I. 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. Shri Vilasrao Deshkukh assumed as Union Minister for Science & Technology and Earth Sciences on 12th July 2011. Prior to that Shri Pawan Kumar Bansal was holding the charge as Union Minister for Science & Technology. Dr. Ashwani Kumar assumed the charge of Minister of State for Science & Technology on 19th January 2011.

The Allocation of Business for the Department is as follows:

- All matters concerning the Council of Scientific and Industrial Research.
- All matters relating to National Research Development Corporation.
- All matters relating to Central Electronics Limited.
- 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 undertakings 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 Asian and Pacific Centre for Transfer of Technology (APCTT) as the focal point in the country.

2. TECHNOLOGY PROMOTION, DEVELOPMENT AND UTILIZATION SCHEME

The Technology Promotion, Development and Utilization (TPDU) Scheme is aimed at promoting technology development and industrial research in the country and encouraging its utilization by various sections of economy including industry, academic/research/scientific institutions and the society at large. The components of the TPDU programme are:

- Industrial R&D Promotion Programme (IRDPP)
- Technology Development and Demonstration Programme (TDDP)

- Technopreneur Promotion Programme (TePP)
- Technology Development Utilization Programme for Women (TDUPW)
- Technology Development and Demonstration Programme (TDDP)
- Technopreneur Promotion Programme (TePP)

2.1 Industrial R&D Promotion Programme

DSIR is the nodal Department for granting recognition to in-house Research and Development centres of industry. As on 31st December, 2011, there were 1618 in-house R&D centres with DSIR recognition. Of these centres, 181 incurred an annual expenditure of over 5 crores each and 330 incurred an annual expenditure in the range of 1 crore to 5 crores.

During the period under report, 323 in-house R&D centres were accorded fresh recognition and recognition of 323 centres was renewed.

Scientific research foundations in the areas of medicine; 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 registered SIROs are eligible for availing customs duty exemption on imports and central excise duty exemption on indigenous purchase of essential scientific and technical instruments, apparatus, equipment (including computers), accessories, spare parts thereof and consumables, required for R&D activities. During the period under report, 40 SIROs have been accorded fresh recognition.

DSIR is the nodal Department for registration of public funded research institutions (PFRI), universities, IITs, IISc and NITs, for availing customs duty exemption and central excise duty exemptions under notifications 51/96-Customs and 10/97-Central Excise. During the period under report, 23 such institutions were newly registered with DSIR; and 222 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 151 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 108 reports valued at 3707 crores have been forwarded to DGIT (E) in Form 3CL, as required under the IT Act.

Secretary, DSIR, 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 the provisions of rule 5(2) of IT Rules. During the period under report, certificates were issued to three companies by DSIR.

Certificate for claiming excise duty exemption under the notification No. 13/99-CE dated 28th February, 1999 was issued to M/s Delta Electrical Industries, Kolkata for LED night/ decorative and indicator lamps for patent on "A replaceable LED system".

2.2 Technology Development and Demonstration Programme (TDDP)

The Technology Development and Demonstration Programme aims at catalyzing and supporting activities relating to technology absorption, adaptation and demonstration including capital goods development, involving industry and R&D organizations. Under the programme, research, development, design and engineering projects for absorption and up-gradation of imported technology, as well as development and demonstration of new and improved technologies are supported. While the DSIR support is catalytic and partial, the bulk of the financial contribution in any project is from the industry.

The Department, under this programme, has so far supported about 260 R&D projects from industrial units. These projects cover products and processes in various important industries such as metallurgy, electrical, electronics, instrumentation, mechanical

engineering, earth-moving and industrial machinery, chemicals and explosives and other Around 54 technologies developed under the programme have been commercialized or are under commercialization. During the period under report, more than 75 new proposals received against open advertisements in leading daily newspapers. Total 30 proposals were recommended through four Technical Advisory Committee (TAC) meetings in the field of engineering, manufacturing, electronics, drugs, chemicals & fertilizers, etc. were awarded to different companies with total project cost of 198.00 crores.

Technology development projects have strengthened industry-institute linkages with more than 25 national research laboratories/ institutions such as NAL, Bengaluru; NIIST, Thiruvananthapuram; IICT, Hyderabad; CIMFR, Dhanbad; IIP, Dehradun; C-DAC, Pune; Institute of Plasma Research, Ahmedabad; ER&DC, Thiruvanantha-puram; Dalmia Centre for Biotechnology, Coimbatore and CMTI, Bengaluru. These have been collaborating with industry in the specific research, design, development and engineering (RDDE) projects having high techno-socio-commercial impact. The programme has hence been successful in synergizing the R&D efforts of industry and national research organizations.

2.3 Technopreneur Promotion Programme (TePP)

The Technopreneur Promotion Programme (TePP) is India's largest network program supporting independent innovators and start-up firms. The network spread out with 34 outreach centres and 100 innovation managers provides grants, pre-seed funds, technical guidance, incubation facilities and assistance to get a sound business plan. The support is provided in two distinct phases - innovation incubation in first phase where maximum support is 15.00 lakh and towards enterprise incubation in second phase where the cap is 45.00 lakh. Since the time of inception, 526 innovations of independent innovators have been supported. Out of these, 430 were supported by DSIR (rest by TIFAC). Some of the successfully completed TePP projects during the year are D-Red motor bicycle, Development of Slide Rule(Ready Reckoner) for decentralized textile sector (Hand looms and power looms), Real time flight data analyzer, Versatile internet communication equipment(VICE), Electric Steering Car, An intuitive programmable electronic kit for edutainment(Bi-box), Development of herbal skin nourishing gel, Manual Compressor, Bio-Razor – semi-automatic Blood Chemistry Analyzer, Medical Surfactants, Active Bio-conjugates – 2-0-alpha pyranosyl-L-ascorbic acid, AnaeMedia Prick free haemoglobin measuring device, Design and development of Pain relieving instrument for Musculoskeletal Pain, Development of first Indian Re-engineered stabilizer for beating heart surgery, Control release crop fertilizer with additives, Development of indigenous micro-carriers for large cell culture, Green technology removal of heavy metals from industrial effluents by efficient biological waste, Alkali lignin products & cooler pads from Dry Pine Needles(TePP Phase-II), Testing of Pollution Control Devices(Dry Scrubber), Modified Chess Game, Development of a fuel flexible multi-draft Thermal Biomass gasifier, Water tank auto shut off alarm (WATASA), Jewellery from indigenous natural fibre of Assam, Multi-crop portable circular oil expeller, Design and development of a holographic pulse portrait camera system, Control release crop fertilizer with additives, Design and developemtn of a DNA fingerprint based photopolymer hologram reader/writer for Personnel Identification and Security, Process optimization and production of novel probiotic consortium(Synshrimp) for eco-friendly shrimp farming, Optimization of production technology for the commercialization of Shrimpactiva(Algal Bioactive) for proactive Shrimp disease management, Quick(1 hr) treatment of dyeing industries effluent and recycling treated waste water for dye house again and so on. The department has supported 56 new projects during the period January 2011 to December 2011.

2.4 Technology Development Utilization Programme for Women

A Technology Development and Utilization Programme for Women (TDUPW) was continued

during the year. The programme is aimed to meet specific needs of women and to enhance their contribution towards technology capability building. 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.
- Promoting technological upgradation of tiny, small and medium enterprises run by women entrepreneur.
- Showcasing of appropriate technologies and organizing demonstration programmes for the benefit of women.
- Design and development of products, processes beneficial to women.

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

Matters pertaining to the APCTT under UN-ESCAP are dealt with the cooperation of the Ministry of Commerce and Industry and the Ministry of External Affairs, DSIR also plays an active role in APCTT's functioning, particularly relating to its programmes and policies.

India, being the host country for APCTT, has been providing institutional support. During the period under report, institutional support of US$ 200,000 in Indian Rupees was provided to APCTT for meeting local costs. In addition, funding for building repairs, renovation work, and municipal taxes was also provided. DSIR has extended programme support towards the APCTT project entitled, "Promotion of National Innovation Systems (NIS) in Countries of the Asia-Pacific Region – Phase II". Among other government support received by APCTT, the Ministry of New and Renewable Energy Sources has funded another APCTT project entitled, "Establishing an Institutional Cooperation Mechanism to Promote Renewable Energy" in Asia and the Pacific.

The revised Statute of the APCTT, adopted by the Commission at its Sixty-first session in May 2005, through its resolution 61/4, stipulates, among other things, that the Centre shall have a Technical Committee consisting of experts from members and associate members of ESCAP and from inter-governmental and non-governmental organizations. Members of the Technical Committee shall be appointed by the Head of APCTT in consultation with the Executive Secretary of ESCAP. The Technical Committee shall be responsible for advising on the formulation of the programme of work and on technical matters concerning the operations of APCTT. The 7th technical committee of APCTT held at China during the year was attended by departmental representative. The Centre shall have a Governing Council consisting of a representative designated by the Government of India and no fewer than eight representatives nominated by other members and associate members of ESCAP elected by the Commission. The members and associate members elected by the Commission shall be elected for a period of three years but shall be eligible for re-election. The members of APCTT's Governing Council for the period 2011 – 2014 are Bangladesh, China, Fiji, India, Indonesia, Islamic Republic of Iran, Malaysia, Nepal, Pakistan, Philippines, Samoa, Sri Lanka, Thailand, and Viet Nam. The 7th governing council of APCTT held at Bangkok during the year was attended by departmental representative who was elected as the co-chairman of the governing council.

Co-ordination with other UN Organisations

The DSIR also maintains effective and cooperation with other various international organizations such as UNCTAD, WIPO, UNIDO, UNESCAP and UNESCO at different levels and in association with other concerned Ministries on various issues related to Technology development and technology transfer.

4. INFORMATION TECHNOLOGY AND E-GOVERNANCE

IT-eG division implements e-Governance in the Department progressively that need be in conformance to the National eGovernance Action Plan. IT-eG Division operates on a separate IT Budget Head that came into effect in DSIR since FY 2004-05 for the implementation of an IT Action Plan.

Various applications like IntraDSIR, Instant Messaging System, ExtraDSIR, Public Grievance Redress and Monitoring System, and Central Plan Scheme Monitoring System (CPSMS) remain operational during the period under report.

The Departmental Website at http://www.dsir.gov.in is regularly updated. 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://dsir.gov.in/rti/rti-dsir.htm.

Integrated Finance, DDO and Utilization Software (IFDUS) has been developed for DSIR and made fully operational. The bills for Salary, Contingency, TA/DA and LTC Advance and Other Advances are prepared and processed. The system is also put under an effective AMC.

A Composite Pay Roll System, developed in-house, has been used in the department for preparation of bills for Salary, all advances, arrears and allowances. The same system is used for calculation of Income Tax and Preparation of Form 16 and e-TDS (quarterly and annually). The system also has an interface for sending transactions to the Bank.

A project entitled 'Design, Development, Implementation of Enterprise Application and Maintenance Support Services for DSIR' is ongoing. The project has two RFPs, ie. RFP1 includes Enterprise Integration, Program Implementation and eService Delivery and RFP2 includes Office Automation Solution, Workflow Management, Record Management, and Data Warehousing.

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 and available on the DSIR Website at *http://dsir.gov.in/rti/rti-dsir.htm* DSIR has complied with the directives received from Central Information Commission.

DSIR has received 60 Applications during Jan-Dec 2011 and all the Applications were registered and disposed off on RTI Request & Appeal Management Information System, http://164.100.42.72/rrmis/.

DSIR has been effectively using various IT applications like RTI-MIS Updation System at *http://164.100.42.72/rtiupd/*, RTI Request & Appeal Management Information System at *http://164.100.42.72/rrmis/* and RTI Annual Return Information System at *http://rtiar.nic.in* . The quarterly returns were uploaded on RTI Annual Return Information System at *http://rtiar.nic.in* .

6. AUTONOMOUS INSTITUTIONS

6.1 Council of Scientific and Industrial Research (CSIR)

Council of Scientific & Industrial Research (CSIR) is the largest and most diverse S&T institution in the country, with a key mission "To provide scientific and industrial R&D that maximises the economic, environmental and societal benefits for the people of India".

CSIR through its network of 37 national laboratories and 39 extension centres, has pan India presence. In the country, CSIR has laid foundation for indigenous R&D in general and for industrial R&D in particular. The constituents of CSIR are pursuing well focused basic and applied research in diverse areas. Its concerted efforts and contributions for making the country self sufficient in some key sectors are noteworthy. As a socially conscious organization, CSIR is providing S&T solutions to many nagging problems being faced by the people at the base of the economic pyramid.

Built on such a past is a present where CSIR has risen to the occasion, meeting diverse challenges put forth due to continuously changing internal and

external policy settings. CSIR is making India proud in high science and is catalyzing industrial growth in certain niche sector CSIR's role in S&T human resource development is noteworthy. Pioneer of India's intellectual property movement, CSIR today is also strengthening and building on its patent portfolio to carve out global niches for the country in select technology domains.

During the year, CSIR has made several significant scientific and technological contributions. These span diverse areas ranging from affordable healthcare to sustainable energy, from smart and functional materials to chemistry & environment and from micro machines & robotics to infrastructure engineering. CSIR has also launched a programme named CSIR 800 to benefit people at the bottom of the economic pyramid from the desired S&T intervention. The year also saw several successful technology transfers to industries for commercialization, which are indicative of CSIR's key role in economic development.

Some significant achievements include:

(i) A New Organ in CSIR System: Academy of Scientific & Innovative Research (AcSIR)

The Academy of Scientific and Innovative Research (AcSIR) has been set up by CSIR as an institution for imparting instructions and awarding degrees in frontier areas of Science and Technology (Gazette notification 17th July, 2010). The Board of the Academy was constituted with internationally reputed scientists. The Academy has registered new students for M.Tech. (160) & Ph.D. (715). Also, about 769 interdisciplinary courses have been framed and over 150 are being offered presently. The Academy Bill has been passed by the Lok Sabha during the Monsoon session 2011 (05.09.2011) and by the Rajya Sabha, during Winter Session (21.12.2011).

The Academy would take advantage of the existing state of art infrastructure and scientific manpower of CSIR. The Academy would be a world class institution of national importance. The Academy will primarily focus on research and imparting training in such areas that are not ordinarily provided by the existing universities in India. The curricula, pedagogy and evaluation will be innovative and directed towards creating highest quality personnel in cross disciplinary areas.

(ii) New Platform for Pursuing R&D: Open Source Drug Discovery (OSDD)

In the context of the Decade of Innovation, it is necessary to look at alternate models of innovation to make healthcare affordable to the common man. CSIR launched Open Source Drug Discovery (OSDD) programme (based on the realization that the current Intellectual Property based models of pharmaceutical innovation do not address the diseases of the poor such as Tuberculosis) has emerged as a new platform for innovation in the domain of healthcare. This CSIR-led 'Team India' consortium with global partnership has more than 5000 researchers from over 130 countries as registered participants.

(iii) Traditional Knowledge Digital Library (TKDL)

Historically, India has been rich in traditional knowledge. The traditional knowledge embodied in Ayurveda, Unani and Siddha systems of healthcare are most sought in other countries. This traditional knowledge needs to be protected for the benefit of the society. CSIR has played a major role in protecting the traditional knowledge by creating a Traditional Knowledge Digital Library (TKDL). The TKDL contains information in 5 international languages, i.e. English, Japanese, Spanish, French and German in 34 million pages concerning 2.37 lakh medicinal formulations in Ayurveda, Unani, Siddha and Yoga. Six International Patent Offices including European Patent Office (EPO), German Patent Office (GPO), United Kingdom Intellectual Property Office (UKIPO), United States Patent & Trademark Office (USPTO), Canadian Intellectual Property Office (CIPO), IP Australia (IPA) and Indian Patent Office have the accessibility to the TKDL database. The efforts have been resulted in withdrawal of 34 patent applications at EPO,

setting aside of two patent applications at EPO, declaration of four patent applications at CIPO as dead patent applications, amendment of two patent applications one at EPO etc. The endevour is so unique that Patent Examiners of USPTO came to India to get training on use of TKDL database. The TKDL database also has database on traditional cuisines and tribal knowledge.

(iv) Setting up of Innovation Complexes

CSIR is in the process of establishing Innovation Complexes at Chennai, Kolkata and Mumbai. These Complexes would be world class facilities for undertaking translational research in the identified domains. They would support network of business, R&D institutions and universities and nurture MSMEs in the designated fields. Each of such complexes would help in creating niche for the country in innovation space by catalyzing innovation ecosystem of the region.

(v) CSIR Opens New Vista through Ayurgenomics

Ayurgenomics is an integrative approach of Ayurveda and Genomics for discovery of predictive markers for preventive and personalized medicine. In a CSIR study, recently a paper has been published in PNAS (Proceedings of National Academy of Sciences), wherein scientists have reported identification of a gene and a genetic marker linked to high altitude adaptation and hypoxia responsiveness, through genetic analysis of extreme constitution types as defined in Ayurveda. EGLN1, a key oxygen sensor gene was linked to high altitude adaptation and Hypoxia responsiveness using this novel integrative approach of clinical phenotyping methods of Ayurveda, population genetics and diseases genomics. Earlier CSIR has published paper on gene expression and biochemical correlates of extreme constitution types (vate, pita and kapha) in 2008, in Journal of translational medicine. Following one of the cues from gene expression differences, wherein a gene could be identified and the genetic marker associated with high altitude adaptation and a high altitude illness. The predictive markers that are identified within this gene by the CSIR group have also been filed for patent. Ayurgenomics study so far has not only provided a novel molecular framework for integration of these two disciplines, but also highlighted that this integrative approach of Ayurgenomics can accelerate/ assist discovery of markers for predictive and personalized medicine.

(vi) Building Techno-preneurship Culture in CSIR: Setting up of CSIR-Tech

CSIR and its constituent laboratories are home to cutting edge scientific capabilities, talent, know-how and intellectual property. To further enhance the innovation capacity of CSIR and to explore newer models of bringing processes, products and services to the markets, an independent company, Review of the Eleventh Five Year Plan namely, CSIR-Tech Private Limited (CTPL) has been incorporated in Pune on 2nd May 2011. The main purpose of CSIR Tech was to hold equity and give feedback loop of technology creation and transfer.

(vii) CSIR Technologies for National Capacity building

(a) CNM5 from CSIR-NAL and Mahindra Aerospace

Designed and developed through a public-private partnership in civil aircraft, the CNM5 is a 5-seater all-metal aircraft. The aircraft was test flown first in the first week of September, 2011 and then had subsequent successful test flights. It is powered by a Lycoming IO-540 engine and features non-retractable landing gear and a spacious cabin with large access door. The cabin interior is reconfigurable to adapt the aircraft to different roles, while simplicity of systems and ease of maintenance are design drivers throughout the aircraft. The CNM5, a light utility aircraft, is designed to meet the latest global standards, while operating in environments with limited infrastructure at extremely low costs per seat mile.

(b) Regional Transport Aircraft (90-seater)

For National Civil Aircraft Development (NCAD) programme, CSIR has prepared a Feasibility Report which provides road map for development

of a 90-seater turbo fan configuration aircraft. The NCAD programme will have two phases: design & development and manufacturing. It is envisaged to involve private sector industry in both the phases. CSIR proposes to take up NCAD program as a mega national project in 12th Five Year Plan.

(c) Autonomous Underwater Vehicle (AUV)

July 17, 2011 was a historic day for CSIR. ON this day the 'AUV-150'– an Autonomous Underwater Vehicle designed and developed by CSIR-CMERI with inputs from the IIT-Kharagpur– literally plumbed a sea depth of 150 m within its estimated mission time. This event marked the end of a protracted effort for obtaining self-sufficiency in the design development underwater robotic systems, for which the country had to depend solely on foreign sources. With this India now has the wherewithal of manufacturing its own functional Automated Underwater Vehicles. The successful sea trial of AUV-150 marked a momentous entry into the annals of robotic research in India and marked the beginning of a more ambitious underwater robotic programme for venturing to 3000 m of ocean depth.

(d) Carbon Fibre Technology – Setting up of a commercial plant

Carbon fibre is an important and strategic raw material for the fabrication of advanced composite materials. Carbon fibre polymer matrix composites are being extensively used as light weight structural materials in a large number of materials. The technology for the carbon fibres and pregregs developed by CSIR-NAL was transferred to M/s Kemrock for commercialization. The Kemrock has set up a plant of 300 tons per annum capacity. In due course, this effort would make the country self sufficient in carbon fibre material.

(e) Sulphate of Potash – A novel technology for self reliance

Technology for recovery of Sulphate of Potash (SOP), developed by CSIR-CSMCRI from bittern has been transferred to M/s Archean Chemical Industries. They are setting up a commercial plant of capacity 1 lakh tone per annum. SOP is a premium fertilizer with highest nutrient value of ~68%. Further, CSIR-CSMCRI has demonstrated the technology to Tata Chemicals Limited (TCL). A pilot plant is being set up in the company's premises which would have potential to produce 3 tons/day (900 tons) of sulphate of potash. The novel technology has been protected (PCT granted in USA, Australia and Canada). Presently entire potash demand is met through imports. The commercialization of the indigenous technology would make the country self sufficient in sulphate of potash.

(f) Helping India to build a modern fighter aircraft

It is the endeavour of CSIR-NAL to support the national strategic sector programmes in a big way. The National Control Law Team led by CSIR-NAL continued to play a pre-eminent role in the activities leading to the Initial Operational Clearance (IOC) of the LCA Tejas air force variants. The achievements of the year include successful validation and update of the wind tunnel aero database of Tejas aircraft from flight test data using sophisticated system identification techniques, release of the IOC-version of flight control laws and air data system algorithms. It was a proud moment, indeed, for all the institutions and CSIR-NAL and its scientists associated with the Tejas programme when the Defense Minister formally announced induction of Tejas into the Indian Air Force on the completion of IOC during the year.

(g) Head Up Display – Commercialization of technology for the first time in the Country

The Head up Display (HUD) is an essential component of the cockpit display by providing the pilot with essential flight information, navigational and target/weapon release cues superimposed on the window to the outside world. It is a transparent display that presents data without requiring the user to look away from his viewpoint. The technology developed by CSIR-CSIO for use in Light Combat Aircraft, has been transferred to M/s. Bharat

Electronics Limited, Panchkula and production has begun.

(h) Commissioning of nano filtration plant

CSIR-IICT have successfully commissioned commercial nano filtration plant (six stage process for a feed capacity of 4000 liters per day) at M/s Consolidated Fibres and Chemicals Ltd., Kolkata, for recovery of impurity free sodium thiocyanate solvent from aqueous process stream. This process is employed in the production of Acrylic Fiber. CSIR-IICT has provided training to the industry personnel on plant operation and membrane maintenance.

(i) Commercialization of wax deoiling

Numaligarh Refinery (NRL), a subsidiary of BPCL is setting up a grass root wax deoiling unit using updated (CSIR-IIP)-EIL process know-how. The unit is based on state-of-the-art technology developed by CSIR-IIP. It will process low value wax distillates in a series of steps comprising of fractional crystallization and filtration. The wax facility being set-up by Numaligarh Refinery will have capacity to produce 50,000 tonnes per annum of food grade paraffin wax and 4500 tonnes of micro crystalline wax by processing two waxy streams, namely Medium Vacuum Gas Oil (MVGO) & Heavy Vacuum Gas Oil (HVGO).

(viii) CSIR-800: S&T Interventions for the people at the base of the Economic Pyramid

(a) Post harvest technology centres

CSIR-CMERI in collaboration with NGOs has set up High Efficiency Post Harvest Drying & Processing Centres in the states of Mizoram and Arunachal Pradesh for post harvest processing of Ginger, Big Cardamom, Turmeric, Chillies etc. More than 10,000 farmers of North East would be able to sell their produce at 20-25% higher price to the processing center. These centers would generate direct employment to about 300 people.

(b) Bus-mounted RO Plant

CSIR-CSMCRI has developed mobile RO plant i.e. a RO plant for water filtration mounted on a bus. It can deliver drinking water maximum at the rate of 60000 litres per day. The bus was put into service in the devastating flood hit areas in the state of Bihar. It had delivered drinking water to the flood affected people through army camps who were monitoring the rehabilitation programme.

(c) Smart Pond Management System for Fresh Water Aquaculture

An Electronic monitoring and control system for fresh water aquaculture ponds has been designed and developed by CSIR-CEERI. The developed embedded system can sense and wirelessly transmit pond parameters (dissolved oxygen, dissolved carbon dioxide, dissolved ammonia, water temperature) and determine stress factor on the fish. An auto fish feeder has also been developed as an ancillary to the main pond management system. The system has been developed in partnership with the Central Institute for Freshwater Aquaculture (CIFA), Bhubaneswar, who also field-tested the system. The developed system can support commercial fresh water aquaculture and help manage it for desired gains.

(d) Air ferry system for societal applications

Continuing the development of system for societal applications, by making use of an inexpensive base vessel made up of bamboo material, a six-seater air ferry system was developed by CSIR-NAL and tested at the MEG Centre, Bangalore. Christened as 'Aam Rath', it is powered by a 33hp aero engine. The air ferry has been observed to perform well in water with respect to speed, turning ability, and, above all, with good stability characteristics. In addition, a three-seater air ferry system, 'Lal Hamsa', with an FRP base vessel and a seventeen hp aero engine, was also developed and tested.

(e) Development of iron making process used by tribals of India

CSIR-NML has demonstrated the scaled-up process of ancient iron making with heat recovery system at two tribal sites namely Tribal Cultural Society, Jamshedpur and Technical Training Institute, Orissa. The product of the process is the

value added wrought iron, extremely suitable for making decorative items, which has got good export market. The adaptation of this scaled–up process with heat recovery system will raise the income and living standards of tribal and rural artisans and preserve the age old technology of iron making.

(f) A glimpse of the Economic Impact of few technologies

The CSIR 800 technologies developed by CSIR were able to create nearly 50 million man-days of employment, the overwhelming 'winner' being the cultivation of *Mentha arvensis* farmed over 150,000 ha and created 40 million man-days of employment. It was followed by the 1 million man-days of employment in cut flower. Cut flowers generated a business of the order of 50 lakh/ month in the Delhi flower market whilst CSIR developed flow driers fabricated by a small engineering concerns generated a direct economic return of 50 lakh/month. The incomes of over 100,000 farmers were raised from between 10 to 25% and more than 1,300 self-help groups benefitted from the trainings. Most impressive were the gains that the salt small scale manufacturers saw, in some cases adding between 1 to 1.5 lakhs to their annual income.

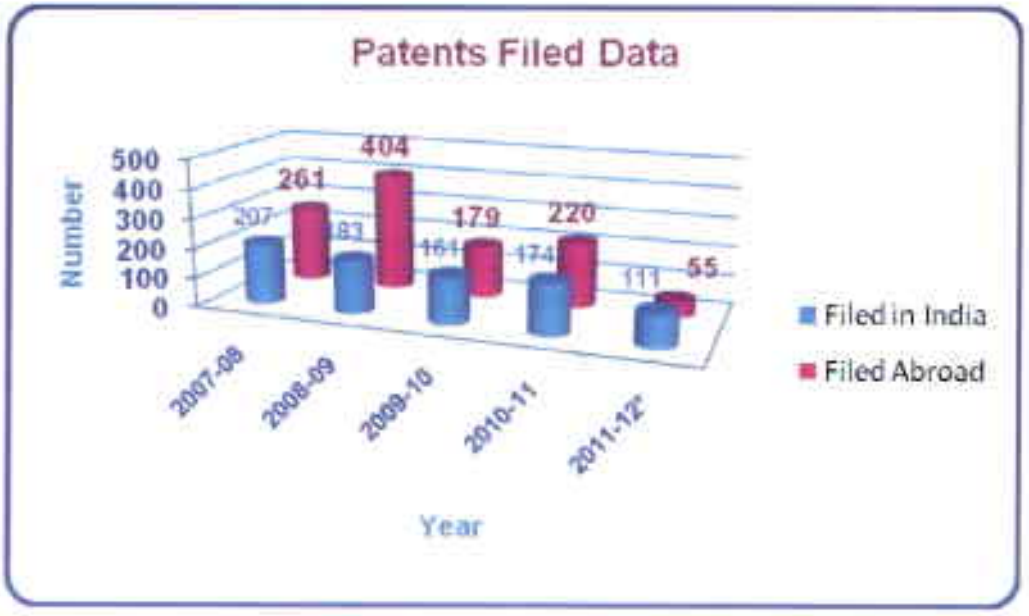
(ix) Unique Licensing of Knowledgebase: New generation thrombolytic molecules

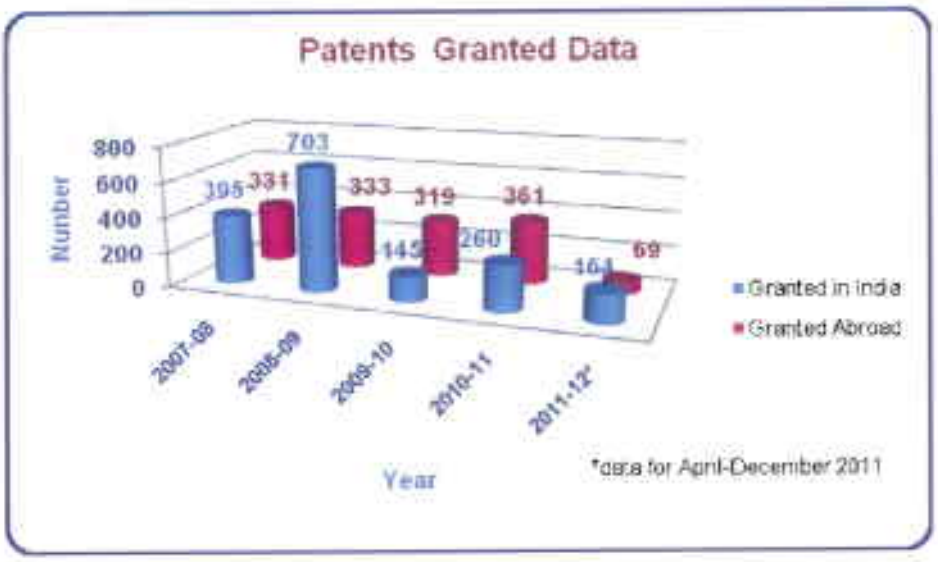
Continuing to create niches in technology licensing, CSIR has signed a unique deal with Nostrum Pharmaceuticals Inc., USA for world-wide licensing of clinical development of new generation thrombolytic molecules. CSIR will be receiving over 150 million US$ through various milestone payments and royalties. This is an outstanding example of Public-Private-Partnership that will ultimately benefit the mankind. The effort is part of CSIR's endeavour of providing affordable healthcare.

(x) Value Generation through Intellectual Property

CSIR has been at the forefront of Intellectual Property generation – it enjoys a unique position amongst publicly funded R&D organizations nationally and internationally.

- CSIR filed 174 patents in India and 220 abroad during 2010-11 whereas it was granted 260 patents in India and 361 abroad.
- CSIR has 3046 foreign patents and 2278 Indian patents in force and 222 patents licensed as on 31-03-2011.





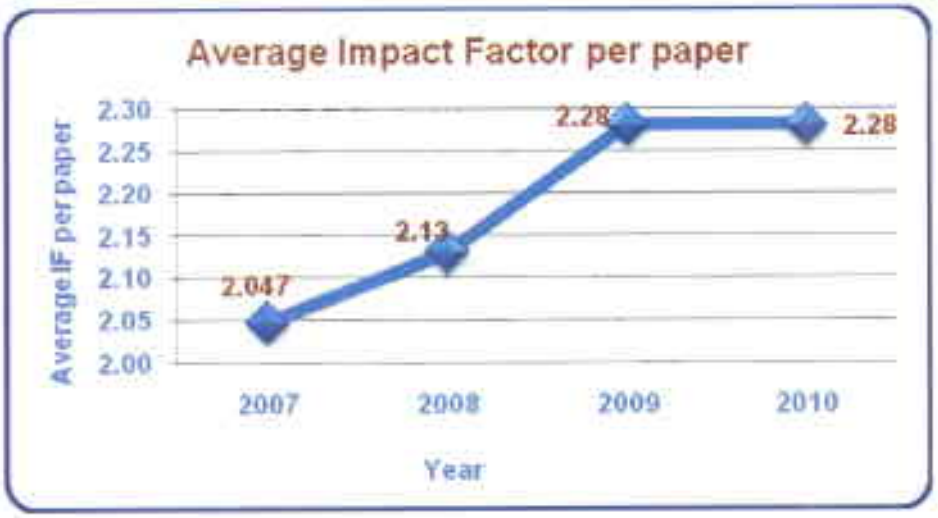
(xi) Scientific Excellence

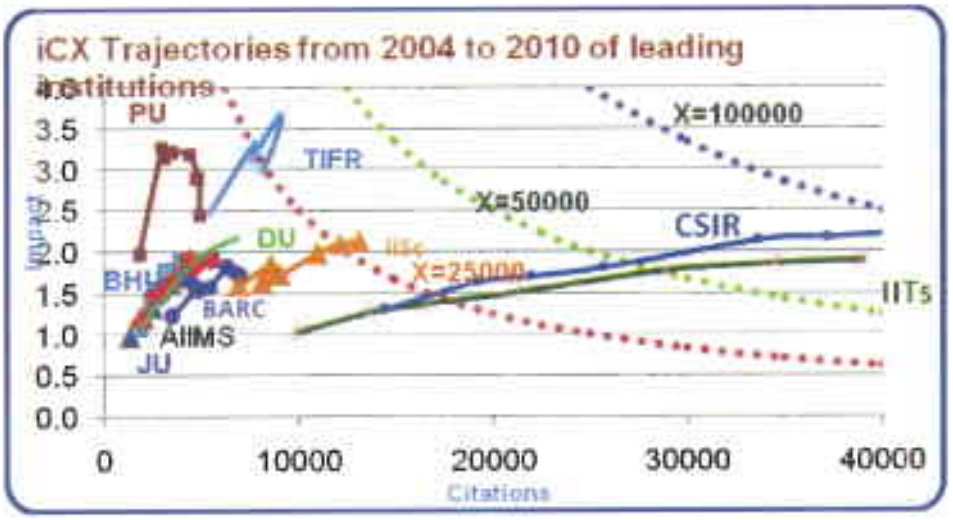
(a) Research Papers

CSIR published 4434 research papers in SCI journals of national and international repute during 2010 contributing to average 12% of National SCI publications. The average impact factor per paper is 2.28.

- CSIR is energized through appropriate interventions - the energy of scholarship is steadily increasing, which is reflected in the Energy – Index graph ($E = C^2/P$, where P is papers of five previous years, and C is the citations received in the target year) which shows the increase in impact/ paper as well as the increase in total number of paper. CSIR's energy scholarship compares advantageously with that of leading R&D institutes in the country.

- CSIR published many research papers during the year in high impact factor (IF>10.0) SCI journals including 'Chemical Society Reviews', 'Nature Medicine', 'Nature Geoscience', 'American Journal of Human Genetics', and others with highest impact factor of 26.583 (Chemical Society Reviews).





(b) CSIR Scientists in Frontier of Science

CSIR scientists have been awarded prestigious fellowships and have won various awards for the contributions made. Following table presents a glimpse of some national recognitions received by CSIR scientists during 2011-2012 (updated upto 20.02.2012).

Fellowship/ Award	Number
Fellows of Indian National Science Academy	2
Fellows of Indian Academy of Engineers	1
Fellows of Indian Academy of Sciences	5
Fellows of National Academy of Sciences	11
Shanti Swarup Bhatnagar Awardees	3
National Geo-science Awards 2010	9
CSIR Young Scientist Awardees	7

(xii) Creating and Nurturing S&T Human Resource for generating wealth

(a) National S&T Human Resource Development

At national level, CSIR has been contributing significantly for the development of the highly qualified S&T manpower in diverse disciplines. CSIR is currently supporting 8396 research fellows and associates. Around 4000 students are pursuing Ph.D. in various CSIR laboratories, whereas close to 7000 project assistants work in various R&D projects and are being trained in diverse disciplines of S&T.

(b) Achieving High Value for Ph.Ds

Currently CSIR produces 500 Ph.Ds and 2000 post graduate degree holders and research trainees every year. As per Kelkar Committee recommended methodology, the differential value per annum after appropriate discounting for guiding these Ph.Ds and training post graduate degree holders and research trainees would be at 225 crore and 450 crore per annum, respectively (675 crore in total).

(xiii) Some cluster-wise S&T contributions

(a) Biological Sciences Cluster

Improved samba mahsuri

CSIR-CCMB, in collaboration with ICAR-Directorate of Rice Research (DRR), Hyderabad, has used marker assisted technology to develop new variety of Samba Mahsuri rice that exhibits excellent resistance against *Xanthomonas oryzae*, which causes bacterial leaf blight and blast in rice. The variety has been released for commercial cultivation and technology has been licensed to a company for mass multiplication of seeds. In Kharif season of 2010, the variety was grown in ~ 20,000 hectares.

INDICO

A network of clinicians and researchers from major research laboratories from all over India has been established and named as INDICO (Indian Diabetes Consortium). An *in silico* disease gene prediction method for type 2 diabetes has been developed. At CSIR-IGIB Genome-wide association study (GWAS) involving 2500 participants from North India belonging to Indo-European ethnicity indicates that new genes and pathways are involved in the patho-physiology of type 2 diabetes in Indians.

Phase II clinical trials of Sepsis

CSIR in association with M/s Cadila Pharmaceuticals, NII, IISc and PGI Chandigarh developed Mw as novel therapy for management of sepsis. The human studies by Mw (Phase IIa, safety using 3 doses) conducted at PGI, Chandigarh showed encouraging results with improvement in different organ functions mainly lungs, liver, and kidney.

Biomarker for valvular heart disease

CSIR-IICB developed composition and methods for diagnosis of valvular heart disease. In particular the study has identified a protein marker for diagnosis of valvular heart disease useful for the detection, characterization and treatment of the disease. The mechanism of upregulation of the protein in human plasma in the patients suffering from valvular disease is established. The increased level of the protein in the urine samples of the valvular disease patients was also verified. Estimation of this marker protein may be useful for diagnostic purpose for the patients with no clinical evidence for valvular disease.

Technology for bioinoculants transferred

CSIR-NBRI has developed abiotic stress tolerant biofertilizer and biopesticides for use as plant growth enhancer and biofungicides. The technology has been transferred to Department of Agriculture, U. P. Govt's biofertilizer & biopesticide manufacturing units; Biotech International, New Delhi; Gujarat Agri Processing Company Ltd., Gujarat and Balaji Crop Care Pvt. Ltd., Hyderabad. Rhizobium and phosphate solubilising bacteria (PSB) technology was used

at U.P. Government's 17 biofertilizer producing laboratories. The institute has also developed *Beauveria bassiana spp.* based technology package for bio-control of agriculture pests especially Spodoptera and termites in legume crops. The novel microbe isolated from the field is thermostable at higher temperature.

Post harvest biology and biotechnology of fruit, flower and vegetable

CSIR-NBRI has developed transgenic tomato plants with increased shelf life up to ten days without affecting other attributes of fruit or plant. Transgenic banana plants carrying anti-sense gene constructs of various ripening related genes from banana have been developed and being grown in the fields. Fruits are being analyzed for their ripening behavior and other attributes. In mango, several genes related to aroma and nutritional qualities were isolated in order to understand ripening process in mango. Functional analyses of genes involved in the processes of abscission and senescence are in progress. In rose, the progress of ethylene induced abscission was shown to be associated with programmed cell death like features.

(b) Chemical Sciences Cluster

Dye-sensitized solar cells based on ZnO bifunctional nanoflowers

CSIR-NCL synthesized zinc oxide nanoflowers loaded with gold nanoparticles by hydrothermal route. It shows power conversion efficiency of 2.5% which is considerably higher than that of ZnO nanoflowers without gold nanoparticles.

Nanocrystalline $Li_4Ti_5O_{12}$ as high-rate performance Li-ion battery a node

Novel materials for efficient transport of Li-ions are important for development of electrodes in Li-ion batteries. CSIR-CECRI has reported development of nanocrystalline $Li_4Ti_5O_{12}$ (LTO), which crystallizes into a cubic spinel-phase by single-step-solution-combustion method in less than one minute. LTO particles thus synthesized are flaky and highly porous in nature.

Transformation of carbon nanotubes to graphene nanoribbons

CSIR-NCL developed a new process for transforming carbon nanotubes to nanoribbons comprising a few layers of graphene. The electrochemical method proposed has unique advantage that it allows controlling the graphene layer thickness and orientation.

Excited state processes in linear ô-system-based organogels

CSIR-NIIST analyzed the role of the self-assembled organogel scaffolds of π-gels derived from linear π-systems in modulating the excited state properties such as excited energy transfer, exciplex emission, phosphorence, and aggregation induced enhanced emission, when compared to the corresponding individual molecules.

Ammonia free deliming of skins/hides

The process developed by CSIR-CLRI is an eco-friendly option for deliming of hides/skins which involves passing carbon-di-oxide while agitating the deliming bath. The process has enormous potential, especially in view of the emerging stringent regulation in certain countries against the use of ammonium salt, which is conventionally used for the purpose of deliming.

(c) Engineering Sciences Cluster

Bioceramics based implants for rehabilitation developed and field tried

CSIR-CGCRI developed all ceramic hip joint prostheses and have been successfully implanted to a number of patients. The first such series of operations took place in a hospital of West Bengal.

Mark-III Autoclave

CSIR-NAL has designed, developed and commissioned the state-of-the-art indigenous

computer controlled high pressure and high temperature autoclave (Mark III). Several innovative features have been incorporated in the autoclave and its systems to meet the stringent requirements of high pressure and high temperature. It has working dimensions of 2 m diameter, 4 m length, operating conditions of 350°C temperature and 15 bar pressure. It can be used for development of high temperature composite structural components like the rear fuselage of fighter aircrafts, engine components. So far the autoclaves have been imported from abroad; the indigenous development of autoclave will pave way for manufacturing high end autoclaves in the country.

Vision guided mobile robotic system

Vision guided mobile robotic system equipped with stereo vision system and Laser range finder has been designed and fabricated by CSIR-CMERI. The environmental data acquired by the sensors can be processed by the on board computer. The robot is capable to navigate in specific area for searching of hazardous material. It can navigate and develop the map of the surrounding simultaneously.

Two-Kg class Fixed Wing Mini UAV (FWMUAV)

CSIR-NAL developed a two-kg Class Fixed Wing Mini unmanned air vehicle. The Mini UAV, Slybird, design has so far been characterized for its aerodynamic behavior through CFD studies. An in-house designed high lift, low Reynolds number airfoil has been used for the wing to maximize the aerodynamic efficiency, lower the stall velocity and also to increase the endurance of the aircraft.

Super hard materials

CSIR-NML developed a process to fabricate superhard diboride based composites with hardness above 40 GPa by SHS compaction technique. Nano-composite coatings in Si-C-N system fabricated by magnetron sputtering technique exhibit hardness above 44 GPa. These composite coating may be used as protective coatings on electronic and space components.

Blast resistant design of explosive storage structures

Laced reinforced concrete (LRC) has been developed as an alternative construction material. It has high rotational capacity and confinement for explosive storage structures. Blast resistant design of explosive storage structures using LRC has been developed. The Design is unique and not available in public domain. It was demonstrated up to 75 T NEC.

Ceramic humidity sensor for nuclear industry

Ceramic humidity sensors are used for on line detection of moisture present in toxic/non-toxic industrial gases which are used in the nuclear metallurgy, defence, navigation etc. CSIR-CGCRI developed and supplied thirty sensors with electronics to Bhabha Atomic Research Centre (BARC). The sensors were tested at loss of coolant accident (LOCA) chamber over six days.

(d) Information Sciences Cluster

Indigenous cloud seeding system developed

Cloud seeding system is an effective tool for precipitation (rain) enhancement. While its use has increased within the country, Cloud Condensation Nuclei (CCN) Dispensers are neither manufactured nor marketed in India. CSIR-CMMACS has indigenously designed and tested CCN dispenser for ground based cloud seeding. In addition material for cloud seeding has also been developed.

Weather informatics for precision agriculture

In a pioneering effort, Hobli-level forecasting of rainfall over Karnataka has been initiated through a collaborative effort with Karnataka State Natural Disaster Monitoring Centre (KSNDMC). The project is being implemented in a resource-sharing environment; while KSNDMC is providing funds for generating the forecasts and their web management, CSIR-CMMACS is providing domain expertise as well as High Performance Computing. The two institutions also share resources in generating high-precision

observations, and ground-based cloud seeding for precipitation enhancement.

Global carbon cycle

CSIR-CMMACS has set up a station (as per World Meteorological Organization (WMO) standards) for the high precision measurement of CO_2 concentrations along with other green house gases in Pondicherry University campus which is expected to provide an accuracy of 0.1 ppm. The data is very valuable in the robust estimation of carbon fluxes as it is expected to have the fingerprints of India, SE Asia and the Indian Ocean. Marine biota plays an extremely important role in the global carbon cycle. Only a comprehensive modeling of the biogeochemical cycles and synthesis of data will yield insight into the physical, chemical and biological processes which influence the carbon cycle on wider spatial and temporal scales.

High performance computing facility

During the year, the most significant enhancement was the installation and commissioning of the 6th fastest supercomputer in the country (Dec '10). The system consists of 1152 processor cores (Intel Xeon 5670) and 2.3 TB of main memory distributed over 96 nodes, which are interconnected in the form of an enhanced hypercube using 4X QDR Infiniband technologies along with 30 TB of Lustre based parallel file system for fast I/O. The peak performance of the system is 13.5 TFLOPS and the sustained performance measured by the High Performance LINPACK (HPL) is about 11.83 TFLOPS. With this system in place, CSIR-CMMACS currently has a total compute power of about 16 TFLOPS (peak) across 7 High Performance Computing Systems. CSIR- CMMACS HPC facility is connected to the National Knowledge Network (NKN) through a 1 Gbps Optical Fiber Link. The supercomputing facility, which includes the largest shared memory system in the country, has been operational on a round-the-clock basis. Computational scientists from several CSIR laboratories have been remotely accessing the supercomputing facility.

Web-based information services

CSIR-URDIP has provided value added information services in the area of Patinformatics, Phytoinformatics and Toxinformatics to wide array of clients including start-up companies, SMEs, Research Institutes within and outside CSIR, large Indian Corporate and Multinational Corporations. CSIR-URDIP's research output is used as input by R&D, legal, new business development and multifunctional corporate teams for Research and Business Planning.

(e) Physical Sciences Cluster

RF MEMS switches for C, X and Ku band applications

CSIR-CEERI developed Radio Frequency Microelectromechanical Systems (RFMEMS) devices for Space Application Centre (SAC-ISRO), Ahmadabad. The developed devices include C, X and Ku band RF MEMS switches (capacitive shunt SPST and SPDT switches) with low voltage (5-20 V) electrostatic actuation-based on symmetric toggle and flexible serpentine configurations. The switches have been successfully evaluated and tested by SAC-ISRO scientists. RFMEMS switches are important for developing compact transmit receive modules, microwave phase shifters for electronic steering of microwave beams in communication and radar systems.

Optical fiber nanoprobe for nanophotonics

CSIR-CSIO invented a novel technique for fabrication of best ever optical fiber nanoprobe, an indispensable optical element used in nanophotonics research and applications, namely, metamaterial, nano-optical twezeers, Near-field scanning optical microscopy (NSOM), tip-enhanced Raman scattering and nano-sensor. The technique has been well established with more than 70% yield. It is a very low cost technique and can be produced in mass. The probe has excellent quality of optics. The optical tweezer has been successfully used as unique probe for manipulating 200 nm silica particle in 3D from an aqueous

solution. Such non-plasmonic nano-manipulator will be promising for research and application in the area of optical-tweezer.

Low-cost portable ECG device

CSIR-NPL developed a high quality, low-cost and portable ECG device, HEARTRACE. The device can be plugged into a laptop/PC for operation which utilizes concept of virtual instrumentation and off-the-shelf, easily-available components.

Genesis of phosphorites

CSIR-NGRI carried out extensive work in the offshore regions of the east and west coast of India with evidence of formation of phosphorites by microbial processes. The results suggested that the nodular phosphorites represent phosphate clasts related to phosphate stromatolites formed in intertidal conditions.

Occurrence of gas hydrates along the continental margins of India, particularly the Krishna-Godavari offshore basin

The presence of gas hydrates along the Indian continental margins has been inferred mainly from the bottom simulating reflection/reflector (BSR) and the gas hydrate stability zone thickness map of India. CSIR-NIO has carried out multidisciplinary investigations in the Krishna-Godavari offshore area along the eastern continental margin of India, which is known for its hydrocarbon potential.

National Energy Sector: GHG Emission Inventory: A National Green House Gas

A national Green House Gas (GHG) emission inventory has been developed by CSIR-NPL for gases like CO_2, CH_4, and N_2O which are emitted from fossil fuel combustion in electricity generation from coal based thermal power plants. The scenario of state level GHG emissions reveals significant increases in states like Uttar Pradesh, Maharashtra and Andhra Pradesh.

Cesium Fountain

CSIR-NPL has been developing a cesium atomic fountain primary frequency standard. The Physics package of the fountain is completely assembled. The developed optical set-up delivers six cooling and two detection beams via single mode polarization maintaining fibers to the physics package.

(xiv) CSIR brand building: Participation in Republic Day Parade

CSIR participated in parade of Republic Day celebrations, 2011 through its Tableaux at Rajpath. The theme of the Tableaux was generics drugs to genomic medicine which was very well received. In the tableaux through an expressive medium, CSIR contributions for development of generic drug industry in the country over the years on one hand and CSIR's continued efforts for development of new drugs and now of genomic medicine on the other were captured.

(xv) Recognition through Awards

(a) Award for "Highest number of Patents in the Country"

CSIR has bagged an award for an Indian institute securing highest number of Indian patents in the year 2009. The award is instituted by Department of Industrial Policy & Promotion (DIPP), Ministry of Commerce and Industry, Government of India. CSIR continues to hold the same position.

(b) Award for "Most Innovative Hi-Tech Academic Institution in the Country"

CSIR has received Thomson & Reuters Innovation Award 2010 for being most innovative hi-tech academic institution in the country. The recipients for this award are decided by analyzing their innovation through patented technology, number and impact of patents, the efficiency and effectiveness of research and the impact of innovation as measured by patent citations.

6.2 Consultancy Development Centre (CDC)

CDC has made significant strides in emphasizing the need for effective use of consultancy services

in various Central/ State Govt. Ministries/ Departments. Consolidating its position as a Centre for promoting and developing consultancy, CDC offers a vast range of services to Clients and Consultants.

During the year 2010-11, CDC undertook various activities keeping in view its mandate of promotion and development of Consulting Profession, Capacity Building, Creating trained human resources in the consulting domain and facilitating Client Organizations in the selection of right Consultants for their projects.

During the year, CDC celebrated its 25th Foundation Day in which document titled CDC Silver Jubilee Celebrations covering CDC achievements for past years was launched by Prof. Samir K. Brahmachari, Secretary DSIR, DG CSIR and Chairman, CDC.

7. PUBLIC SECTOR ENTERPRISES

7.1 National Research Development Corporation (NRDC)

The National Research Development Corporation (NRDC) is a Public Sector Undertaking, under Department of Scientific & Industrial Research (DSIR), Ministry of Science & Technology, engaged in the development, promotion and commercialsation of the R&D results/ technologies emanating from Research Institutes/ Universities / Industries, etc. The Corporation provides comprehensive technology transfer services and acts as a catalyst for transforming innovative research into marketable industrial products. The Corporation is a unique organization entrusted with the mandate of both promotional function of development/up-scaling of lab-scale technologies, promotion and inculcating the spirit of inventivity and commercial function of transferring/licensing these technologies to industry and making them commercially successful. During its operation for nearly six decades since its inception, the Corporation has developed strong links and network with various R&D organization in the country as well as abroad for transfer of technologies. Its operations cover the entire spectrum of industrial technologies ranging from Agriculture to Agro processing, Chemicals to Metallurgy, Mechanical engineering, Electrical engineering, Electronics, Biotechnology and so on.

During the year 2010-11, the Corporation's total income was 959.47 lakhs as compared to 1085.92 lakhs in the previous year and principal source of revenue i.e. Lumpsum Premia and Royalty on the licensing of technologies to industry was 782.58 lakhs, as compared to 618.65 lakhs, in the previous year. During 2010-11, the Corporation incurred Loss to the tune of 158.24 lakhs (before tax) as compared to Profit of 15.38 lakhs in the previous year. The Department of Public Enterprises has given 'Good' rating to the Corporation for the year 2009-10 and the likely rating for 2010-11 is 'Fair'.

7.2 Central Electronics Limited (CEL)

Central Electronics Limited is the other Public Sector Undertaking of DSIR engaged in the field of SPV. CEL's objectives are as follows:

- **Solar Photovoltaics:** To be a major global and domestic player in the area of Solar Photovoltaic cells and Modules by capacity enhancement and by manufacturing higher wattage modules with special emphasis on use of thinner wafers to become price competitive in the domestic and international markets.

- **Railway Equipment:** To maintain leadership in the development, manufacturing, supply and commissioning of signaling and safety equipment for the Indian Railways to meet their existing and emerging modernization needs in line with their future strategies.

- **Defence:** To expand the product portfolio using state-of-the-art technology for supply of strategic components such as PCM to be used by DRDO laboratories; PZT and di-electric material for use by BEL, NPOL and BARC; and heat fuse to be used by ordinance factories.

- **Safety and Security:** To diversify into security systems and equipment used to counter terrorist threats in India by commercializing the latest state of-the-art technology from abroad.