

CSIR VISION 2030

Innovative S&T
Solutions for Global
Leadership



**Council of Scientific &
Industrial Research**
New Delhi 110 001

CSIR VISION – 2030

Innovative S&T for Global Leadership



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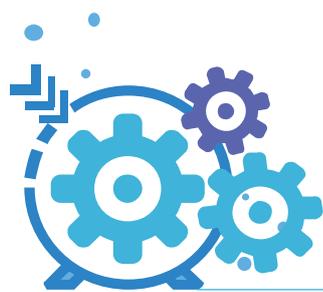


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PREAMBLE

The Council of Scientific and Industrial Research (CSIR) was founded as an autonomous society in September 1942, to address the needs of industrial research in the country. With Dr Shanti Swarup Bhatnagar as the first Director General, CSIR made forays into setting up a chain of national laboratories starting with five national into labs. This was the foundation of one of the largest publicly funded research and development organisations in India. As CSIR turns 80 in 2022, it has grown into an organisation with 37 labs of 3439 scientists, who are supported by 4193 technical staff, 2514 administrative & other support staff and about 5500 young scholars, that addresses every facet of scientific development required in the country. CSIR has made long strides in intellectual property generation and protection and it continues to be the top patent-securing publicly funded R&D organisation in India & abroad. Currently, CSIR has a patent portfolio of 8366 patents in India and 7806 abroad. As a result of research carried out in the national laboratories over 5600 research papers have been published in internationally peer reviewed journals. With the current annual budget of Rs.5563 crores, CSIR continually realigns itself to the changing needs of the country, establishing innovative R&D for addressing emerging challenges. In recent times, CSIR has come out with vision document 2001 and CSIR @ 80: Vision & Strategy 2022. Keeping in view the aspirations of the country to be Atmanirbhar the organisation has embarked on developing Vision 2030 within the ambit of the National Vision 2047.



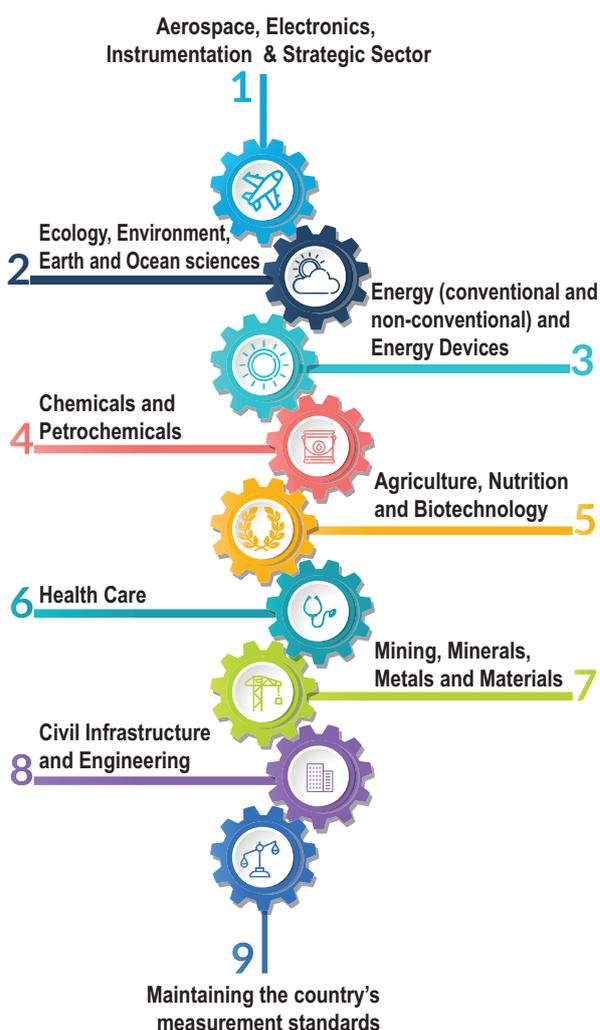
CSIR @ 2022

CSIR addresses national needs through its innovative research, strong fundamental science, industry partnerships, entrepreneurship, translation research, capacity building, and policy making. Some of the significant contributions of CSIR in the past decade include the development of an indigenous two-seater Hansa-NG aircraft for pilot training, Bio-jet fuel for sustainable aviation, developing India's own footwear sizing system, earth-quake resistant structures for seismic zone IV and V and India's first fuel cell driven automotive. Besides pioneering work in these areas, CSIR today has established many societal benefit programs that target marginalised communities, including women such as; aroma mission, sea weed cultivation, first ever demonstration of heeng cultivation and the purple revolution in Jammu and Kashmir. CSIR labs are catering to the un-met needs of the states and UTs such as North-East, Ladakh, H.P. through S&T Interventions. Embracing the new with our heritage, CSIR's Traditional Knowledge Digital Library now contains information of about 4 lakh formulations of Ayurveda, Siddha, Unani, and Sowa Rigpa, and Yoga techniques.

CSIR rose to tackle the challenges of the unforeseen pandemic, COVID-19, that struck in 2020, by reorienting the scientific manpower in providing quick relief in various domains such as, Digital and Molecular Surveillance; Rapid and Economical Diagnostics; New Drugs / Repurposing of Drugs; Hospital

Assistive Devices and PPEs; and Supply Chain and Logistics Support Systems. From developing BiPAP-SwasthVayu ventilators, Oxygen Plants to rapidly deployable make-shift hospitals, and diagnostics, CSIR, as a whole, rose to the needs of the nation.

Today, CSIR labs are working cohesively and synergistically towards harnessing the emerging opportunities to bring in new technology in key areas.





Global networking has opened up new horizons and as the world stands together to face the challenges threatening our planet, CSIR once again, re-orient itself to face the immediate threats of climate change, health care, water scarcity, poverty, land use management,

and habitat and biodiversity loss, with its Vision@2030. The vision document presents a new roadmap aligning to National Vision 2047 for achieving sustainable development, integrating national priorities and reaching new heights of prosperity.



Bio Jet fuel for Sustainable aviation



COVID - 19 MAKESHIFT HOSPITAL



'Swasth Vayu': Non-Invasive Ventilator For COVID-19 Patients



Distillation units at Ladakh



Seaweed cultivation



Purple Revolution (Lavender)



Medical Grade Oxygen (MO2) Concentrator System



India's first fuel cell driven automotive



VISION

Enhance the quality of life of the citizens of India through innovative science and technology, globally competitive R&D, development of sustainable solutions and capacity building to fulfil the dream of *Atmanirbhar Bharat*.

MISSION

It is essential for CSIR and important for the country that it continues to be as relevant as it was in the past, but even more so in the future particularly India's vision for 2047. The guiding beacon for CSIR would continue to be its mission across various socio-economic sectors as below.

- Technology innovation and translational research and commercialization of technology and know-how to align with national goals
- Development of national strengths through advanced technology solutions for national aerospace programs, design and development of small and medium sized civil aircraft to promote a vibrant Indian civil aviation
- Synergizing diverse expertise to solve the grand challenges of new-age science, industry and society
- Creation and demonstration of scalable and sustainable green technologies in the energy sector, contributing to real-time applications towards long-term energy security of the country
- Meeting international benchmarks and societal needs
- Improving wellness indices and health outcomes through a synthesis of biology, chemistry, engineering and computation
- To be a leader in civil and infrastructural engineering domain for the growth of sustainable civil infrastructure
- Provide globally benchmarked sustainable processes for chemicals leading to reduction in trade deficits
- Catalyze & optimize sustainable production and processing of metals and materials, their use and reuse for local and global benefits
- Ensuring sustainable agriculture and nutritional security through biotechnological research and innovation
- Management and rejuvenation practices for the environment and natural resources
- Capacity building to enable globally competitive R&D
- Developing technologies for Carbon neutrality and achieving net zero plan across various industries
- Providing value-added services to the industry, and society at large

The long-term goals of CSIR are aligned to the aspirations for India@2047 which encompasses new heights of prosperity



THE NEED

Publicly funded national scientific organisations like CSIR need to periodically redefine and recalibrate their vision statement, mission and the strategies to keep pace with the ever changing global scientific and disruptive innovation landscape, industrial and technological breakthroughs and national competitiveness driven by the global knowledge economies. This CSIR vision document lays down the future roadmap (short, medium and long term) for CSIR to maintain its scientific competitiveness and innovative edge necessary to meet and actualise the national goals of India. The vision/mission document has been prepared after multilayer consultations (internal and external) with the stakeholders, aligning CSIR goals with various national schemes, missions and

sustainable development goals. The vision, mission and deliverables are sharply focussed on key areas of national knowledge and technology competitiveness in the global economic ecosystem, particularly in providing local and affordable solutions to the needs of Indian society, industry and strategic sector through cutting-edge science, innovation, translation, partnership and deployment. CSIR being a unique organisation with core competence and deep expertise in diverse and specialised scientific domains from healthcare to aerospace relevant to the most the industrial/societal and strategic requirements of the country, its new vision document has been prepared to bring the required clarity of purpose to the organisation to keep growing and live up to the expectations of the country.





CSIR

THEMATIC

VISION & GOALS

CSIR THEMATIC VISION & GOALS



1 • Aerospace, Electronics & Instrumentation and Strategic Sector (AEISS)

VISION STATEMENT

A global R&D hub delivering state-of-the-art innovative technologies securing India a leading manufacturing hub for aerospace, electronics & instrumentation for civil & strategic sector

FOCUS AREAS

- **Civil & Military Aviation:** Regional Air Connectivity, Urban Air Mobility, UAVs & High-Altitude Platform (HAP)
- **Aerospace Advanced Materials/ Fuels:** Aerospace Grade Carbon Fiber & Prepregs, Alternate Fuel (biofuel) and Lubricants, Thermoplastic Composites, Thermal Barrier Coatings, stealth materials & environment friendly coatings.
- **Aerospace Mechanical Systems:** Indigenous Line Replaceable Units (LRUs) suitable for Environmental Control Systems (ECS) and Hydraulic Systems, Fuel Line etc. Mechanical systems for civil & fighter including missile launching systems for Defence
- **Electronics & Embedded Systems:** New Generation Semiconductor Technologies and Sensors, High Power Microwave Devices, Terahertz Quantum Cascade Laser (QCL) & Components/systems for 5G/6G Communications, Optoelectronics
- **Biomedical Instrumentation:** Diagnostic & Therapeutic, Imaging & Machine Intelligence based Technologies, Rehabilitation & Assistive Technologies, Orthopaedic Implants, Standard & Calibration Instruments
- **Smart Agriculture:** Drone based electronic control systems for smart agriculture & precision farming,



Goals

Focus Areas	Short Term Goals	Medium Term Goals	Goals Beyond 2030
<p>Civil Aircraft for Regional Commutation/ Connectivity</p> <p>Trainer Aircraft, Urban Air Mobility</p> <p>UAVs :</p> <ul style="list-style-type: none"> Broad-Band Communication & Surveillance Heavy pay load & long endurance 	<ul style="list-style-type: none"> 19-seater Light Transport Aircraft for connecting Tier-II & Tier –III cities Electric - 2 seater trainer Aircraft 100 kg pay load Long Endurance (1hr) BVLOS UAVs 	<ul style="list-style-type: none"> 70–90-seater Regional Transport Aircraft for regional connectivity 5-Seater Electric (eVTOL) Flying Air Taxis Solar powered high altitude long endurance platforms as a low-cost substitute to satellites, terrestrial infrastructure and RPAS 	<ul style="list-style-type: none"> Hybrid–Electric Aircraft (50%) Fully Electric Aircraft (100%) for renewable electricity
<p>Aerospace Materials & Coatings</p>	<ul style="list-style-type: none"> Lightweight Aircraft Armor, Metal Matrix Composites, Smart Composite Coatings 	<ul style="list-style-type: none"> Thermoplastic Composite, Li.Al alloys, Stealth Materials & Coatings for Fighter Aircraft, Sustainable Bio-fuels/ Alternate Bio-fuel 	<ul style="list-style-type: none"> Ceramic Radomes, Indigenous MoS₂-based sprayable lubricant
<p>Electronic Instrumentation – Radio Frequency Microelectromechanical Systems (RF MEMS) based Actuators & Sensors</p>	<ul style="list-style-type: none"> Sensors & MEMS fabrication – Gyroscope, RF MEMS switches, Accelerometer & magnetometer Optoelectronics Instrumentation – Near Vertical Incidence Skywave, Multi-sensing surveillance & seismic systems 	<ul style="list-style-type: none"> Cyber Physical Systems & IoT Technologies Tera Hertz quantum Cascade Laser (QCL) and 6G Wireless Components HUD for Advanced Medium Combat Aircraft (AMCA) 	<ul style="list-style-type: none"> New generation semiconductor technologies & sensors Next generation optoelectronics & instrumentation for civil & military applications
<p>TWTs for Satellite Communication</p>	<ul style="list-style-type: none"> Microwave devices & 5G components systems 	<ul style="list-style-type: none"> TWT, Klystrons, Magnetrons, Gyrotrons, Plasma assisted devices & passive components 	<ul style="list-style-type: none"> THz BWOs for next generation communication & THz spectroscopy GaN Fab & devices



Focus Areas	Short Term Goals	Medium Term Goals	Goals Beyond 2030
Medical Devices & Instrumentation	<ul style="list-style-type: none"> • 3D microscopy visualization & guidance system • Smart material for orthopedic implants – cervical lattice spinal cages • 3D endoscopic vision system for MIS 	<ul style="list-style-type: none"> • Whole-slide digital microscope, AI enabled non-contact vital signs monitoring, Non-invasive- hemoglobin measurement, Robotic Vascular Catheterization System • Zirconia based clear dental braces, Lattice structured cervical and spinal implants • Biomedical equipment standard for the calibration of Electrical safety & Incubator analyzer 	<ul style="list-style-type: none"> • Drone ambulance with cardiac specialty/features for organ/blood transport etc., • Indigenous robotic assisted rehabilitation & assistive technologies. • Emotions assessment based psychological health monitoring systems (PHMS)



Indigenous Hansa-3(NG) for Pilot Training (80 nos.LOI)



2 Ecology, Environment, Earth Sciences, Ocean and Water (E3OW)

VISION STATEMENT

Evolving impactful knowledge-based solutions for resolving grand challenges in natural resource exploration, mitigation of geo-hazards, ocean dynamics and sustainable environment

FOCUS AREAS

- **Solid Earth**
 - » Geophysical Imaging and Geodynamic Process Modeling
 - » Anticipating Geo-Hazards & Developing Early Warning Systems
 - » Geo-exploration for mineral and energy resources
- **Ecology and Environment**
 - » Sustainable Resource & Environmental Process Management
 - » Waste Management
 - » Environmental Policy and Planning
- **Oceans**
 - » Marine and Coral Reef Ecosystems
 - » Coastal Processes and Nearshore Dynamics
 - » Marine Natural Products for Various Industrial Applications
- **Water and Wastewater**
 - » Aquifer Mapping and Groundwater Management
 - » Conservation and Management of Rivers, Lakes and wetlands
 - » Village Level Water Management- A CSIR initiative for Gaon Ka Pani Gaon Me



Goals

Focus Areas	Short Term Goals	Mid Term Goals	Goals Beyond 2030
Solid Earth			
Geophysical Imaging and Geodynamic Process Modeling	<p>Probing the Structure and Kinematics of the NW Himalaya for Assessment of Earthquake Hazard Potential</p> <p>A panoptic assessment of crustal deformation across India.</p> <p>Unravelling the antiquity and geological evolution of Singhbhum craton, Eastern India</p> <p>Natural Resource Exploration and Earthquake Hazard Assessment of the UT of Ladakh</p>	<p>A comprehensive model for earthquake genesis along the Himalayan arc</p> <p>Deformation and Plate Kinematics in the Indo Burmese arc and Shillong Plateau</p> <p>Deciphering the role of climate and tectonics in landscape evolution and regional drainage reorganization in NE India</p> <p>Establishment of Center of Excellence for Earth System modelling involving AI & ML and Big data Analytics</p>	<p>A viable model for Earthquake genesis in intra- and inter-plate settings</p> <p>Imprints of early life and craton evolution through geological times</p> <p>Discovering new locales of conventional and non-conventional energy resources</p>
Anticipating Geo-Hazards & Developing Early Warning Systems	<p>Earthquake Hazard Assessment in Moderate and Severe Seismic Zones of India</p> <p>Earthquake and Landslide Hazard, Risk preparedness and mitigation in Jammu and the UT of Kashmir</p> <p>Seismogenesis of the NCR-Delhi</p>	<p>Early Warning System for Himalayan Floods, Landslides, GLOFs and triggered Flow Cascades</p> <p>Generating strain map of India</p>	<p>Development and application of Earthquake Hazard Science for the safety and security of the country</p> <p>Next generation Earthquake Hazard Map of the country</p>
Geo-exploration for minerals and energy resources	<p>Genetic model for prognosticating deep concealed ore deposits</p> <p>Development of innovative Seismic Data Acquisition techniques for detection of thin layers</p> <p>Assessment of CO₂-EOR potential of declining oilfields and CO₂ storage potential of the Indian coalfields</p> <p>Evaluating the influence of methane/methane hydrate on ecology and biodiversity in the methane seep locations in Indian EEZ</p> <p>Exploration of geothermal resources in Ladakh</p>	<p>Identification of target areas for specific concealed ore deposits such as Iron, REE, PGMs and Base metals</p> <p>Rare Metals and Rare Earth Elements (RM & REE) from Beach Sand Minerals and Marine Regions</p> <p>CSIR's facility on Carbon Capture and Utilization (CCU)</p> <p>Application of Fiber-Optic Sensors for seismic monitoring</p> <p>Mapping of Unconventional Resources such as CBM and Shale Gas</p>	<p>Establishment of contemporary rapid analytical laboratories for mineral characterization with specific reference to the mineral industry</p> <p>Establishing strategies for converting resources to reserves for Concealed Iron Ore, REE, PGM, Base Metal deposits, towards achieving self-reliance</p> <p>Technologies for CO₂ Recycling & Solar energy conversion to green H₂/ Fuels</p>



Focus Areas	Short Term Goals	Mid Term Goals	Goals Beyond 2030
Ecology and Environment			
Sustainable Resources and Environmental Process Management	Air quality Monitoring and Modeling	Air Pollution Control Measures & Technology development (Green crematoria)	Tools for Bio-monitoring environmental niches, with specific reference to water and soil
	Degraded land reclamation	Assessment of Micro Plastics in aquatic environments	Quantitative Risk Assessment and Disaster Management Plan
	Land slide /slope stabilization	Human exposure analysis and health risk assessment including fugitive emissions	Center of Excellence for Climate Change mitigation/ adaptation strategies and cross disciplinary CCUS initiatives
Waste Management	SAR AR-CoV2 surveillance in domestic sewage and Wastewater-Based Epidemiology (WBE)	Pollution control methods for Urban regions, biomass & MSW burning, vehicular emission	Strategies & technologies for the environmentally sound management of E-waste, Bio-medical, Waste, Plastic, Waste Industrial Solid Waste, menstrual waste
		Molecular level understanding of fate and transportation of pollutants (As, Cr, molecular markers)	
		Antimicrobial Resistance (AMR) mitigation in WWTPs	
Environmental Policy and Planning	Advisory to NGT, Government departments	Comprehensive assessment & characterization of existing solid waste system	Development and validation of Biomarkers for Health Risk Assessment for environmental regulations
		Assessment and remediation of contaminated sites	
		Development of Decision Support Tool for informed decisions and actions	
		Engagement with experts and stake holders and build partnerships	Life Cycle Assessment (LCA) tools for Ecological Planning & Application

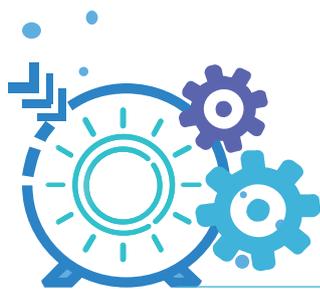


Focus Areas	Short Term Goals	Mid Term Goals	Goals Beyond 2030
Oceans			
<p>Marine and Coral Reef Ecosystems</p>	<p>Sustainable utilization and management of resources in the South Eastern Arabian Sea</p> <p>Interactions between trace metals and marine biota in the Indian Ocean</p>	<p>Biodiversity, Biogeochemistry and Ecology of Subsurface Thin Biological Layers of the Indian Ocean</p> <p>Ocean acidification along the Indian Coast</p> <p>Trans-disciplinary Research for improved forecasting of Indian Marine Fisheries</p> <p>Development of Deep Sea Autonomous Vehicle rated upto 6000 mts depth</p>	<p>The Deep Sea microbial diversity of the Indian Ocean</p> <p>Centre of Excellence in Marine Viral Research</p> <p>MetaDNA repository for the Indian Ocean</p> <p>Development of techniques to remove atmospheric CO₂ from the ocean</p> <p>Expansion of oxygen minimum zones (dead zones) in the northern Indian Ocean</p>
<p>Coastal Processes and Nearshore Dynamics</p>	<p>Long-term evolution of monsoon and associated processes</p> <p>Ecological processes and prediction of coastal pollution in Mumbai waters</p>	<p>Role of climate change on the health of the coastal waters along the Indian coast</p> <p>Coastal and Deep-Sea Bioluminescence in the Indian Ocean</p> <p>Monitoring of Coral reefs</p>	<p>Exploring the carbon offset potential of coastal ecosystem</p> <p>Climate Change-driven impacts on the coastal zone</p> <p>Setting up of coastal observatories and predictive systems</p>
<p>Marine Natural Products for Various Industrial Applications</p>	<p>Farming of Seaweeds and their Value Addition as an Alternative Livelihood For Coastal Fisher Folk</p>	<p>Marine natural products for healthcare, food & aquaculture industries</p>	<p>Development of marine derived molecules for some therapeutic areas specially cancer & infectious diseases</p>



Focus Areas	Short Term Goals	Mid Term Goals	Goals Beyond 2030
Water and Wastewater			
Water	<p>High Resolution Aquifer Mapping & Management in Arid Regions of India</p> <p>Development of affordable IoT-enabled Water Service Delivery Systems</p> <p>Development of a novel technique for 3D sub-surface mapping</p> <p>Design and development of mid-size desalination plant (1.0 MLD) in coastal areas</p>	<p>Sustainable groundwater management in water scarce areas using heliborne technology</p> <p>Conservation and Management of Rivers, Lakes and wetlands</p> <p>Village Level Water Management– A CSIR initiative for Gaon Ka Pani Gaon Me</p> <p>Arsenic Hazard Evaluation In the Ganga-Brahmaputra Basin and Management Solutions for Alleviation</p> <p>Single stage seawater reverse osmosis membrane and module development</p> <p>Fabrication of the world's thinnest polyamide nanofilm (4.5 nm thick) composite membrane/ modules for desalination</p> <p>Development of energy efficient electrochemical remediation / desalination and comprehensive reject management processes</p>	<p>Real time prediction with Big data and ML for Decision Support Tool</p> <p>Establishment of Critical zone observatories</p> <p>Subsidence of global deltas (sinking of river deltas and remediation measures</p> <p>Creation of a Centre of Excellence on Hydrological Models & Projections management</p> <p>Establishing Centre of Excellence for developing India centric hydrological models.</p>
Wastewater	<p>Redesigning for efficiency optimization of Soak Pit</p> <p>Redesigning & development of of Common Effluent Treatment Plant (CETP) to suit different Industrial clusters</p>	<p>Achieving Carbon Neutrality in Wastewater Treatment Plants</p> <p>Development of compact, integrated & efficient STP to suit Urban needs</p> <p>Development of multifunctional granular biomass for improved wastewater treatment</p> <p>Bio-surfactants and its use in environmental remediation</p>	<p>Development of Sanitation safety plan- (100% sewage treatment, recycling & reuse) by 2047 in cities</p> <p>Bio-mimetic and Phyto-Technologies designed for low-cost purification and recovery of water</p>





3 Energy (Conventional & Non-conventional) & Energy Devices



VISION STATEMENT

To be a global leader in benchmarking scalable and sustainable green technologies, ensuring long-term energy (conventional & non-conventional) security of the country, managed through renewable and non-renewable energy resources to enable self-reliant India as a global hub for start-ups in energy sector



FOCUS AREAS

- **Coal Energy (including clean coal technologies/gas/gas hydrate)**
 - » Development of gasification and syngas utilization technologies for conversion of coal to methanol, and chemicals
 - » Direct extraction of hydrogen from coal and green hydrogen production via blue-green/green microalgae and bacteria by a combined fermentation process using versatile substrates
- **Petroleum/Bioenergy including Bio-waste to Energy**
 - » Reduction of crude oil import and making India self-sufficient in sustainable aviation fuel and green fuel implementation
 - » Promotion of bio-jet fuel, green diesel, bio-diesel, and waste plastic to diesel production apart from integrated 2G ethanol technology
- **Hydrogen Energy including Hydrogen Economy**
 - » Next-generation and indigenous low- and high-temperature proton exchange membrane fuel cells, and water electrolyser membranes for green hydrogen
 - » End-to-end technologies for hydrogen value chain including generation, storage, and utilization
- **Energy Conversion and Related Devices**
 - » Development of third generation photovoltaics for decentralized and off-grid energy harvesting applications
 - » Light sharing agri-voltaic, and solar-allied technologies, smart materials, devices, and planar optics

Focus Area Continue on next page...





FOCUS AREAS

- **Energy Materials and Energy Storage Devices**
 - » Development of Li-ion batteries (LIBs) for India-specific applications, beyond lithium technologies for consumer electronics and hybrid devices for e-mobility
 - » Battery recycling and efficient recovery of metals from spent batteries based on circular economy approach, safety ensured BMS and fast charging options
- **Energy Management/Energy & Environment**
 - » Energy conservation through integrated energy audit and sustainable energy management in CSIR labs
 - » Industrial Energy Audit and benchmarking studies

Goals

Focus Areas	Short Term Goals	Mid Term Goals	Goals Beyond 2030
Coal Energy	Coal to Methanol	Membrane-based technology for direct extraction of hydrogen from coal	Syngas via dry, bi- and tri-reforming, Direct Methane to lower olefins, Methanol (oxygenates) and Aromatics
	Solar energy-Based cooking system (Solar Chulha)	Syngas to lower olefins	Database on mercury in Indian coal
	Beneficiation of coking coal fines and washery rejects by flotation process	CO ₂ capture via microbial route	Developing Certified Reference Materials (CRMs) for coal, coal ash and solid biofuels
Petroleum Energy	Biomass waste to bio-coal	Petroleum residue or heavy oil to fuel	Bio-jet fuel and Green Diesel production
	Bio-CNG 2G ethanol (enzymes and waste) and waste plastic to diesel	Integrated Bio-ethanol Technology	Bio-diesel production Plasma treated MSW for syngas production
Hydrogen Energy	Economically viable green hydrogen production from all possible options	Storage and distribution infrastructure	To provide technology and market intelligence to Indian companies in the area of hydrogen technologies



Focus Areas	Short Term Goals	Mid Term Goals	Goals Beyond 2030
Energy Conversion and Related Devices	Development of technology (R&D) for solar cells and agrivoltaics	Development of Nanogenerator-based energy conversion devices, Development of Lab-scale Devices / Characterization	Development of Prototypes & Modules of DSSC, TE and SPV, building integrated photovoltaics (BIPV) and agrivoltaics (BIAV)
Energy Storage and Devices	Safer lithium ion batteries (LIBs) and LIB pack development for EV and strategic applications	Supply chain creation and management to ensure sustainable LIB technology	Public-private partnership, commercialization
	Beyond lithium technologies for real-time applications	Electrodes & electrolytes to match with changing battery chemistry and its applications in devices	Rechargeable Zn-air batteries, Metal-halide and Organic Redox Flow Batteries, Battery and Supercapacitor Hybrid Device
	Battery management systems for safer LIBs	Master-Slave BMS with energy management system for BESS applications & EV swapping stations	Establishing end-to-end indigenous supply chain and large scale manufacturing of raw materials and electrodes Renewable energy-based multi-unit EV charging for the battery-swapping station
Energy Management / Energy & Environment	Data science & machine learning applications in energy management	Energy management system (EMS) for Industry 4.0	Advanced and India specific carbon capture & utilization technologies for the energy sector
	Assessment and Remediation of environmental impacts for energy technologies including renewable energy options	Energy Conservation through Integrated Energy Audit and Sustainable Energy Management in CSIR Labs and Capacity Building	LCA of various energy options, Advanced waste incinerators with energy-efficient emission control including decentralized biomedical waste incinerators, and mask and sanitary pads incinerators





4 • Chemicals (incl. Leather) & Petrochemicals



VISION STATEMENT

Becoming a global leader in R&D on chemicals, petrochemicals, leather, and footwear with a focus on developing technologies that are economically, environmentally, and socially acceptable, with lesser carbon, energy and water footprint compared to benchmarked alternatives.



FOCUS AREAS

- **C1 Chemistry**

To reduce CO₂ emissions through improving energy and atom efficiency of processes, moving to renewable energy sources, and by converting syngas from gasification or bi-reforming of CO₂ with methane from point sources into chemicals and materials, replace fossil derived chemicals like formic acid, olefins, BTX, alkyl carbonate, and to C5+ chemicals by catalytic processes using renewable carbonaceous resources.

- **Biomass to Chemicals & Leather**

Substituted phenols and other oxygenates from lignin, hemicellulose and other bioresources such as cashewnut shell liquid, reforming of

glycerol, and other biomass derived products to hydrogen, conversion of cellulosic biomass into well identified monomers/ chemicals and materials, especially in integrated biorefineries.

- **Agrochemicals**

Structure based design of sustainable indigenous crop protection agents, screening for new and proprietary agrochemicals, Season long lures, deuterated pheromones, PBW and FAW and blends for select high-priority pests as identified by concerned stakeholder ministries, improved and targeted delivery of formulations with minimal impact on desired biodiversity. AI driven approaches to increase accuracy, and speed of solution identification and development.

Focus Area Continue on next page...





- **Marine chemicals including potash fertilizers, salt, and magnesia:**

Substitute potash imports by ~10% of 2021 baseline by 2030; ultrapure salts that meet pharma needs and fortified salts; high purity refractory grade magnesia for the Indian steel industry, marine-based biopolymers and chemical / bioactives.

- **Active Pharma ingredients and Key starting material**

Replace 20% of 2021 level API, KSM and intermediates import with domestic alternatives by 2030. Identify effective molecules as new molecular entities, Solvent free mechanochemical synthesis and solvent based solid form screening; Nanoformulations based on biopolymers, biodegradable carriers, vesicles and having target specificity.

- **Sustainable Chemistries**

The target is a 50% reduction by 2030 relative to 2021 baseline in use of water, solvents, and energy for at least 5 major bulk chemicals, processes of 50,000 tons per year or more annual production within India and 50+ specialty chemical processes with industry acceptance. Progress towards net zero carbon footprint in leather processing and biodegradable strategies for footwear.

- **Performance and Fluoro Chemicals**

Build self-reliance in medicinal chemistry, polymer and composites, dyes and pigments, smart coatings, biodegradable polymers for non-leather footwear, security printing inks, energy materials, biological materials, and up segment leather. Develop 4th generation refrigerants with zero ODP and negligible global warming potential, processes for fluoro intermediates for agrochemicals, fluorinated chemicals for electronic industry, pharmaceuticals etc.

- **AI/ ML framework for accelerated design**

To develop AI-ML framework for accelerated product, and process design for catalyst design, material design, solvent design, process design, and automatic tools for online process control, fault detection and diagnosis. To employ AI-ML framework to address industrially relevant problems such as conversion of biomass and CO₂ to value added chemicals, hybrid materials for hydrogen storage and sorption enhanced steam methane reforming process, green solvents for separation processes, process design for gasifier, photocatalytic, and multiphase reactors.





Goals

Focus Areas	Short Term Goals	Mid Term Goals	Goals Beyond 2030
C1 Chemistry and CO ₂ Chemicals	Establish 2.5 TPD semi-commercial pilot plant at industrial location for MeOH to DME using CSIR's technology comprising globally benchmarked catalyst giving greater than 85% conversion, 99% selectivity and high durability	Lab scale process for converting syngas directly to DME with more than 85% conversion and 60% selectivity	To reduce CO ₂ emissions e.g., by increasing process efficiencies, hydrogen generation from methane using pyrolysis, etc CO ₂ chemicals to formic acid and other high value chemicals/materials through new processes such as flow electrochemistry/photochemistry, etc; Lower olefins through hydrogenation and to C ₅ + chemicals by catalytic processes
Biomass to Chemicals & Leather	Leather like materials from cellulosic biomass Black liquor based dyes and synthetic tanning agents for leather At least 2 C ₆ , 2 C ₅ chemicals	Substituted phenols from lignin Develop process chemistries for one high value chemical derived from CNSL Country wide mapping of resources At least 2 C ₆ , 2 C ₅ chemicals	Sustainable solutions for utilization of all the lignocellulosic biomass At least 2 C ₆ & C ₅ chemicals
Agrochemicals	Technology transfer packages for 5 agrochemicals	Season long lures, deuterated pheromones, PBW and FAW and blends for Anar butterfly	AI driven approaches to identify plant tissue diseases would be undertaken to identify the right chemistries needed. Hybrid pesticides, botanical extracts, plant growth regulators
Marine Chemicals including Potash Fertilizers, Salt, and Magnesia	Potash fertilizers using distillery spent wash and ash, and sea bittern	Substitute potash imports by ~10%; Ultrapure salts that meet pharma needs; fortified salts; High purity refractory grade magnesia with a focus on meeting the needs of the Indian steel industry;	New chemistries and niche competence on marine-based bio-polymers and chemicals/bio-actives for diverse applications



Focus Areas	Short Term Goals	Mid Term Goals	Goals Beyond 2030
Silicates	<p>Precipitated silica (viz., rubber grade), aluminosilicates (viz., detergent grade Zeolite)</p> <p>Silica based tanning agents</p>	Cost competitive technology solutions, with thrust on efficient utilisation of indigenous resources	Address India's import dependence of Si-based materials
Active pharma ingredients and key starting material	14 APIs are in advanced stages of development and translation.	At least two solvent free mechanochemical synthesis technologies and solvent based solid form screening	At least one product technology on vehicles for nanoformulations based on biopolymers, biodegradable carriers, vesicles and having target specificity
Performance chemicals	Medicinal chemistry, polymer and composites, dyes and pigments, Smart coatings, biodegradable polymers in non-leather footwear	Security printing, smart materials, medicinal chemistry, polymers for clean energy, separations, smart packaging, 3D printing, diagnostics and devices in healthcare, composites for strategic and clean energy applications, dyes and pigments, coating materials, energy materials, biological materials, and upsegment leather, superhydrophobic-, antimicrobial-, transparent conducting-smart coatings	Self-reliance in relevant areas
Green Polymers & Degradation	<p>Pre-treatment technologies for delamination, delabeling, adhesive and dust removal</p> <p>Application in non-leather footwear</p>	<p>Polymer degradation into monomers, fuels, gases, hydrocarbons</p> <p>Relevant application in the area of non-leather footwear</p>	Scalable processes for production of alternate polymers – based on renewable feedstock
Specialty chemicals for leather and textiles	Functional chemicals for lighter weight, heavier impact leathers – applications in upholstery and footwear	<p>Reducing carbon footprint through appropriate chemical technologies</p> <p>REACH Compliant chemicals</p>	Chemical for leather and textiles meeting zero discharge of hazardous chemical norms



Focus Areas	Short Term Goals	Mid Term Goals	Goals Beyond 2030
Sustainable chemistries	Focus on atom economic continuous manufacturing, continuous flow synthesis of organic compounds, Process intensification in leather and footwear industry for reduced carbon, energy and water footprint	Create an entity with appropriate governance structure that will enable rapid scale up/ deployment of at least 30 continuous flow platform technologies p.a. Chemicals that are REACH compliant.	The target is a 50% reduction in use of water, solvents, and energy.
Circular economy	Develop at least 3 specialty/ performance chemicals from wastes of manufacturing industries	Develop 5 specialty/ performance chemicals from wastes of manufacturing industries Reduce by 20%, 2021 as baseline, carbon footprint by adoption of circular economy by 2025	Reduce by 40%, 2021 as baseline, carbon footprint by adoption of circular economy by 2030





5 • Agriculture Nutrition • Biotechnology



VISION STATEMENT

Ensuring sustainable agriculture and nutritional security through biotechnological research and innovation



FOCUS AREAS

- **Agrotechnologies and improvement of medicinal and aromatic plants (MAPs)**
 - » Improvement of prioritized medicinal and aromatic plants (MAPs): Ashwagandha, Mentha and Ocimum
 - » Improvement of prioritized essential oil-bearing aromatic crops for transforming India from an importer country to exporter country
 - » Agro technology development for Saffron and Heeng
 - » Registration/release of CSIR varieties of medicinal and aromatic crops
- **Biostimulants**
 - » Seaweed extract formulations for plant growth promotion
- » Biofertilizers and biostimulants using microbial consortia for plant growth promotion
- » Capsules/Nano based biostimulant formulations
- » Bio-pesticides
- » Stress ameliorator
- » Green molecules as biostimulants
- » Secondary metabolite(s) enhancer
- » Development of MAP-based bio-stimulant formulations for enhanced crop productivity
- **Crop improvement through breeding and transgenics**
 - » Cotton crop improvement for biotic and abiotic stress resistance
 - » Rice crop improvement for bacterial blight disease resistant and low GI (diabetic-friendly), and low grain arsenic

Focus Area Continue on next page...





FOCUS AREAS

- » Cannabis crop improvement for low THC and high CBD, oil, fibre and proteinaceous seeds
- » Tomato crop improvement for specific nutrients and early maturity
- » Improvement of Fragrance, Flavor, and Floriculture crops
- **Enzymes**
 - » Industrial enzymes: Carbohydrases and Proteases
 - » Technology for cellulase hyper production and secretion, and cost effective and efficient biomass hydrolyzing enzyme cocktail(s) production for biorefineries
- **Farm mechanization and Precision farming**
 - » Technologies for Farm Mechanization with focus on small scale, energy efficient and cost-effective machineries
 - » Technologies for Precision Agriculture
 - » Development of sensors and supporting hardware for IoT-based agri-informatics
- **Nutritional Security**
 - » Geriatric nutritional products
 - » Obesity
 - » Macronutrient deficiency, Anaemia
- **Value addition**
 - » Valorization of agricultural waste through biomass-based processes and products
 - » Microalgae for industrial applications and carbon sequestration
 - » Certified Reference Materials (CRMs)
 - » Plant proteins and meat analogues
 - » Development of traditional knowledge-based foods, nutraceuticals and dietary supplements
 - » Technologies for minimizing pre and post harvesting losses for fruits and vegetables
 - » Quality assurance certification for raw drugs and materials, and value-added products of medicinal and aromatic plants (MAPs)



Goals

Focus Areas	Short Term Goals	Mid Term Goals	Goals Beyond 2030
Agro Technologies & Improvement of Medicinal & Aromatic Plants			
Genetic improvement of Ashwagandha for high withanone, withanamide and Ocimum for chavicol and rosamarianic acid and other valuable terpenoids and phenylpropanoids through breeding and genome-editing approaches	Genome edited lines developed.	Varieties developed	Continues for other industry prioritized MAPs.
Development of climate-resilient medicinal and aromatic crops (Ocimum, Ashwagandha and Mentha) and improved cultivation practices.	Ready for release		
Development of off season, short-duration and resource efficient varieties of MAPs	Ready for release of resource efficient varieties	Ready for release of off season and short-duration MAPs	
Improved Ocimum variety for terpenoids and phenylpropanoids or improved cold tolerance		Ready for release	
Ashwagandha variety for improved root quality, withanolide content or leaf blight tolerance		Ready for release	
Improved flax variety with decreased cyanogenic glycoside		Ready for release	
Improved green tea variety		Ready for release	
Improvement of prioritised essential oil-bearing aromatic crops for transforming India from an importer country to exporter country	Ready for release of at least 2 varieties each of Lemongras, Palmarosa, Citronella, Lavender and Vetiver	Ready for release at least 2 varieties each of Patchouli, Rosemary, Geranium and Tagetes	Continues for other essential oil bearing crops



Focus Areas	Short Term Goals	Mid Term Goals	Goals Beyond 2030
Expansion of area under cultivation of Saffron and Heeng	Agrotechnology will be developed	Area expansion for self-reliance will be achieved.	
Registration/release of CSIR varieties of medicinal and aromatic crops	NBPGR registration	AICRP and PVV&FRA registration	Continues for all the varieties developed/to be developed.
Bio-stimulants			
Seaweed extract formulations for plant growth promotion	Formulation will be ready and biostimulant registration process will be over		Innovations will be made to improve the products and delivery system such as phyto-inspired peptides and small molecule-based biopesticide formulations
Biofertilizers and biostimulants using microbial consortia for plant growth promotion and abiotic stress amelioration	Formulation will be ready	Biostimulant/biofertilizers registration process will be over as per the regulations, and commercialized.	Innovations will be made to improve the products and delivery system
Capsules/Nano based biostimulant formulations	Formulation will be ready	Biostimulant/biofertilizers registration process will be over as per the regulations, and commercialized.	Innovations will be made to improve the products and delivery system
Bio-pesticides	Formulation will be ready	Biostimulant/biofertilizers registration process will be over as per the regulations, and commercialized.	Innovations will be made to improve the products and delivery system
Stress ameliorator	Formulation will be ready	Biostimulant/biofertilizers registration process will be over as per the regulations, and commercialized.	Innovations will be made to improve the products and delivery system
Green molecules	Formulation will be ready and biostimulant registration process will be over		Innovations will be made to improve the products and delivery system
Secondary metabolite(s) enhancer	Formulation will be ready	Biostimulant/biofertilizers registration process will be over as per the regulations, and commercialized.	Innovations will be made to improve the products and delivery system
Development of MAP-based bio-stimulant formulations for enhanced crop productivity	Formulation will be ready and biostimulant registration process will be over		Innovations will be made to improve the products and delivery system



Focus Areas	Short Term Goals	Mid Term Goals	Goals Beyond 2030
Crop Improvement through breeding & transgenic			
Transgenic high yielding cotton resistant against Whitefly (Introgression of Tma12 gene in ICAR high yielding variety)	Ready for release		
Transgenic high yielding cotton resistant against Whitefly and Helicoverpa (Staking of Cry1 Ac and Tma12 genes)		Ready for release	
Transgenic high yielding cotton resistant against Whitefly, Helicoverpa and pink boll worm (Staking of Cry1 Ac, Cry1EC and Tma12 genes)		Ready for release	
Improved cotton varieties for drought tolerance – molecular assisted breeding		Ready for release	
Cotton varieties suitable for HDPS and machine picking with enhanced boll weight – molecular assisted breeding		Ready for release	
50K Cotton Chip	Ready for commercialization		
Super-improved Samba Mahsuri - Bacterial blight disease resistant and low GI (diabetic-friendly)		Ready for release	
Rice grain with low Arsenic - Molecular Breeding		Ready for release	
Rice grain with low Arsenic - SDN1/SDN2 Genome editing	Ready for release		
Cannabis – low THC and high CBD varieties – breeding/genome editing	Ready for release following conventional breeding/ genome editing approaches	Ready for release following molecular assisted breeding	

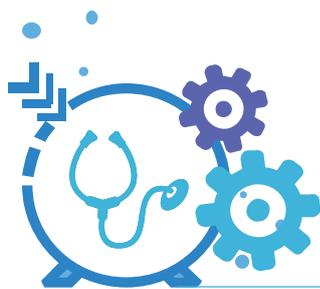


Focus Areas	Short Term Goals	Mid Term Goals	Goals Beyond 2030
Cannabis – low THC and high fibre, oil and proteinaceous seed varieties – breeding/ genome editing	Oil and fibre varieties ready for release following conventional breeding	Oil and fibre varieties ready for release following molecular assisted breeding	Proteinaceous seed varieties ready for release following molecular assisted breeding/genome editing
Flavonoid rich tomato – SDN1/SDN2 genome editing	Ready for release		
Fragrance, Flavor, and Floriculture crops– Mutation breeding and hybridization	Ready for release through mutation breeding and hybridization		Fragrance induction in gladiolus
Enzymes			
Carbohydrases	Complete import substitution		
Proteases	Complete import substitution		
Technology for cellulase hyper production and secretion, and cost effective and efficient biomass hydrolyzing enzyme cocktail(s) production for biorefineries		Release by Regulatory Bodies and complete import substitution	
Farm Mechanization			
Technologies for farm mechanization with focus on small scale, energy efficient and cost-effective machineries	Prioritized machineries and equipment are ready. Prototypes for big equipment are ready.	Full commercialization of farm implements after due certification.	Continuous upgradation of implements maintaining the cost effectiveness.
Technologies for Precision Agriculture	The technology should be ready.	Field deployment of the system.	Continuous upgradation of the system maintaining the cost effectiveness.
Development of sensors and supporting hardware for IoT-based agri-informatics	The technology should be ready.	Field deployment of the system.	Continuous upgradation of the system maintaining the cost effectiveness.
Certification system development for farm implements, machineries and sensors	The system should be in place.		



Focus Areas	Short Term Goals	Mid Term Goals	Goals Beyond 2030
Nutritional Security			
Geriatric nutrition	Products are ready for regulatory approval	Field deployment	Improvement of the formulations
Obesity	Products are ready for regulatory approval	Field deployment	Improvement of the formulations
Anaemia	Products are ready for regulatory approval	Field deployment	Improvement of the formulations
Macronutrient deficiency	Products are ready for regulatory approval	Field deployment	Improvement of the formulations
Value Addition			
Valorization of agricultural waste through biomass-based processes and products	Products and processes as targeted will be ready for commercialization e.g. industrial enzymes	<ul style="list-style-type: none"> Additional products will be developed e.g. important diols Net zero carbon emission 	
Freshwater and marine microalgae for industrial applications and carbon sequestration	Biocrude processing technology to be ready A few nutraceutical products will be ready	Improved technology for greater cost effectiveness of biofuel production Many more nutraceutical products.	Continuous improvement of technologies
Certified Reference Materials (CRMs)	At least 500 CRMs are produced and marketed indigenously	All CRMs required for our country is produced within the country.	
Plant proteins and meat analogues	Targeted products will be ready and approval from regulatory body will be obtained.	Full-scale commercialization with continuous quality improvement.	
Development of traditional knowledge-based foods, nutraceuticals and dietary supplements	Targeted products will be ready and approval from regulatory body will be obtained.	Full-scale commercialization with continuous quality improvement.	
Minimizing pre and post harvesting losses for fruits and vegetables through technology development	Farm site post harvesting technologies will be developed and small portable machineries will be deployed	Pre-harvesting losses can be minimized by developing appropriate biocontrol agents.	Both pre- and post-harvesting losses is controlled for most fruit and vegetable crops.
Quality assurance certification for raw drugs and value-added products including those of MAPs	Certification process will be developed in respect of raw drugs, essential oil and value-added products from MAPs.	More MAPs covered.	





6

● Health Care (HTC)



VISION STATEMENT

Invent, adapt and, deploy the latest bio-innovations, tapping into modern technology and traditional knowledge to make healthcare in India affordable and accessible, ensuring physical and mental wellness.



FOCUS AREAS

- **Wellness and Disease Biology**

- » Cohorts: long-term longitudinal studies to identify factors that contribute to the transition from health to disease.
- » Precision Health: empower medicine to achieve a more optimal, nuanced view towards therapeutic interventions.
- » Modeling human diseases: Animal models, patient derived inducible pluripotent cells, organoid and inter-organoid models in addition to computational models.

- **Diagnosis and Surveillance**

- » CRISPR based diagnostics: accurate, efficient and very sensitive CRISPR based diagnostic assays deployed at rural and remote sites for testing for emerging diseases.
- » Wearable devices: easy-to-wear wettable sensors that can monitor various parameters important to wellness and disease prediction.

- » Biosensors: Reliable and robust biomarkers that can detect and predict disease, Inter-disciplinary development
- » Genomics and big data: Large sets of genomic data and health monitoring wearable devices for big data analysis to alert the healthcare system towards potential pockets of genetic susceptibilities or potential outbreaks of infectious diseases.

- **Technology and Therapeutics**

- » Drug development: Infrastructure and skill base of chemistry optimization, preclinical studies, clinical trials, IPR, commercialization under one roof.
- » Drug Self-sufficiency: From synthesis and export of APIs, build up in house capability of end-to-end drug manufacture to be self-reliant and provide affordable drugs to India and other poorer nations.





FOCUS AREAS

- » Vaccines: Latest vaccine technologies such as mRNA vaccines, better and safer adjuvants as part of an expanding portfolio.
- » Affordable and cutting-edge therapeutics: RNA based therapeutics (and vaccines), genome-editing, organelle transplantations and photothermal therapies are in development stages. Ensuring affordable and accessible solutions based on these new technologies.
- » Biomaterials: New biodegradable scaffolds and biomaterials for transient as well as permanent implants. Robust engineering solutions for developing prosthetics

Goals

Focus Areas	Short Term Goals	Mid Term Goals	Goals Beyond 2030
Wellness and Disease Biology	Cohort Building, iPSCs and organoids	Wearable devices for wellness monitoring	Precision Genomics
Diagnosis and Surveillance	Rare Disease Diagnostics with Sequencing tools, CRISPR based diagnostics for genetic diseases	Big data analytics for surveillance	Big data analytics for surveillance
Technology and Therapeutics	Biodegradable scaffolds, Biosimilars and other drugs	RNA based therapeutic strategies, Vaccines and adjuvants	Drug self-sufficiency
Frontier Area			
Brain Biology	Genomics to detect rare neurological diseases, Location trackers for dementia patients Indian gut microbiome and secretome, Nutraceuticals and brain foods, Traditional remedies for cognitive wellness	Wearable sensors for stroke and seizure Drugs delivery into brain, AI based diagnostics for neurological disorders,	Traditional remedies for cognitive wellness, Futuristic technologies for medical imaging
	Cutting edge research for understanding of the brain, capitalizing on India's strength of a large and diverse population.		





7 • Mining, Minerals, Metals & Materials (4M)

VISION STATEMENT

Catalyze & optimize sustainable metals and materials production and processing, their use and reuse for local and global benefits

FOCUS AREAS

• **Advanced Materials & Processes**

The sub-domains in this thrust are

- » Advanced Ceramics
- » Advanced Composites
- » Functional Materials
- » Materials for sensors
- » Energy Materials

• **2D Materials**

- » Graphene and graphene derivative,
- » MXenes and other emerging 2D materials.

• **Lean and Low-grade resource processing**

The target areas are

- » Coal Characterization and Beneficiation
- » Lean ore processing

- » Valorization of industrial wastes

• **Strategic Materials**

The target areas are

- » Metallic Foams
- » Stealth Materials
- » High strength alloys
- » Armor materials
- » Special Composites
- » Sensors for defense

• **Strategic metals from primary & secondary resources**

- » Comprehensive extraction methodologies and process

• **Engineering critical assessment**

- » ECA Devices/ protocols, ML enabled databases on ECA



Goals

Focus Areas	Short Term Goals	Medium term goal	Goals Beyond 2030
Advanced Materials & Processes	Bio-ceramics	Powder for Additive manufacturing	Fibre Laser technologies
	Self-healing Coatings	Super-hydrophobic coatings	Fuel cells
Membrane technologies			
2D Materials	Graphene Nano platelets	Mxenes	2D devices and appliances
Strategic Materials	Strategic glasses	Advanced High Strength steels	Stealth Coatings
	Metallic Foams	Fiber reinforced composites	
Lean resource processing	Utilization of Non-Coking coal for Coke making	Dry beneficiation protocols	High purity EMM and EMD production
	Cobalt and Nickel recovery from wastes and effluents	Recovery of values from lean & low-grade ore	
	Platinum group metal recovery from primary & secondary sources	Utilization of metallurgical plant waste	
Strategic metals from primary & secondary resources	REE extractions from secondaries	Ca extraction	REE extraction from primaries
	W extraction from secondaries	Li extraction from secondaries	LI extraction from primaries
Engineering critical assessment	ML enabled databases on ECA	ECA Devices/ protocols,	IOT/AI enablement of industrial components





8

• Civil Infrastructure & Engineering (CIE)



VISION STATEMENT

To be a forerunner in civil and infrastructural engineering domain by excelling in research in frontier and cutting-edge areas, developing competitive technologies, embracing innovative inter-and trans-disciplinary approaches for the growth of sustainable civil infrastructure, and providing high value-added services to the industry and society at large



FOCUS AREAS

- **Structural Health Monitoring & Life Extension:** Structural Health Monitoring, Aging Infrastructure & Smart City Infrastructure for clientele like; Indian Railways, NTPC, NHAI, Construction Industry, NHAI, Urban Bodies and State Governments
- **Disaster Mitigation:** Disaster resilient infrastructure, Renewable energy infrastructure, Strategic infrastructure, climate action, Special and multi functional structures for clientele like; Offshore renewable energy industries, NIWE and Power industries
- **Building Physics & Materials:** Next generation construction materials like 3D printing of cementitious composite elements, self-healing sustainable concrete, Circular economy in construction materials,
- **Rural Infrastructure:** Solar powered cold storage for agricultural produces, Post harvesting technologies for high humid environment, Agricultural waste to value added products, Cold mix technology for high volume roads, Bamboo reinforced concrete structures for low cost housing
- **Mobility Infrastructure & Planning:** Techniques for road assets management, Safe road connectivity for hilly terrain, Hill road widening using light weight geofoam blocks, Traffic circulation plan around metro station & impact quantification, Indian Road (Highway) safety manual and folded textile reinforced panels





- **Automation & Robotics:** Focus on robotics & automation and Industry 4.0, Additive manufacturing, next generation digital manufacturing, next generation electric mobility
- **Waste to Wealth:** Geopolymer concrete for fast-track construction, Self-compacting

high-strength concrete, Polymer/nanocomposite using plastic waste, Self-sustainable Integrated Municipal Solid Waste Disposal System (IMSWDS) for bulk waste generator utilization of waste materials, industrial solid wastes, and valorization of sludge in construction.



Goals

Focus Areas	Short Term Goals	Medium term goal	Goals Beyond 2030
Structural Health Monitoring & Life Extension	<ul style="list-style-type: none"> • Methodologies for real-time structural health monitoring (SHM) including corrosion monitoring • Indigenous sensor development • Focus on different structural parameters for analysis of buildings and other structures • Building Information modeling (BIM) towards bringing construction sector into the digital • Development of IoT based toolbox for monitoring of structures and data analysis 	<ul style="list-style-type: none"> • Implementation of data warehouse on cloud in order to provide global access for SHM using IoT • Centre of excellence for SHM • Indigenous development of vibration measurement and control devices • Standards for SHM of civil infrastructure including pavements 	<ul style="list-style-type: none"> • Drone based real-time defect identification in infrastructural facilities • Cyber-physical systems for SHM (IoT, ICT, Industrial Internet of Technology (IIoT) enabled maintenance scheduling of infrastructure, Digital twin)
Disaster Mitigation	<ul style="list-style-type: none"> • Onshore / offshore renewable energy structures • Performance based seismic safety evaluation methods • Retrofitting techniques for various infrastructure • Agro infrastructure (poly houses, grain storage) 	<ul style="list-style-type: none"> • Design of pilot floating offshore structures for RE farming • AI and ML based risk assessment methods • Disaster warning systems • New sustainable materials and prefabricated elements/connections 	<ul style="list-style-type: none"> • Development of hybrid floating renewable energy system • Establishment of large-scale and full-scale testing facilities for verification of developed technologies • Structural re-engineering to address climate change



Focus Areas	Short Term Goals	Medium term goal	Goals Beyond 2030
Disaster Mitigation		<ul style="list-style-type: none"> • Seismic Safety of traditional housing • Establishment of “Center for Excellence in Multi-hazard Risk Reduction” in CSIR • Offshore structural engineering including pipelines, barge structures, floating and fixed structures 	<ul style="list-style-type: none"> • Agrivoltaics for simultaneous solar power generation and agriculture • Bio-inspired engineering of structures
Building Physics & Materials	<ul style="list-style-type: none"> • Advanced Cementitious Composites for 3D printing • Development of special construction materials such as textile reinforced concrete, geopolymer concrete, cold weather concrete admixture, multifunctional materials • Data science applied to building engineering • Building information modeling in high rise buildings 	<ul style="list-style-type: none"> • Computational material modelling with Material-Structure integrated approach • Circular economy in construction materials • New technologies for enhanced productivity at construction sites • Net zero energy and carbon neutral buildings • Concrete surface coatings and corrosion inhibitors • Design and development of enhanced workspace series-parallel robot with macro-mini approach for 3D printing of civil concrete structure • Development of new age construction chemicals 	<ul style="list-style-type: none"> • Net Positive Energy Buildings • Self-healing sustainable materials • Meta materials • Low-cost carbon sink construction materials (towards carbon capture and utilization)
Rural Infrastructure	<ul style="list-style-type: none"> • Cement-free manufacturing of Building Bricks and Interlock Blocks for Low-Cost Housing • Bamboo reinforced concrete structures for low-cost housing • Utilization of agro-waste in building products • Mechanized scavenging 	<ul style="list-style-type: none"> • Curbing air pollution from brick-chimneys • Self-Compacting Geo-Polymer Concrete • Low cost wall plastering machine • Bamboo in large-scale construction 	<ul style="list-style-type: none"> • Cold mix technology for high volume roads



Focus Areas	Short Term Goals	Medium term goal	Goals Beyond 2030
<p>Mobility Infrastructure & Planning</p>	<ul style="list-style-type: none"> • Slope Stability analysis for road infrastructure • Technology for faster construction of concrete roads • Drone, Satellite and Vehicle (onboard sensor) based Road Condition Monitoring Techniques for Road Asset Management • TRC fencing panels for highway • Innovative Designs to utilize various localized Marginal Materials in Embankment, Flexible and Rigid Pavement Construction. 	<ul style="list-style-type: none"> • National Test Laboratory of Road Signs and Markings to conduct various performance related tests • Country's maiden Simulator based Driver Training and Testing Laboratory to enhance psychomotor driving skills and support authorities in licensing • Innovative Controlled Blasting Technique for Tunnel construction for Metro Systems to increase speed of construction, prevent slope failures, fatalities and structural damages • Intelligent Sensor based Warning System to avoid the Vehicle-Animal Conflicts in Forrest/ Hilly Areas • Establishment of Centre of Excellence in Artificial Intelligence / Machine Learning (AI / ML) • Application of 3-D Printing Technology for pavement (bituminous and concrete) rehabilitation 	<ul style="list-style-type: none"> • Drone based Automatic Road Safety Audit System • National Crash Barrier Test Facility • Hyperloop and Intercity High Speed Rail feasibility • Feasibility of Autonomous Vehicle Operation for Indian Traffic Conditions
<p>Automation & Robotics</p>	<ul style="list-style-type: none"> • Demonstration of miniature Foundry 4.0 (20ft x 20ft)& Associated Technologies for low melting temperature alloy i.e. aluminium. • Multifunctional product design and AM process design and optimization on existing systems and new processes for materials like ceramics, glasses 	<ul style="list-style-type: none"> • Development and Demonstration of Foundry 4.0 in Sand, investment and pressure die casting sector and its diffusion to foundry cluster. • Large scale production technologies for indigenous materials suitable for Additive Manufacturing and application in different areas such as aerospace, medical 	<ul style="list-style-type: none"> • On demand manufacturing in space and lunar manufacturing with in-situ resource utilization. • Implementation of Advanced Driver Assistance Systems (ADAS) • Integration of power electronics with battery charging functions



Focus Areas	Short Term Goals	Medium term goal	Goals Beyond 2030
Automation & Robotics	<ul style="list-style-type: none"> • Developing actuation systems and their control for physically interactive applications • Soft robots for medical applications • Underwater robotics for underwater inspection of structures, ship hull, deep sea exploration etc • Next generation fully electric machines/ vehicles • Hybridization of battery, ultracapacitor and fuel cell sources. • To provide solutions to strategic sector in the area of Unmanned Ground Vehicles both for outdoor and indoor surveillance and active interventions 	<ul style="list-style-type: none"> • Integrated computational modelling for new alloy design using multiscale modelling • Development of a digital twin for in-situ certification process • Robots for Advanced Industry, mobile health, hospital management, pipeline inspection, defence, explorations in remote, inaccessible and hazardous areas • Design and development of Unmanned Aerial Vehicle for various applications such as Bridge Inspection, Disaster management etc. • Development of modular electric power train components 	<ul style="list-style-type: none"> • Sustainable robotic solutions to cater the need to the country for strategic, industrial, societal and other domains • Incorporation of intelligence to the robotic systems using various AI/ ML for human friendliness and operations in the unknown and unpredictable environments
Waste to Wealth	<ul style="list-style-type: none"> • Development of Bio Binders from various Industrial and Agricultural Wastes for Road Construction • Development of a process technology in converting various waste materials in to value-added composite materials for structural and non-structural applications 	<ul style="list-style-type: none"> • Upscaling and pilot scale manufacturing of developed composites materials • Utilization of Iron ore tailings in brick manufacturing 	<ul style="list-style-type: none"> • Multi attribute optimizing processes to develop cost effective building materials using industrial wastes • Development of green building materials to avoid carbon emission in civil infrastructure





ALIGNMENT TO NATIONAL MISSIONS / SCHEMES / SDGs

CSIR as a dynamic, responsive organisation, as in the past, responded quickly to the needs and priorities of the nation. CSIR objectives & goals are aligned to the needs and the opportunities of National Missions/Schemes and Sustainable Development Goals (SDGs). In aligning CSIR goals/targets the guiding principles are

- High levels of Novelty and Innovativeness
- Global competitive positioning in Science & Technology
- Potential Private Goods, Public Goods, Societal Goods & Strategic Goods benefits that could be accrued to the Socio-economic development of the country





ACCELERATING INNOVATIONS & ENTREPRENEURSHIP FOR SUSTAINABLE ECONOMIC GROWTH

Start-up Ecosystem – Indian Context

Start-up India is a flagship initiative of the Government of India, intended to build a strong eco-system for nurturing innovation and Start-ups in the country that will drive sustainable economic growth and generate large scale employment opportunities. The start-up emergence in product manufacturing sector needs support from industries, R&D establishments technology interventions, to scale-up their new ideas and innovations to become global companies. Together these **Three Pillars** viz., **Private Industry, R&D establishments** both in Public & Private sector through innovation and scalable technology, and **Start-ups** can generate impactful solutions, and thereby act as vehicles for socio-economic development and transformation.

“*I see start-ups, technology and innovation as exciting and effective instruments for India’s transformation.*”

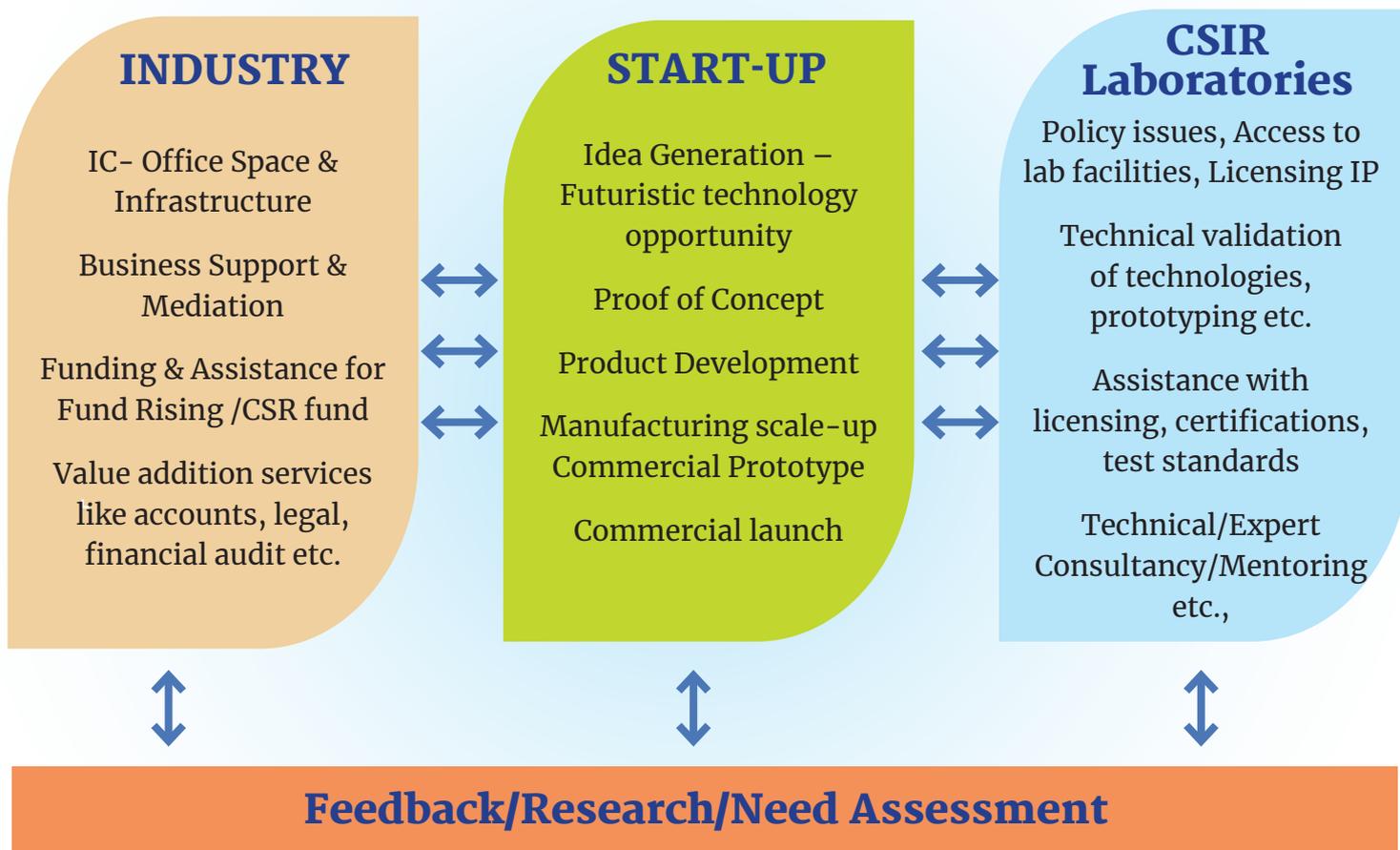
Shri Narendra Modi
Prime Minister of India



CSIR Framework of Three Pillars for Start-up Ecosystem

Incubators can play a vital role in ensuring that the [start-ups] experiments are conducted in an effective manner by providing the necessary skills, resources and support systems

Goals For Sustainable Development





Way Forward

Transitioning technology oriented product manufacturing start-ups from “concept to market” is extremely complex and requires a multi stage innovation curation and de-risking model. Innovators may need support and guidance of the stake-holders of the ecosystem for establishing product-market fit, pilots and validations, capital access, regulatory pathways and accelerated market entry. This approach would carry great hopes to make India as an innovation and manufacturing hub for sustainable economic development leading to large scale employment generation.

Setting-up Theme specific Innovation/Incubation cum Tech Parks– Hub & Spoke Model

- ✓ 8 theme-based Innovation/Incubation cum Tech Parks shall be set-up at the theme nodal laboratory in **PPP mode** by creating section-8 company.
- ✓ The Innovation cum Tech parks breaks down the traditional, artificial barriers of innovation through its connectivity and collaborative interaction.
- ✓ The **theme laboratories to work in a hub and spoke model** and collaborate with Central & State governments, Indian and foreign VCs, angel networks, banks, other incubators, tech-parks, legal partners, consultants, and academia.

Launch of Grand Innovation Challenge Projects

- ✓ Theme specific projects with funding from CSIR for finding **ultra-low-cost solutions to India’s pressing and intractable problems**

Entrepreneurship Promotion

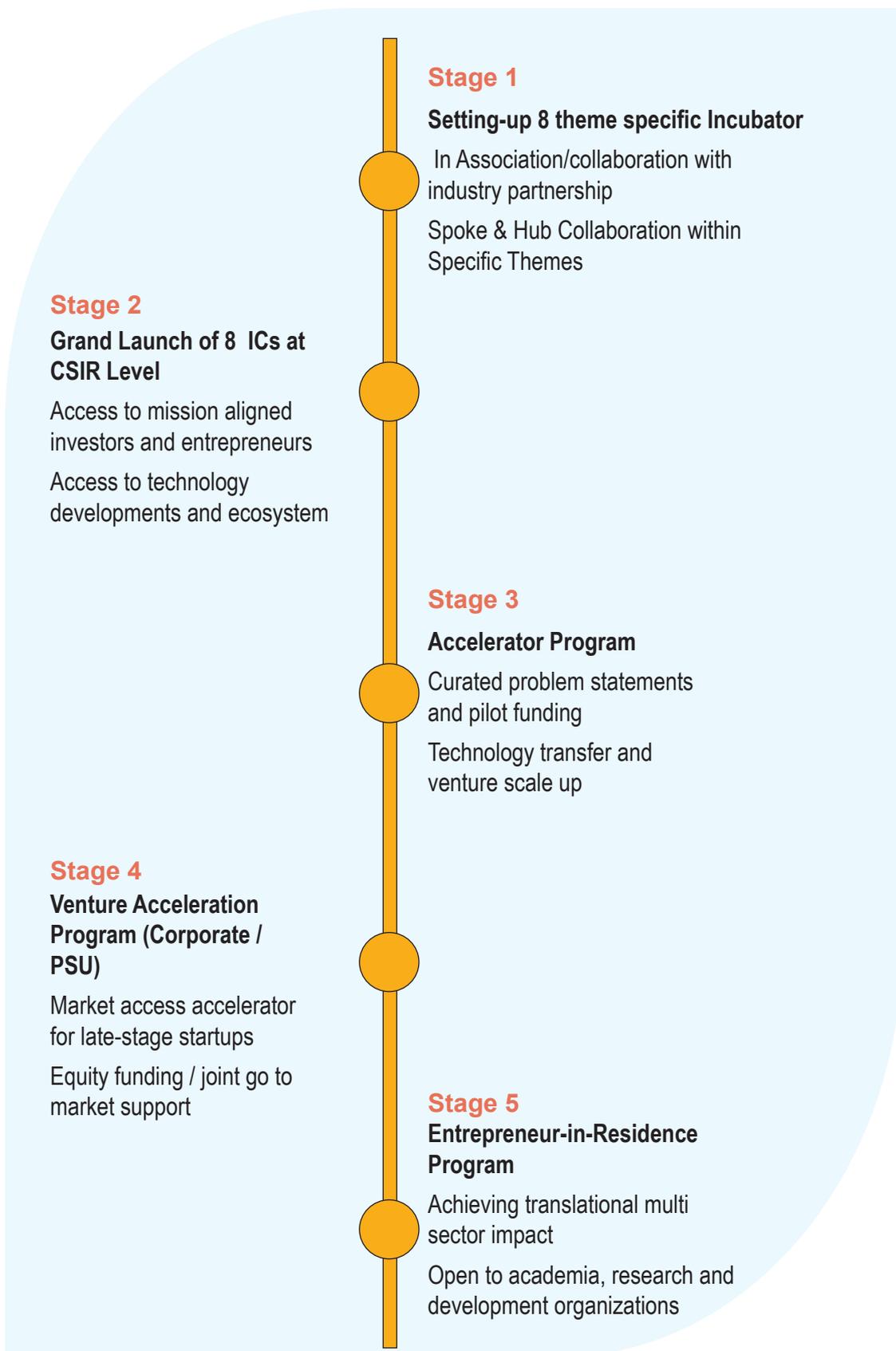
- ✓ From existing big cities to semi-urban and rural areas to promote **Rural Entrepreneurship**
- ✓ **Talent utilization:** Simplification of policy & handholding of **CSIR scientists to become entrepreneurs** with their innovations to contribute to economic growth
- ✓ Special incentives for **CSIR Women Scientist Entrepreneurship**

Incubation Centre for Skill Development

- ✓ Start-up Enabling Platform for today’s youth who want to gain meaningful opportunities in their career and start-up space. Theme/Industry specific comprehensive programs in collaboration with Central/State Skill Development Councils to create skilled personals and India’s NextGen Entrepreneurs!



IMPLEMENTATION PLAN OVERVIEW





STRATEGY

- **Involvement of industries from the beginning**

CSIR, with its long history of collaborating with the industry, realizes the value of early partnerships. Connections with industry must be forged from the beginning of projects to allow a constant monitoring of relevance and impact.

- **Movement of staff from CSIR to Industries and vice versa**

A constant bi-directional flux of human resource between CSIR and Industry at all levels, from skilled lab personnel to top leadership that energizes both scientific and industrial R&D and creates an environment of mutual growth. CSIR will facilitate and incentivize such a flux and allow the best practices of both work environments to be adopted.

- **Collaboration**

Synergistic collaborations that strengthen the CSIR system through inter-lab collaborations, will promote borderless, interdisciplinary research. CSIR will create opportunities and ambience that encourages and rewards inter-laboratory interactions. CSIR will actively pursue tie-up with academia on the one hand and industry on the other, providing an intellectually rich ambience for young innovators in start-ups and young scientists in R&D.

- **Co-location of CSIR labs in industries**

CSIR will set-up focused technology development units within the premises of industrial plants and factories, to facilitate the rapid development of technologies demonstrated in the lab, by the industry. Government funded scientists and projects will be embedded in industries to create an ecosystem of market awareness and industry relevant research in CSIR

- **Monitoring by LSG**

Lab Strategy Group to guide laboratories on taking-up grand challenges project, frontier research areas, industry driven projects and formulate strategy for implementation within and across CSIR labs

- **Change Management**

An organization that is ready to adapt to changing situations is an organization that maximises its chances of success in a dynamic world. CSIR will create institutional strategies to embrace and manage change effectively through policies that encourage and reward individuals and teams that engage in continuous learning and re-learning.



- **Working for cutting-edge technologies, R&D**

CSIR will promote fundamental research in frontier areas of science and technology to create a talent pool of globally competitive scientific leaders who contribute to the growth of knowledge. In the technology driven and technology dependent future, the ability to adopt and build on this knowledge through cutting edge technologies, is a national need. CSIR, with its clear focus on leading technologies, can enable its collaborators by becoming the local hub, often working with state governments, to tap into, for advice, experience, training and skilling of workforce.

- **Connect with Stakeholders**

CSIR, through science and technology exhibitions, industry meets and conventions, keeps a deep and dynamic connection with stakeholders spanning start-ups, SMEs, ministries, academia and NGOs. These opportunities for liaisons will be strengthened in quality and frequency.

- **Whole of Government**

CSIR will align its programmes to meet the expectations and objectives of the national mission, national schemes of the various Ministries like Regional Transport Aircraft for the UDAN scheme, Clean water technologies for Jal Jeevan Mission, Medicinal plants for National Aayush Mission, Lean resource processing for National Mission for Waste to Wealth, Mobility infrastructure for smart cities. The holistic approach of CSIR labs and interdisciplinary expertise would help to provide impetus to Government Missions/Schemes.

- **Policy Impetus**

National policy that safeguards the interests of our people has to be based on science and technology. CSIR aims to be the governments' reliable partner in providing scientifically correct and accurate information that enables strong policy decisions.





CAPACITY BUILDING

The self-reliant India campaign, is the vision of new India, envisaged by the Hon'ble Prime Minister Shri Narendra Modi and is based on five pillars; Economy, Infrastructure, System, Vibrant Demography and Demand. Contributing to this vision, CSIR promotes ground-breaking solutions that aim to foster incubation centres, start-ups, renewable energy options, creating wealth from waste and a number of such options. This is done by continuously working on Capacity building of its human resource by developing and improving skills, mindsets and processes required to address the growing needs of the country. The human resource capacity building aims to develop world class, outstanding and inclusive research manpower through research fellowships, grants and awards, such that they can catalyse India to be a global power of innovation.

Along with capacity building of its human resource, CSIR strives to improve capacity building of its infrastructure to support new skill sets and stand tall in a globally competitive world. CSIR addresses “**Change Management**” with its efforts on improving capacity building on a regular basis.





OUTREACH INITIATIVES

Outreach programs are aimed to uplift, and support those who are in need of certain services and rights. It is really imperative for CSIR to leverage its network with society, industries, academia, socio-economic ministries and NGOs

Over the years, Council of Scientific and Industrial Research (CSIR) has contributed substantially by developing several technologies for societal and industrial development of our country. The S&T interventions made by CSIR could considerably impact society, benefitting common man in several fields like housing, agri-income enhancements, safe drinking water, food, environment, etc. CSIR successfully addressed the problems related to poverty, inequality, access to health, education and housing, significantly benefitting rural population especially those at the base of economic pyramid. CSIR, through its several mission-driven high-impact programmes have considerably enhanced the income of farmers. Aroma mission alone has benefitted more than 20,000 farming families, enhancing their incomes by at least Rs. 50,000-60,000/ha annually. This programme has become a source of about 1000 tones of essential oils worth Rs. 10 crores for our Aroma industry. Similarly, sea weed cultivation, making incense sticks from offered flowers has provided substantial benefits to several self-help women groups. It is estimated that the Medicinal and Aromatic Plant-based technologies of CSIR can generate rural employment of about 600 lakhs man-days every year. For an effective reach out of S&T interventions to a common man, CSIR would be integrating itself with government policies and interface effectively with socio-economic ministries responsible to deliver social goods and services.

CSIR, will be identifying the need of technological interventions and the laboratories who can provide appropriate solutions and pro-actively approach National Flagship Programmes like Swachh Bharat Abhiyaan, Poshan Abhiyaan, Jal Shakti Abhiyaan, Prime Minister Matsya Sampada Scheme, Pradhan Mantri Awaas Yojna, National livelihood Mission etc. as a technology partner to work in a Mission Mode to address those identified technology needs. Also PhD scholars, as a part of their curriculum, may once in a year go to industry cluster/ MSME sectors, National Flagship Mission etc. to identify unmet technology needs. For an effective dissemination as well as deployment of technologies, the possibility of collaboration with corporate NGOs to support technology solutions to address ground-level issues in diverse fields will be explored. CSIR laboratories will hand-hold small and rural entrepreneurs including CSIR scholars and project staff wishing to become tech-entrepreneurs by deploying CSIR technologies/expertise. CSIR will engage itself with banking sectors through banks like NABARD or State Finance Corporations by assisting them with model DPRs for inclusion of CSIR supported social sector entrepreneur into their portfolio of bankable projects.



For an effective reach out of S&T interventions to common man, CSIR would be integrating itself with government policies and interface effectively with socio-economic ministries responsible to deliver social goods and services. CSIR initiated a programme for school going children named Jigyasa which aims to develop the culture of inquisitiveness for motivating them to choose science as their career. CSIR as part of its scientific social responsibility, is instilling scientific curiosity among school children by exposing them to science through this flagship Jigyasa program and Virtual Lab platform. It aspires to expand science outreach in regional languages on one hand and to connect them to global science on the other hand such that they rise to be champions of Atmanirbhar Bharat.





ROADMAP

- Promote young leadership: Identify young leaders and fast track their ideas in parallel tracks for knowledge generation or technological innovation
- Tap CSR funds: building self-reliance in research funding while improving ties with the industry
- Set up porous borders between Industry, Academia and CSIR: Set up processes that facilitate movement of scientists between these three pillars of the knowledge economy.
- Research-Industry Conclaves: Frequent conclaves of research and industry with a focus on problems and challenges, pan-CSIR science meets to promote inter-institute collaborations
- Build an organization that is ready to embrace change: Embedding continuous learning in the evaluation system for individuals and teams
- Transform Scientists to leaders: Lectures by IIM faculty for scientists to learn the industry eco-system.
- Leverage maximum impact from technological innovations: Involve domain experts in licensing negotiations
- Build Techno-parks and incubators in each CSIR institute to nurture and cross ideas over from research to start-ups.
- A lean and focused CSIR: pan-CSIR challenges on focused problems where the best minds may work in close collaborations.
- Sustainability and inclusivity: A strong thrust to technologies that use circular economy and sustainable solutions.
- Bouquet of technological solutions that collectively have a large footprint on making lives easier





ANNEXURES

The following eight Thematic Vision Documents form the basis of CSIR Vision 2030.

1. Aerospace, Electronics, Instrumentation & Strategic Sector
2. Ecology, Environment, Earth and Ocean Sciences
3. Energy (conventional and non-conventional) and Energy Devices
4. Chemicals and Petrochemicals
5. Agriculture, Nutrition and Biotechnology
6. Health Care
7. Mining, Minerals, Metals and Materials
8. Civil Infrastructure and Engineering

The above documents can be downloaded from the following link
www.csir.res.in



