research, , Ministry of Science and Technology, GoI under the promotional programme for nurturing ideas and innovation into successful start-ups.

The Corporation continued the programme and advertised in paper inviting applications from start ups for the FY 2019-20 and FY 2020-21.

During financial year 2019-20 NRDC has invited application from Start-up companies and the matter is in process for providing seed funds to the eligible start-up companies.

4.0 START-UP INDIA INITIATIVE

4.1 Assessment of Start-Up-India Applications for Tax-Exemption

"Start-up-India" is an initiative of 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 20859 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 (IMB) 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 submitted report for more than 2670 cases up to 42nd IMB meeting. Based on the recommendation of assessment by NRDC the IMB has approved more than 270 start-ups for availing tax benefits.

4.2 Filing of Patent, Trademark and Design application under SIPP Scheme

Indian Patent Office , Government of India recognized NRDC as a facilitator for filing patents, design and trademarks of start-ups under the Start-up Intellectual Property Protection (SIPP) scheme (CG/Misc./Facilitator/2016/506 dated 27.052016).

In the year 2019-20, 4 trademark applications were filed under the SIPP scheme along with the filing of the complete specifications of the previously filed patents, trademarks and design.

The list of newly filed SIPP applications is as follows:

S. No.	Name of the start-up	Type of application (patent/ trademark/ design)	Status of the application
1.	Infiamp Renewable Energy (OPC) Private Limited	Trademark (Class 9 and 42)	Published
2.	VAS BROS Enterprises Limited	Trademark (Class 11 and 40)	Filed
3.	Pratyaksha Agrotech Private Limited	Trademark (Class 1 and 31)	Published
4.	Zucate Mind Solutions Private Limited	Trademark (Class 41 and 42)	FER issued

5.0 CONSULTANCY

5.1 IOCL SUS Indian Oil Start-Up Scheme: Mentoring/Monitoring 11 selected Start-Ups

Indian Oil Corporation, India's flagship national oil major, has launched a start-up scheme with a revolving corpus fund of □. 30 crores to promote promising start-ups and nurture an eco-system conducive to innovations in the domestic hydrocarbons sector.

Driven by Indian Oil's Research & Development Centre based at Faridabad, the scheme is supporting projects that aim to establish innovative technology and business process reengineering 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 commercialisation of select validated PoCs through equity participation.

Based on NRDC experience in working in Start-up eco system, IOCL requested NRDC

for assistance in short listing and fixing of milestone from the proposals received from the start-ups for funding. Further, NRDC signed the MoA with IOCL on 21st September 2017 for mentoring and monitoring the 11 start-ups for first tranche of funding, and 13 Start-Ups in second tranche respectively on 21st September 2017 and 30th March 2019. The role of NRDC as per the MoA is to mentor, incubate, monitor, evaluate and review the Start-up projects selected under the scheme and to provide inputs and assistance to validate the Idea/project till proof of concept stage, and to recommend the release of funds based on milestones agreed.

For the services rendered to IOCL by NRDC under this MoA, IOCL is paying Rs. 1.1 Crore plus applicable taxes to NRDC for the MoA period.

5.2 Engagement of NRDC as an IPR Consultant for Bharat Dynamics Limited (BDL), Hyderabad

A MoA was signed between BDL and NRDC to provide support to BDL for filing of IPR applications and for organising capacity building training programmes/ workshops for creating awareness in IPRs.

During the financial year 2019-20, the Corporation filed more than 35 IPR applications (patents and copyrights) for BDL through our empanelled attorneys.

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 a MoU with IPFC of DGQA, Department of Defence Production, Ministry of Defence on 9th 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 years.

The major roles and responsibilities shall be 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

NRDC has already filed a patent application on "Sarvatra Kawach" for Army Design Bureau as well as formulated the policy for Creation and Management of Intellectual Property (IP) by Defence Public Sector Units & Ordnance Factories. NRDC has also placed two full time Consultants at IPFC cell for providing support and professional guidance to the IPF Cell.

5.4 Advanced Workshop on "IPR in Defence & Aerospace R&D" for DRDO

NRDC conducted a two day advanced workshop on "IPR in Defence & Aerospace R&D" from 5th – 6th December 2019 at NASC Complex, Pusa Campus, New Delhi under the Grants in Aid scheme of DRDO.

The objective of the workshop was to engage capacity building in the areas of identification and propagation of intellectual properties in cutting edge indigenous defence technologies.

Around 46 delegates who attended the workshop were senior employees/ researcher/ scientists from the different DRDO labs/ establishments like Armament Research & Development Establishment (ARDE), Combat Vehicles Research & Development Establishment (CVRDE), Institute for Systems Studies & Analyses (ISSA), Scientific Analysis Group (SAG), Proof and Experimental Establishment (PXE) etc. Few delegates were also nominated by Indian Council of Agricultural Research (ICAR), Technology Information Forecasting Assessment Council (TIFAC), IPR firms like R.K.Dewan & Co., Lexonovate Legal Advocates etc.

The workshop comprised of active discussions and questioning rounds on the issues of Intellectual Property Rights in Aerospace & R&D between the delegates and the resource persons who delivered lectures during the workshop.

6.0 ASEAN-INDIA INNOVATION PLATFORM (AIIP)

Under the overall aegis of ASEAN-India Science, Technology and Innovation Cooperation Program, the Department of Science and Technology (DST) of the Government of India has entrusted the job to manage and coordinated the ASEAN-India Innovation Platform (Research Innovation component) to National Research Development Corporation (NRDC).

6.1 Workshop on "Intellectual Property Rights and Technology Transfer" under Asia India Innovation Platform (AIPP)

Under this project, NRDC organised a five day workshop from 1st April, 2019 to 5th April 2019, New Delhi under the ASEAN India Innovation Platform (Research Innovation Component), to impart knowledge about Intellectual Property Rights in ASEAN Member State (MS) in order to promote technological growth of the nations, technology transfer process and facilitate networking between member countries.

17 delegates from different ASEAN countries participated in the workshop. The delegates were from organizations like the Patent office, Department of Science and Technology, Universities and R&D organizations. The workshop comprised of active discussions and questioning rounds on the issues of Intellectual Property Rights and Technology transfer between the representatives of ASEAN countries and the resource persons who delivered lectures during the workshop.

6.2 INDIA- ASEAN InnoTech Summit

The Corporation being a Research Innovation Partner under the ASEAN-INDIA Innovation Platform conducted a panel discussion on "Experiences and Challenges for Commercializing Technologies from Research Laboratories" at "2nd INDIA-ASEAN InnoTech Summit"—a three-day Technology and Innovation Summit which was held at Davao City, Philippines from on 20th- 22nd November 2019.

ASEAN-India Innovation Platform (Research Portal) developed by NRDC was also launched during the workshop. The portal is a data bank of the technologies developed

in India and the ASEAN-MS and is available for transfer and commercialization

The workshop constituted a good opportunity to foster the networking among ASEAN Member States and India and promoting technological growth of the nations.

The summit had more than 500 delegates from India and ASEAN region constituting of S&T Advisors, technology companies, start-ups, enterprises, industries, institutions, technology and innovation experts.

7.0 HUMAN RESOURCE

The real asset of any company is its human resource. The total regular manpower of the Corporation as on 31st March, 2020 was 61 viz. (Group A-32, Group B-08, Group C-18 and Group D-3) and 15 contractual engagements (viz 10 technical + 5 Non-technical). The representation of reserved category of regular employees as on 31.3.2020 stood at SCs (31.1 % - (19 employees) ST (Nil % - No employee) OBC (6.5 % - 4 employees), PwD (1.6 % - 1 employees), ESM NIL (No employees) and women representation (19.7 % - 12 employees) and Minority Community (4.9% - 3 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 was given due priority by the Corporation to increase effectiveness. Special emphasis was given to organisation building and shaping right attitudes, team building and work culture besides preparing employees to understand the trends in fast changing technology/switching over to latest technology for achieving higher results in productivity and profitability. Due to financial constraints and paucity of time, during the year only 02 officials of the Corporation were deputed to training programmes on Right to Information Act.

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 is having a "Women Cell" to look after the well-being and welfare of the female employees. The Women Cell is provided with requisite facilities and a drop box has also been put up at the reception to receive the complaints. The Cell also brings out awareness programmes to the notice of all female employees about the sexual harassment at the work place. The Cell also displays posters / drawings to show the type of harassment act at work places. All the circulars pertaining to the welfare / protection of women rights received from the Govt. Departments are brought to the notice of female employees for awareness.

The Women Cell members will look into the grievances of women employees and complaints of sexual harassment received if any. The Corporation has also allotted a common room for the female employees. There is a cordial atmosphere between the 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 Public Sector Undertaking, 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, 2019 to March 31st, 2020, a total of 25 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 01 appeal against the information provided, which too was 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 PIO/FAA.

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 IMPLEMENTATION OF OFFICIAL LANGUAGE

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 2019-20. 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 diglot 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 2019). During the Pakhwara Hindi Essay writing competition was organized & cash awards were given to the winners. Cash Awards were also given to employees under "Rajbhasha Incentive Scheme". Four Work Shops on Use of Hindi in day to day work were organized for making the Hindi work more comfortable. 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 CENTRAL ELECTRONICS LIMITED

2.1 Introduction

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.

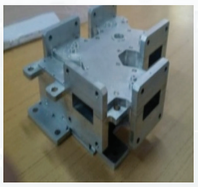
CEL is involved in development of critical products for strategic applications for defense like, Ceramic Radome for Missile radar for Air force, circulators & Isolators for ISRO, body armours, (Bullet proof jackets and Vests), K-33 materials for ISRO, Piezo ceramic array for Sonars, laser fencing systems for border security etc. CEL is also working on failsafe new generation railway signaling and safety systems.

Body Armours



Ceramic RADOM:

X-Band / Ku-Band RF Circulator and Laser Fencing 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. Major Developmental Achievements

Railway Signaling Systems:

Voice over Internet Protocol System has been developed and demonstrated for Indian railways. The system includes the development of IP Based telephony for Railways and VoIP Based Train control. The system provides voice communication between controllers' at HQ and between officers manning the way side stations for train operation and control. This technology serves as an alternate to the existing Communication which uses PD Mux that is getting obsolete.

Voice over Internet Protocol (VoIP) System

Solar Photovoltaics

CEL has earlier developed a solar technology park for demonstration of solar powered energy generation systems for rural and urban applications. A remote monitoring system has been developed and deployed for these system which logs the data of the various solar energy parameters along with the local weather conditions. This provides insight on the power generation patterns at different weather conditions.

Memorandum of Understanding (MoU)s Signed

- MoU signed with Council of Scientific and Industrial Research(CSIR) for collaboration on common research activities of CEL and CSIR laboratories
- MoU signed with Cement Corporation of India(CCI) for solar energy plant under RESCO model
- MoU signed with DMRC for developing various indigenous rail and engineering & system technologies under the "Make in India" initiative

Other Recent Achievements at a Glance

1st Mega Watt level Solar Power Plant installed by CEL for SJVN Ltd. at a height of 4600 ft of Himalaya mountain in Himachal Pradesh.

MOU signing between Sh. B. N. Sarkar, CMD, CEL and Sh. B. V. N. Prasad, CMD of CCIL in presence of officials of both PSUs.

Dr. Shekhar C.Mande, Director General, CSIR and Secretary DSIR launching Divya Nayan (a device for visually impaired) in presence of Shri B. N. Sarkar, CMD, CEL and other dignitaries

Commitments of CEL towards Society

CEL is discharging its' responsibility of Corporate Social Activities in very efficient and control manner. All the funds available for CSR is being used for welfare of the deprived and differently able society people. Over Rs.80 Lakhs spent under Corporate Social responsibility(CSR) in last 3 years. CSR Contribution to PM cares fund Rs.25.58 Lakhs in FY2019-20.

Financial Performances

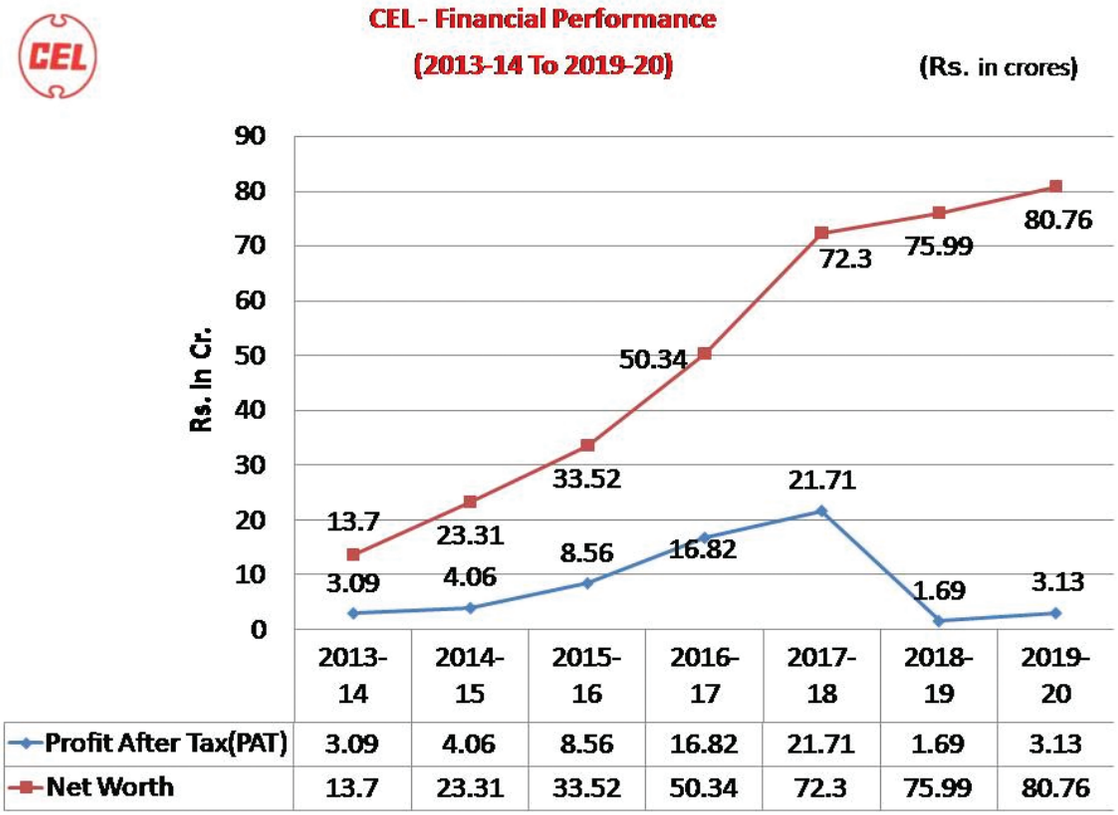
CEL is a profit making enterprise with positive reserves. It is growing at its fastest speed with fined research and by development of new products with future commercial prospects under leadership and specified guidance of CMD Shri B.N.Sarkar. A continuous profit making organization since FY2013-14. Highest ever Networth of Rs.80.76 Cr. as on 31.3.2020 with positive reserves. Debt equity Ratio less than 15% as on 30.09.2020.

A.Turnover and Production Achieved

Divisions	Turnover Rs. In Cr.		Production Rs. In Cr.	
	2019-20	2019-20	2019-20	2018-19
SPV	104.46	130.87	105.66	122.77
SPD	90.97	65.54	96.23	65.45
Defence Business	29.76	32.37	25.66	37.31
SSG	15.91	3.77	15.91	3.77
CCG	4.89	-	5.63	0.43
Total	**246.00**	**232.55**	**249.09**	**229.73**

B. The Company has orders in hand of Over Rs.1000 Cr.

C. The profits and Net worth of the company can be summarized and depicted as below:



ADMINISTRATION AND FINANCE

ADMINISTRATION AND FINANCE

1. ADMINISTRATION

The Department of Scientific & Industrial Research (DSIR) was created in January 1985. The Administrative Division of the Department, comprising of Establishment Section, General Section and Vigilance Unit, looks after activities related to personnel, implementation of the Flexible Complementary Scheme (FCS) promotion mechanism meant for the Scientists (Group 'A'), foreign deputations of officers, vigilance matters, administrative reforms mechanism, work relating to CGHS facilities, staff welfare, coordination etc.

Since both DST & DSIR are situated in same premises, all the events such as Hindi Pakhwada, Vigilance Week, Yoga Day, Constitution Day etc. are celebrated jointly with active cooperation of both Departments.

1.1 Staff Strength

The staff in position in different groups in the Department other than that of Autonomous Bodies viz. Council of Scientific and Industrial Research (CSIR) and Consultancy Development Centre(CDC) and Public Sector Undertakings viz. National Research Development Corporation (NRDC) and Central Electronics Limited (CEL) as on 26th November, 2020 is given below and in **Annexure 12**

	General	SC	ST	OBC	Total
Group 'A' (Gazetted)	26*	04	02	04	36*
Group 'B' (Gazetted)	06	03	00	00	09
Group 'B' (Non-Gazetted)	08	00	02	03	13
Group 'C'	03	07	01	02	13
Total	**43***	**14**	**05**	**09**	**71***

**Excluding one post of JS (Admn.) which is on notional basis.*

1.2 Rajbhasha Section

With a view to ensure compliance of the constitutional and legal provisions regarding Official Language of the Union and to promote the use of Hindi for the official purposes of the Union, Rajbhasha Section has been set up in the Department of Scientific & Industrial Research under the Ministry of Science & Technology. The Rajbhasha Section has been making continuous efforts for accelerating the progressive use of Hindi in transaction of the official business of the Union. During the period under report the Rajbhasha Section has taken following steps to ensure the progressive use of Hindi in the department and in Autonomous Bodies and Public Sector Undertakings under its administrative purview-

- In pursuance of the Section 3(3) of the Official Language Act, 1963 implementation of the provisions of the Act was complied with fully and all the documents, reports, monthly summaries, etc. were issued bilingual.
- 04 Quarterly Progress Reports pertaining to propagation of Hindi and Annual Hindi Assessment Report were made available to the Department of Official Language in time.
- Hindi Pakhwada from 11 to 22 September, 2020 was celebrated in collaboration with the Department of Science and Technology wherein a number of competitions were held and cash prizes along with citations were given away.

2. Finance

The financial summary giving the BE 2020-21, RE 2020-21, AE 2020-21 (up to 12th January 2021) and BE 2021-22 (proposed) for DSIR is given in Table -1.

Table -1

Details of DSIR BE 2020-21, RE 2020-21, BE 2021-22 and AE 2020-21 (upto 12.01.2021)									
Scheme	BE(2020-21) in crore Rs.			RE (2020-21) in crore Rs.	BE (2021-22) in crore Rs.	Actual Releases upto 12.01.2021 in crore Rs.			
	Revenue	Capital	Total (Rev.+Cap.)	Total (Rev.+Cap.)	Total (Rev.+Cap.)	Revenue	Capital	Total (Rev.+Cap.)	% of RE
A. DSIR Excl. CSIR									
1.DSIR(Sectt.)	14.00		14.00	12.00	17.00	9.48		9.48	79
2.DSIR Building		3.50		3.50	20.00		3.50	3.50	100
3. Central Sector Schemes									
(i) Industrial R&D									
PRISM	3.30		3.30	2.00	2.50	1.50		1.50	75
PACE(Grant)	2.20		2.20	1.08	0.85	0.73		0.73	67.6
PACE(LOAN)		4.00	4.00	0.00	1.65		0.00	0.00	0
BIRD	16.50		16.50	8.06	11.00	8.06		8.06	100
A2K+	4.60		4.60	1.36	5.00	1.08		1.08	79.14
Total IR&D	26.60	4.00	30.60	12.50	21.00	11.37		11.37	90.96
(ii) Asst. to PSEs									
NRDC(PIII) [PSU]	6.60		6.60	2.87	6.00	1.87		1.87	65.16
NRDC(PDTC) [PSU]	6.60		6.60	2.42	6.00	1.20		1.20	49.59
(CEL)[PSU]	4.40		4.40	2.29	7.30	2.29		2.29	100
CEL(Equity)	0.00	1.80	1.80	1.80	0.00		1.80	1.80	100
Total Asst. to PSEs	17.60	1.80	19.40	9.38	19.30	5.36	1.80	7.16	76.33
Total Central Sector Schemes	44.20	5.80	50.00	21.88	40.30	16.73		18.53	84.69
4. APCTT(Cont.)	5.00	0.00	5.00	5.58	7.50	4.84		4.84	86.74
5. APCTT(Bldg)	0.00	0.50	0.50	0.50	0.50		0.00	0.00	0
6. CDC	0.00	0.00	0.00	0.00	0.00				
Total DSIR excl. CSIR	63.20	9.80	73.00	43.46	85.30	31.05	0.00	36.35	83.64
B. CSIR	5312.00		5312.00	4208.40	5346.97	3914.06		3914.06	93
Total DSIR incl. CSIR	5375.20	9.80	5385.00	4251.86	5432.27	3945.11		3950.41	92.91

ANNEXURE - 1

STATEMENT ON RECOGNITION (FRESH) OF IN-HOUSE R&D UNITS

Month	Year	Receipts	Cumulative Receipts*	Disposal	Cumulative Disposal
January	2020	24	24	32	32
February	2020	13	37	26	58
March	2020	13	50	10	68
April	2020	13	63	23	91
May	2020	13	76	11	102
June	2020	7	83	16	118
July	2020	36	119	10	128
August	2020	7	126	29	157
September	2020	13	139	16	173
October	2020	15	154	10	183
November	2020	15	169	10	193

*Includes 21 applications for additional R&D centers during the period under report 01.01.2020 - 30.11.2020.

ANNEXURE – 2

STATEMENT ON RENEWAL OF RECOGNITION OF IN-HOUSE R&D UNITS WHO'S RECOGNITION WAS VALID UPTO 31.03.2020

Month	Year	Receipts	Cumulative Receipts	Disposal	Cumulative Disposal
December	2019	58	58	14	14
January	2020	205	263	14	28
February	2020	188	451	4	32
March	2020	57	508	7	39
April	2020	0	508	62	101
May	2020	9	517	70	171
June	2020	15	532	36	207
July	2020	23	555	41	248
August	2020	11	566	28	276
September	2020	4	570	83	359
October	2020	15	585	67	426
November	2020	6	591	27	453
December	2020	5	**596**	53	**506**

Note: A total of 90 applications are under process out of which 24 cases received after October 2020 3rd week are being processed and balance cases are under processing subject to receipt of information.

ANNEXURE – 3

List of Scientific & Industrial Research Organizations (SIROs) recognized by DSIR during the period December 2019 to November 2020.

Sl. No.	Name of the Organization	Recognition granted upto
Natural and Applied Sciences		
1.	Alva's Institute of Engineering & Technology of Alva's Education Foundation, Moodbidri, Dakshina Kannada (Karnataka)	31.03.2022
2.	Bio Valley Incubation Council, Visakhapatnam (Andhra Pradesh)	31.03.2022
3.	Consortium for DEWATS Dissemination Society, Bengaluru (Karnataka)	31.03.2022
4.	Eshwar Trust, Coimbatore (Tamil Nadu)	31.03.2022
5.	Aristotle Educational Society, Chilkur Village, Moinabad Mandal, Ranga Reddy District (Telangana)	31.03.2022
6.	VIT Bhopal University, Kothrikalan, District Sehore (Madhya Pradesh)	31.03.2021
7.	Martin Luther Christian University, Nongrah, Shillong (Meghalaya)	31.03.2022
8.	Ramakrishna Mission Vivekananda Educational & Research Institute (Deemed to be University), Belur Math, District Howrah (West Bengal)	31.03.2022
9.	Sarvasumana Association, Bengaluru (Karnataka)	31.03.2021
10.	Wildlife Conservation Society-India, Bangalore (Karnataka)	31.03.2022
11.	Srinivas University, Mangaluru (Karnataka)	31.03.2022
12.	JAIN (Deemed to be University), Bengaluru (Karnataka)	20.06.2020
13.	Jaypee Institute of Information Technology (Deemed to be University), Noida (Uttar Pradesh)	31.03.2022
14.	The Society of St. Francis Xavier, Palayamkottai, Tirunelveli (Tamil Nadu)	31.03.2022
15.	Pradip and Kumkum Ghosh Family Foundation, Kolkata (West Bengal)	31.03.2022
16.	Brainware University, Kolkata (West Bengal)	31.03.2022
17.	Shivani Educational & Charitable Trust, Dhenkanal (Odisha)	31.03.2022
18.	Centre for Incubation, Innovation, Research and Consultancy, Bengaluru (Karnataka)	31.03.2023
19.	Association for Scientific Pursuits for Innovative Research Enterprises (ASPIRE), Hyderabad (Telangana)	31.03.2023
20.	Chitkara Educational Trust, Chandigarh (Punjab)	31.03.2023
21.	Vignana Jyothi, Hyderabad (Telangana)	31.03.2023
22.	TCG Centres for Research and Education in Science and Technology, Kolkata (West Bengal)	31.03.2022

Sl. No.	Name of the Organization	Recognition granted upto
23.	Vijnan Foundation for Innovation Research in Science and Technology, Udupi (Karnataka)	31.03.2022
24.	Mody University of Science and Technology, Lakshmangarh, District Sikar (Rajasthan)	31.03.2022
25.	Wildlife Research and Conservation Society, Pune (Maharashtra)	31.03.2023
26.	Electronics and Quality Development Centre (EQDC), Gandhinagar (Gujarat)	31.03.2023
Agricultural Sciences		
27.	Centre for Innovation in Science and Social Action (CISSA), Thiruvananthapuram (Kerala)	31.03.2023
28.	Rani Lakshmi Bai Central Agricultural University, Jhansi (Uttar Pradesh)	31.03.2022
Medical Sciences		
29.	Vasantha Lakshmi Charitable Trust and Research Centre, Nellore (Andhra Pradesh)	31.03.2022
30.	Medanta Institute of Education and Research, Gurugram (Haryana)	31.03.2022
31.	Indian Dental Association, Mumbai (Maharashtra)	31.03.2022
32.	Centre for Public Health Kinetics, New Delhi	31.03.2022
33.	Sri Shankara Cancer Foundation, Bangalore (Karnataka)	31.03.2022
34.	SRM Institute of Science and Technology Trust, Chennai (Tamil Nadu)	31.03.2022
35.	Asha Kirana Charitable Trust, Mysore (Karnataka)	31.03.2022
36.	Liver Foundation West Bengal, JCM Centre for Liver Research and Innovations (JCMLRI), Kolkata (West Bengal)	31.03.2022
37.	MGM Institute of Health Sciences (Deemed to be University), Navi Mumbai (Maharashtra)	31.03.2022
38.	Om Drishti Trust, Nagpur (Maharashtra)	31.03.2023
39.	Santosh (Deemed to be University), Ghaziabad (Uttar Pradesh)	31.03.2023

ANNEXURE – 4

LIST OF COMPANIES APPROVED UNDER SECTION 35(2AB) OF INCOME TAX ACT, 1961

S. No.	Company Name
1.	M/s. SMC Corporation (India) Pvt. Ltd.,
2.	M/s. Ceat Specialty Tyres Ltd.,
3.	M/s. Vihita Chem Pvt. Ltd.,
4.	M/s. TRL Krosaki Refractories Ltd.,
5.	M/s. Benzo Chem Industrial Pvt. Ltd.,
6.	M/s. Mahakoshal Refractories Pvt. Ltd.,
7.	M/s. Indfrag Biosciences Pvt. Ltd.,
8.	M/s. Hyva (India) Pvt. Ltd.,
9.	M/s. Asha Cellulose (India) Pvt. Ltd.,
10.	M/s. JNS Instruments Ltd.,
11.	M/s. Siddharth Starch Pvt. Ltd.,
12.	M/s. Ghatge Patil Industries Ltd.,
13.	M/s. Avon Meters Pvt. Ltd.,
14.	M/s. Agriland Biotech Ltd.,
15.	M/s. Schaeffler India Ltd.,
16.	M/s. Mazagon Dock Shipbuilders Ltd.,
17.	M/s. RL Fine Chem Pvt. Ltd.,
18.	M/s. Lasenor India Pvt. Ltd.,
19.	M/s. Srikem Laboratories Pvt. Ltd.,
20.	M/s. Suraj Cropsciences Ltd.,
21.	M/s. CDE Asia Ltd.,
22.	M/s. Asahi India Glass Ltd.,
23.	M/s. Sure Safety (India) Pvt. Ltd.,
24.	M/s. Sensient India Pvt. Ltd.,
25.	M/s. Phyto Life Sciences Pvt. Ltd.,
26.	M/s. Mahima Life Sciences Pvt. Ltd.,
27.	M/s. Val Organics Pvt. Ltd.,
28.	M/s. Finar Ltd.,
29.	M/s. Hindusthan Speciality Chemicals Ltd.,
30.	M/s. Kems Forgings Ltd.,
31.	M/s. General Optics (Asia) Ltd.,
32.	M/s. Ghanta Foods Pvt. Ltd.,

S. No.	Company Name
33.	M/s. Indore Biotech Inputs and Research Pvt. Ltd.,
34.	M/s. Ravi Hybrid Seeds Pvt. Ltd.,
35.	M/s. P2 Power Solutions Pvt. Ltd.,
36.	M/s. Bombay Super Hybrid Seeds Ltd.,
37.	M/s. Daftari Agro Biotech Pvt. Ltd.,
38.	M/s. Lotus Wireless Technologies Pvt. Ltd.,
39.	M/s. QH Talbros Pvt. Ltd,
40.	M/s. Sarv BioLabs Pvt. Ltd,
41.	M/s. Swarnim Farms India Pvt. Ltd.,
42.	M/s. Reliable Autotech Pvt. Ltd.,
43.	M/s. Pune Instrumentation Pvt. Ltd.,
44.	M/s. Prodigy Technovations Pvt. Ltd.,
45.	M/s. Salicylates & Chemicals Pvt. Ltd.,
46.	M/s. Artek Surfin Chemicals Ltd.,
47.	M/s. Baerlocher India Additives Pvt. Ltd.,
48.	M/s. Aartech Solonics Ltd.,
49.	M/s. Celon Laboratories Pvt. Ltd.,
50.	M/s. Kaisha Lifesciences Pvt. Ltd.,
51.	M/s. Eugia Pharma Specialities Ltd.,
52.	M/s. Bhansali Engineering Polymers Ltd.,
53.	M/s. Devtech M2M Ltd.,
54.	M/s. VVD and Sons Pvt. Ltd.,
55.	M/s. Sitaram Ayurveda Pvt. Ltd., (Formerly M/s Sitaram Ayurveda Pharmacy Ltd.,)
56.	M/s. Chem-Verse Consultants (India) Pvt. Ltd.,
57.	M/s. Century Metal Recycling Ltd., New Delhi
58.	M/s. Ecoled Illuminations Pvt. Ltd., Hyderabad
59.	M/s. Skipper Ltd., Kolkata

ANNEXURE – 5

DETAILS OF PROJECTS SUPPORTED UNDER PROMOTING INNOVATIONS IN INDIVIDUALS, START-UPS and MSMEs (PRISM)

[During the year 2020-2021]

Sl. No.	Name of the Project

New Projects supported

1. Development of materials with antimicrobial efficacy for biomedical applications.
2. Design and development of Low-cost Concentrated Photovoltaic Power Plant with Energy Efficient Dry Cooling system and Low-cost Tracking system.
3. A paper based microfluidic chip to detect HR=HPV during cervical cancer screening.
4. Home-made Bending Machine.
5. Automated Tea Leaf Harvester.
6. Affordable Solar Power Baby Warmer.
7. Validation of single device for detection of three most prevalent mosquito born diseases (Marlaria, Chikungunya and dengue).
8. Braille slate for Maths Learning.
9. Cost Effective Precision Aeroponic System.

Ongoing projects supported

1. Affordable Solar Power Baby Warmer.
2. Designing & Building Prototypes of Novel Automatic Energy Monitoring Device with Wirelessly Connected Multiple Mini Units.
3. Development of Linear Switched Reluctance Actuators for Looms.
4. Development of a novel cell therapeutic product for the treatment of Diabetic foot ulcers and other non-healing wounds to prevent amputations.
5. Count Cap: A small mechanized bottle's cap, providing features of direct measuring, controlling & pre-setting of fluid amount which passes through it.
6. Eco-friendly processing of Eri Silk to promote value chain.
7. Design and Fabrication of cost-effective improved biomass cook stove for domestic utility.

ANNEXURE – 6

DETAILS OF COMPLETED PROJECTS SUPPORTED UNDER PROMOTING INNOVATIONS IN INDIVIDUALS, START-UPS and MSMEs (PRISM)

Completed Projects during the year 2020-2021

Sl. No.	Name of the Project

Completed Projects supported

1. IoT Based Affordable Cattle Monitoring System (Working Prototype) for Empowerment of India farmers.
2. Self-propelled three row potato seeding device for restricted holdings.
3. Development of Working Model for Highly Miniaturized process Intensified Distillation Unit.
4. Design and Development of a novel 3D Printed Splints & Arm Supports for Arthritis and Arm Injured Patients.
5. Development of Peripheral Blood Smear Instrument.
6. Flexi Datun.

ANNEXURE – 7

Cumulative List of TDDP/ PATSER Projects Commecialized so far

S. No.	Company	Project title
1	Abilities India Pistons & Ring Limited, New Delhi	Development of Small Size Pistons for Two Stroke Engines by High Pressure Die Casting Process
2	ACE Designers Pvt. Ltd., Bengaluru	PC Based CNC System
3	Aesthetic Technologies Pvt. Ltd., Kolkata	Dev. of an Interactive Multimedia Package for Intellectual Property Rights Training
4	Aishwaraya Telecom Pvt. Ltd., Hyderabad	Design & Development of Optical Power Meter (Type A & B) and Optical Talk Set
5	Aishwaraya Telecom Pvt. Ltd., Hyderabad	Hand Held Optical Test Equipments (Optical Power Meter, Optical Light Source 1310/1550NM, and Fiber Identifier)
6	Andrew Yule & Co. Ltd., Kolkata	Dev. of Rough Top Conveyor Belting
7	Anu's Lab Ltd., Hyderabad	Development of process for manufacture of 1-Bromo-3-chloropropane (B.C.P.) and 1-3-dibromo Propane (D.B.P.) in pilot plant
8	Arch Pharmalabs Ltd., Mumbai	Scale up Studies for Polymorphic Form-I of ClopidogrelBisulphate Process
9	Ardee Technologies Pvt. Ltd. (Formerly Ardee Business Services Pvt. Ltd.), Vishakhapattanam	Dev. of a Mobile, Four Channel Modular, RAMDARS System for Dry Beneficiation of Coal.
10	Ardee Technologies Pvt. Ltd. (Formerly Ardee Business Services Pvt. Ltd.), Vishakhapattanam	Development of Higher Dimension Aluminum Granules Coded Wire along with Complete High speed Wire Feeder
11	Ardee Technologies Pvt. Ltd. (Formerly Ardee Business Services Pvt. Ltd.), Vishakhapattanam	Manufacture of Magnesium & Calcium Metal Power
12	Aron Universal Limited, Bengaluru	Bench and pilot Scale process Development for UV Reflective Security Inks and Pigments (UVRIP)
13	ATCOM Technologies Ltd., Mumbai	Dev. of Microbalance of 200 gm. Capacity with 1 mg. Accuracy
14	Bel Optronic Devices Ltd., Pune	Development of High Sensitivity Photo Cathode for 18mm SUPERGEN Image Intensifier Tubes

S. No.	Company	Project title
15	Bharat Earth Movers Ltd. (BEML), Bengaluru	Dev. of Crankshaft for Engines by Casting and machining process
16	Bharat Earth Movers Ltd. (BEML), Bengaluru	Upgradation of 50 T Dumper 200 HP Front end loader
17	Biocon Ltd., Bengaluru	Glargine Process Improvement
18	Celestial Labs Ltd., Hyderabad	Development of Toxicity Prediction Module and Integration with CELSUITE - A Computer Aided Drug Design Tool
19	Central Electronics Ltd., Sahibabad	Digital Axle Counter for Railway Signaling
20	Delta Agro Chemicals Ltd., Krishna	Dev.of process for manufacture of Furfural Alcohol by Hydrogenation of Furfural
21	Dolphin Industrial Co-operative Society Ltd., Vizianajaram	Glazing of terra-cotta Clay Products
22	Eddy Current Controls Ltd., Kerala	Development of 90KW Brushless Eddy Current Clutch Gear Unit for Radiator Cooling fans in diesel electric locomotives of the Indian Railways.
23	ELICO Ltd., Hyderabad	Development of Indigenous development of FT-IR Spectrophotometer
24	Elkay Chemicals Limited, Pune	Development of Next Generation Amino Silicone based on Hydrosilation Technology
25	Encon Thermal Engineers (P) Ltd., Faridabad	Dev. of Technology for Design and Manufacture of Improved Industrial Natural Gas Burners
26	Enercon Systems Pvt. Ltd., Bengaluru	Development of Centralised Electrical Energy Management System
27	Engineers India Ltd. (EIL) , New Delhi	Development of Membrane Technology for Natural Gas Separation
28	Genus Power Infrastructure Ltd., Jaipur	Smart Closed Loop Energy Management Solution
29	Gland Pharma Ltd., Hyderabad	Hyaluronic Acid and Formulation
30	Goldstone Teleservices Limited, Secundrabad	Designing and developing the technology for manufacturing of EHV Composite Insulator for application in 132KV,22KV & 400KV electric power T&D line.
31	Gujarat Mineral and Dev. Corporation	Dev. of Column Flotation Technology
32	Gujarat NarmadaValley Fertilizers Co.Ltd., Bharuch	Dev.and Demo. of Liquid Phase Oxidation Process for Hydrogen Sulfide Removal

S. No.	Company	Project title
33	Haryana Leather Chemicals Ltd., Haryana	Technology Development and Demonstration for application of Cross Linkables Aqueous Aliphatic Polyurethane Dispersions for Leather and Shoe Finishing
34	Haryana Leather Chemicals Ltd., Jind	Development of technology for polymeric fatliquors for upholstry leather
35	HERO Cycles Ltd., Ludhiana	Design,Development,Installation and Commissioning of 6-Hi Cold Rolling Mill
36	Hexagon Product Development Pvt. Ltd.,Vadodara	Development of Prototype of 3-dimensional Mixer
37	Hindustan Zinc Ltd., Udaipur	Extraction of Cobalt to Extract Copper Sulphate
38	Hi-Tech Robotic Systemz Ltd., Bhiwadi	Smarter Material Handling Automated Guided Vehicles (AGVs)
39	IBP Co. Ltd., Gurgaon	Detonationg Cord for Shaped Charges
40	Innovation Communications Systems Ltd., Hyderabad	Development of Interactive Voice Response System With Multilingual Capability
41	Insecticides (India) Limited, Bhiwadi	A new approach to sythesis of an import substitute 3-methyl-N-nitroimino perhydro-1,3,5-oxadiazine (MNIO), an intermediate for the manufacture of Thiamethozam.
42	Intas Pharmaceuticals Ltd., Ahmedabad	Development of Endoxifen as a new efficacious and safe therapeutic agent for the treatment of breast cancer
43	JSL Industries Ltd., Anand	Dev. of Air Circuit Breaker
44	Klas Technology Ventures Ltd., Bengaluru	Research & Development of Aluminium Cylinders for Liquified Gases for Domestic, Automotive Applications
45	Lifecare Innovations Pvt. Ltd., New Delhi	Liposomal Amphotericin-B
46	Litex Electricals Ltd., Pune	Laser Pumping Lamps
47	The Maharashtra State Seeds Corporation Ltd., Mumbai	Design, Development and Fabrication of Mini Dry Gas Cotton Seed Delinting Plant (0.5 TPH Capacity)
48	Maini Materials Movement Pvt. Ltd., Bengaluru	Development of In-plant Material Handling Equipments
49	MECPRO Heavy Engineering Ltd., New Delhi	Demonstration of on Efficient Solvent Extraction Plant & Technology with the Vent Air Cracking system

S. No.	Company	Project title
50	MECPRO Heavy Engineering Ltd., New Delhi	Development and Demonstration of Eco-friendly and Efficient Edible Oil Refining technology of Twin Bleaching system and Deacidification-cum-Deodorization System
51	MIC Electronics Ltd., Hyderabad	Development of Fraud Management and Control Centre (FMCC)
52	Minda Industries Ltd., Delhi	Development of Auto Electrical Switches using Rapid Prototyping Facility of I.I.Sc.
53	Minda Industries Ltd., Delhi	Innovative electronic control system for PNG (Pipeline Natural Gas) Fueled Stationary Engine.
54	Mishra Dhatu Nigam Ltd., Hyderabad	Development of Technology for Welding Molybdenum Coils to make coils in single coil weight of 20 kgs.
55	Mishra Dhatu Nigam Ltd., Hyderabad	Development of Technology for producing Wires With Superior Surface Finish employing Wet Drawing Technique
56	NALCO, Bhuvneshwar	Dev. of Technology at Pilot Scale Production of Special Grade Alumina
57	Natco Pharma Ltd., Hyderabad	Dev. of Anaerobic Reactor System for Pharmaceutical waste at pilot plant level
58	NED Energy Ltd., Bangaluru	Development of High Energy Density Valve Regulated Lead Acid Batteries
59	Neuland Laboratories Ltd., Hyderabad	Innovative process development for the manufacture of peptide APIs
60	Nirmal Seeds Pvt. Ltd., Jalgaon	Development of novel Biopesticides from antagonistic microbes Bacillus subtilis and Trichodermaviride using Dextrose as a Carrier
61	Ogene system India P. Ltd., Hyderabad	Nano Labelled DNA/RNA compounds
62	Organic Coatings Ltd., Mumbai	Development of (I) Water-based flexo inks used for alsorgent stock (craft paper) and Coated Stock (aat paper) (ii) U.V. radiation cuving inks used for coated stock and non-alsarlentsufistrates such as PVC Polyster etc.
63	Oriental Engg. Works Pvt. Ltd., Yamunanagar	Solid Handling Fluid Transfer Pump
64	Pan India Electromech Pvt. Ltd., Gurgaon	Development and Demonstration of Complete Automated Solution for Hydrography

S. No.	Company	Project title
65	Pennwalt Ltd., Mumbai	Development of Tech. for coating of Chemical process equmt. with fluoropolymers and other high performance polymeric products.
66	Poona Health Services Ltd., Pune	Development of Implants for Knee Joints
67	Praj Industries Ltd., Pune	Development of Energy Efficient Pilot Ring Dryer
68	Pricol Limited, Coimbatore	Design and Development of Capacitance Type Fuel Level Sensor for Flexi Fuels
69	Priya Klay Pvt. Ltd., New Delhi	Development of Technology, Equipment and related "Product(s)" for Production of Stone Ware/ Vitrified Clay Pipes and other Pipes of other materials, made/produced as a result of this Project having large Diameters of 600 mm to 1000 mm and above and lenght
70	Punjab Chemicals & Pharmaceuticals Ltd., Delhi	Development of process for the manufacture of Ethyl 2(2-aminothiazol-4-yl)-2- methoxyiminoacetate and 2-formylamino-4-thiazole acetic acid ethyl ester in pilot plant
71	Pure Tech India, Trichy	Liquid Coolant Recovery Systems
72	Radiant Cables Pvt. Ltd., Hyderabad	Development of (a) Low loss RF cables for higher frequency above 10GHZ,(b) Data Bus cable with fire survival, low capacitance dielectric properties and © Laser marked loom assemblies.
73	Rajasthan Electronics & Instruments Limited	Development of small PV-Wind Hybrid power plant for rural application
74	Rishabh Instruments Pvt. Ltd., Mumbai	Design, development & manufacture of (i.) 5 3/4 digit multimeter & (ii) 6 3/4 digit multimeters
75	Rishang Keishing Foundation for Management of Tribal Areas, New Delhi	Ginger Oil
76	Sai Life Sciences Limited (formerly Sai Advantium Pharma Limited), Hyderabad	Manufacture of Corey's Lactone and Prostanoids: Iloprost, Lubiprostone and Travoprost
77	Sami Labs Limited, Bengaluru	Development and Pilot Plant Trials Towards Commercilisation of two Products, namely (I) A pentapeptide with a Natural Triterpenoid Conjugate (ii) Extraction of Pterostilbebe from PterocarpusMarsupium & Conversion to Resveratrol

S. No.	Company	Project title
78	Sami Labs Limited, Bengaluru	Optimizatin and Pilot Plant Trials Towards Commercilisation of standardized Colcynthin extract from the medicinal plant "Citrulluscolocynthin"
79	Sapala Organics Private Ltd., Hyderabad	Development of indigenous technology of materials for nano photofunctional applications
80	Select Packaging Machines Ltd., Thane	Special Blister Packaging Machines/Form Fill-seal Machine
81	Sequent Scientific Ltd., Thane	Development of Nitroscanate
82	Sequent Scientific Ltd., Thane	Development of Dorzolamide HCI
83	SM Telesys Ltd (SMTL), Noida	Dev. of Two Line Indian Language Multilingual Pager (ILP)
84	Solaris Chemtech Ltd. (formerly BILT Chemicals), Mumbai	Dev.and demo. of Technology for the manu. of Tetra Bromo Bisphenol-A (TBBA) on a pilot plant level
85	Som Shiva (Impex) Ltd., Ahmedabad	New Process Development for Special Elastomer compound
86	Sonodyne Technologies Pvt. Ltd., Kolkata	DSP Based High-end professional Audio Speakers
87	Steel Strips Wheel Ltd., Chandigarh	Technology Development and Demonstration of Improved Manufacturing Process for Automotive Wheel Discs
88	Sundaram Clayton Limited, Chennai	Development of Magnesium alloy pressure die castings for automotive applications
89	T. Stanes & Company Ltd., Coimbatore	Establishing and Producing bio Control Agents on Pilot Plant Scale
90	T. Stanes and Company Limited, Coimbatore	Development of Biofertilizers (Emulsifiable concentrate) for Nutrient Management of Agricultural Crops
91	T. Stanes and Company Ltd., Coimbatore	Dev. of technology for manufacture of Digested Organic Supplement (DOrS)
92	Tejas Networks Limited, Bengaluru	Development of LTD Macro eNodeB Base Stations
93	Transasia Bio-Medicals Ltd., Mumbai	Fully automated high speed blood chemistry analyser for through put of around 1000 tests/hour
94	Tropilite Foods Pvt. Ltd., Gwalior	Upscaling and commercial production of Lactic Acid Bacteria Starter culture for Yogurt/Curd production

S. No.	Company	Project title
95	Uday Computer Aided Manufacturing (P) Ltd, Bengaluru	Develop and demonstrate the Large Size CNC Rotary Table 2500 x 2500 with Translation Movement – Model URH – SQ 2500 – X Cance
96	Uniproducts (India) Ltd.	Development of UNI-Density Insulator for Vehicles
97	United Telecom Ltd., Bengaluru	Asymetric Digital Subscriber Line (ADSL) System
98	United Telecom Ltd., Bengaluru	Development of AAM (ATM Access Multiplexer)
99	VINS Biproducts Ltd., Hyderabad	Purification of Gas Gangrene Causing Clostridium Toxins and Development of Monovalent and Polyvalent Antitoxins
100	Zen Technologies Ltd., Hyderabad	Design and Development of 6 DoF Electrical Motion Platform
101	Zen Technologies Ltd., Hyderabad	Interactive Small Arms Training Simulator (ISAT)
102	Zim Laboratories Ltd., Nagpur	Development and demonstration of technology to manufacture a new dosage form namely – Oral Thin Films

ANNEXURE – 8

LIST OF APCTT'S PARTNER INSTITUTIONS

- Anand and Anand, Intellectual Property Law Firm, India
- Asian Institute of Technology, Thailand
- Asia- Pacific Economic Cooperation
- Asia-Pacific Industrial Property Center, Japan Institute for Promoting Invention and Innovation
- Asia Public-Private Partnership Institute, Toyo University, Japan
- Association of South East Asian Nations
- Council of Scientific and Industrial Research, Government of India
- Department of Cottage and Small Industry, Ministry of Economic Affairs, Government of Bhutan
- Green Climate Fund, Republic of Korea
- Guangzhou University, People's Republic of China
- Indonesian Institute of Science, Indonesia
- Institute for Global Environmental Strategies, Japan
- Korea Enterprise Innovation Promotion Institute, Republic of Korea
- Korea Advanced Institute of Science and Technology, Republic of Korea
- Ministry of Higher Education, Science, Research and Innovation, Thailand
- Ministry of Innovative Development, Republic of Uzbekistan
- Ministry of Science and Technology, People's Republic of China
- Private Financing Advisory Network, Thailand
- Thailand Institute of Scientific and Technological Research, Thailand
- UNITEN R&D Sdn. Bhd, Malaysia
- World Economic Forum
- World Resources Institute, India

United Nations agencies

- Energy Division, ESCAP
- Environment and Development Division, ESCAP
- Trade Investment and Innovation Division, ESCAP
- United Nations Educational, Scientific and Cultural Organization, Regional Science Bureau for Asia and the Pacific, Jakarta, Indonesia
- World Intellectual Property Organization, Geneva, Switzerland

LIST OF PUBLICATIONS BY APCTT

Publication title	Focus area	Periodicity	Target audience
Asia-Pacific Tech Monitor	Promotion of technology-based start-ups in the Asia-Pacific – Policies and strategies (Oct-Dec 2019)	Quarterly	Science technology and innovation policymakers, small and medium enterprises, research and development institutions, academia, technology transfer intermediaries
	Science Technology and Innovation for a Sustainable Ocean Economy – Strategy, opportunities and partnerships in the Asia-Pacific (Jan-Mar 2020) in support to the theme of the 76th ESCAP Commission Session held in May 2020	Quarterly	Science technology and innovation policymakers, small and medium enterprises, research and development institutions, academia, technology transfer intermediaries
	Intellectual Property Management – Innovative strategy for technology transfer and commercialization (Apr-Jun 2020)	Quarterly	Science technology and innovation policymakers, small and medium enterprises, research and development institutions, academia, technology transfer intermediaries
	Technological innovations to control COVID-19 pandemic – Opportunities, strategy and best practices for the Asia Pacific (July- Sep 2020) (In press)	Quarterly	Science technology and innovation policymakers, small and medium enterprises, research and development institutions, academia, technology transfer intermediaries

Publication title	Focus area	Periodicity	Target audience
Publication on Intellectual Property Management and Technology Licensing	Intellectual property management and technology licensing (In press)	One-time publication	Science technology and innovation policymakers, small and medium enterprises, research and development institutions, academia, technology transfer intermediaries
Publication on Innovation and Technology Transfer for Clean Energy in Asia and the Pacific	Innovation and technology transfer for clean energy (Under development)	One-time publication	Science technology and innovation policymakers, small and medium enterprises, research and development institutions, academia, technology transfer intermediaries

CSIR Establishments

BIOLOGICAL SCIENCE

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 Bioresource 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-NISCAIR	National Institute of Science Communication and Information Resources, New Delhi
CSIR-NISTADS	National Institute of Science Technology and Development Studies, New Delhi
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

ANNEXURE – 11

Entrepreneurship Development Programmes during 2019-20 in North East and Rural Areas.

Sr. No.	Name of Organisation	EDP
1.	Centre for Research and Industrial Staff Performance, Bhopal	Garment making with computer aided design Venue: Bhopal, MP
2.	Women Child care Mission, Imphal, Manipur	Promotion of medicinal plants Venue: Imphal East Dist
3.	Shri Vishwajyotii Educational Society, Tekkadi, Sri kakulam Dist Andhra Pradesh (AP)	Skill india through EDP Venue: Bimli, Srikakulam Dist.
4.	RELF, Mita Tarafdar, Jamshedpur, Jharkhand	Skill training on ulitlization of paper waste for rural entrepreneurship development Venue: Jamshedpur
5.	J&K Industrial & Technical Consultancy Organisation Ltld., Jammu	Cultivation of Aromatic/medicinal plants and processing through distillation. Venue: Jammu
6.	Dr. Uengkhom Disco Singh, College of Horticulture and Forestry, Central Agricultural University, Pasighat, Aru Pradesh	Intervention of Post Harvest Technologies on Horticultural Produce Venue: CAU, Imphal, Manipur
7.	Centre for Indian Bamboo Resource and Technology (CIBART), New Delhi	Bamboo handicraft training of tribal community in Vishunapur, Baharaich, UP Venue: Bahairaich
8.	Rajmata Vijayaraje Scindia Vishwavidalaya, Fruit Research Centre, Bhopal	EDP of Fruit and Vegetable processing Venue: Bhopal
9.	Anna University, Regional Campus, Coimbatore, TN	EDP on Apiculture Training Venue: Kalakoti, tribal village, TN
10.	Vasantha Lakshmi Charitable Trust and Research Centre (VLCT&RC), Nellore, AP	EDP on Coir Products from Tender Coconut Husk. (women empowerment from Waste to Wealth) Venue:Nellore
11.	Induction Educational and Welfare Society, Jaipur	Upgradation of Zari Handicraft through science and technology intervention (design and technical development) among rural woman of sanganer, Jaipur Venue: Sanganer, Jaipur, Raj.

Sr. No.	Name of Organisation	EDP
12.	Social Economic & Versatile Welfare Association, U.P	EDP on fruit preservation through manufacturing of fruit crush without any chemical pr eservative in outskirts of Ghaziabad, Venue: Ghaziabad, UP
13.	People in Need Foundation, Nagaland	EDP on bamboo and cane products Nagaland
14.	Annapurna Sewabhavi Santha, Satara	EDP on milk processing technique Maharashtra, Venue: 5 village of Karad, MS
15.	Centre for sustainable rural development and research centre, Vellore Tamil Nadu	EDP on Appropriate technologies on agro food, Vellore Tamil Nadu Venue: VIT, Vellore TN
16.	Technical Training Institute, Bahanaga, Balasore, Odisha	Upgradation of Traditional Skills by way of conducting EDP and enhancing their earning & livelihood. Venue: TTI, Balasore, Orissa
17.	Bahara Sidapaa Adibasi Mahila Samiti, W.B.	Business livelihood promotion with advanced skills to youth tribal women at W.B (NER), Venue: Ranibagh, Bankura, WB
18.	Harshal Gramin Vikas Bahu. Sanstha, Chandrapur Maharashtra	EDP on Innovative technologies Maharashtra, Venue:Chandrapur, MS
19.	Somling farm vikas mandal, Solapur Maharashtra	EDp on carpet production training, Solapur Maharashtra, Venue: Solapur, MS

ANNEXURE – 12

REPRESENTATION OF SCs, STs AND OBCs

AS ON 26th November, 2020

Groups	Number of Employees (As on 26-11-2020)					Number of appointments made during the Calendar year										
						By Direct Recruitment				By Promotion			By other Methods			
	Gen.	SCs	STs	OBCs	Total	SCs	STs	OBCs	Total	SCs	STs	Total	SCs	STs	OBCs	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Group A	26*	4	2	4	36*	-	-	-	-	-	-	-	-	-	-	-
Group B	14	3	2	3	22	-	-	-	-	-	-	-	-	-	-	-
Group C	3	7	1	2	13	-	-	-	-	-	-	-	-	-	-	-
Total	43*	14	5	9	71*	-	-	-	-	-	-	-	-	-	-	-

Note: 1. DSIR recruits only Scientific and Technical posts.

2. *Excluding one post of JS (Admn.) which is on notional basis.

REPRESENTATIONS OF THE PERSONS WITH DISABILITIES

AS ON 26th November, 2020

Group	Number of Employees				Direct Recruitment							Promotion						
					No. of Vacancies reserved				No. of Appointments Made			No. of Vacancies reserved			No. of Appointments Made			
	Total	VH	HH	OH	VH	HH	OH	Total	VH	HH	OH	VH	HH	OH	Total	VH	HH	OH
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Group A	36*	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Group B	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Group C	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	71*	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*Excluding one post of JS (Admn.) which is on notional basis.

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
GST	Good and Services Tax
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