



tcg crest

Inventing Harmonious Future

Institutional Profile
2020

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Inventing Harmonious Future

TCG Centres for Research and Education in Science and Technology

Facilitating Research in Fundamental Science and Cohesive Technology



The Chatterjee Group

Founded by Dr. Purnendu Chatterjee in 1989

01

The Chatterjee Group (TCG), a premier conglomerate, has an enviable track record as a strategic investor, with businesses and operations spanning several continents and industries.

02

The Chatterjee Group (TCG) specializes in Petrochemicals, Pharmaceuticals, Biotech, Financial Services, Real Estate and Technology sectors in the US, Europe and South Asia.

03

It provides end-to-end product and service capabilities through its investments and companies in these sectors.

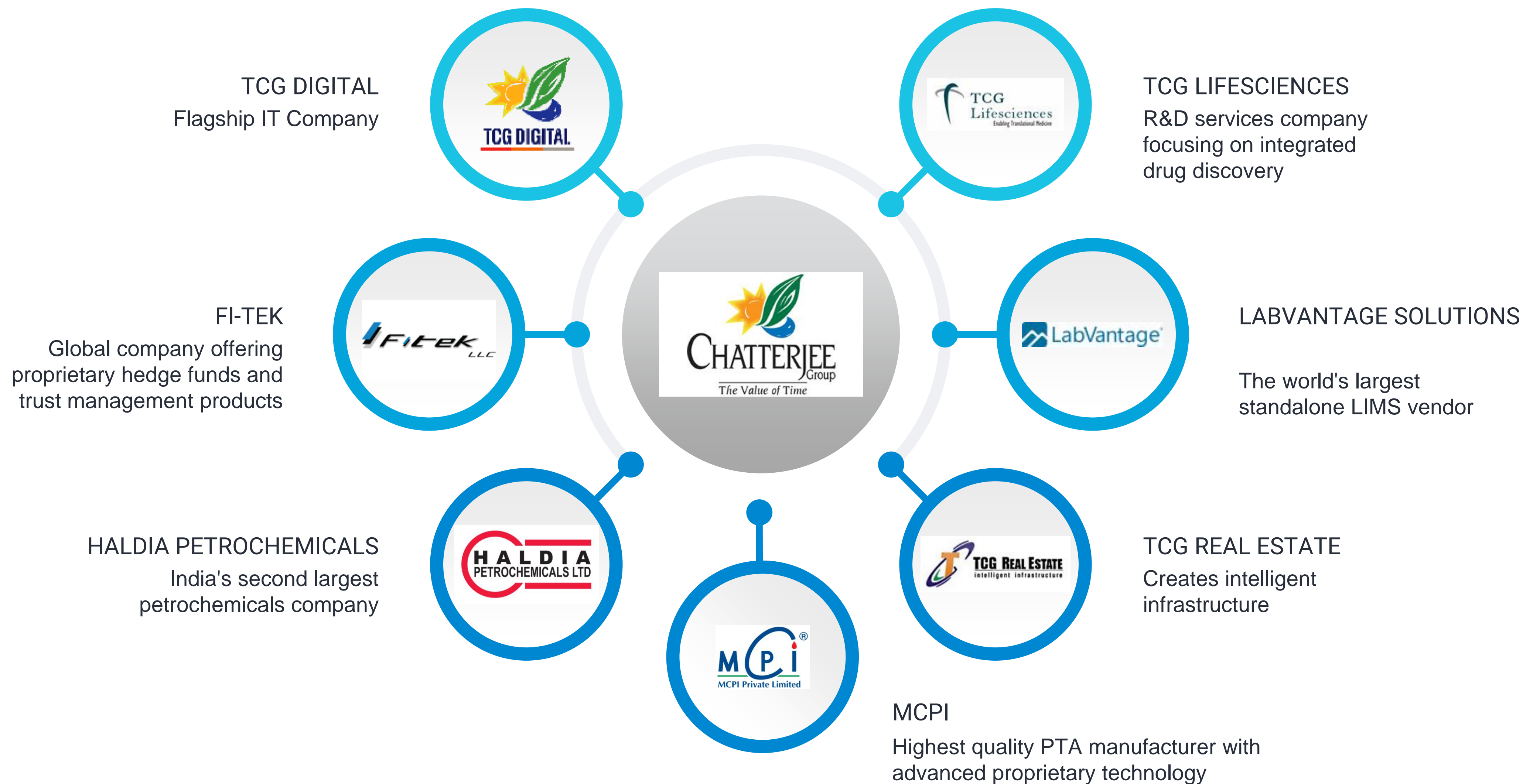
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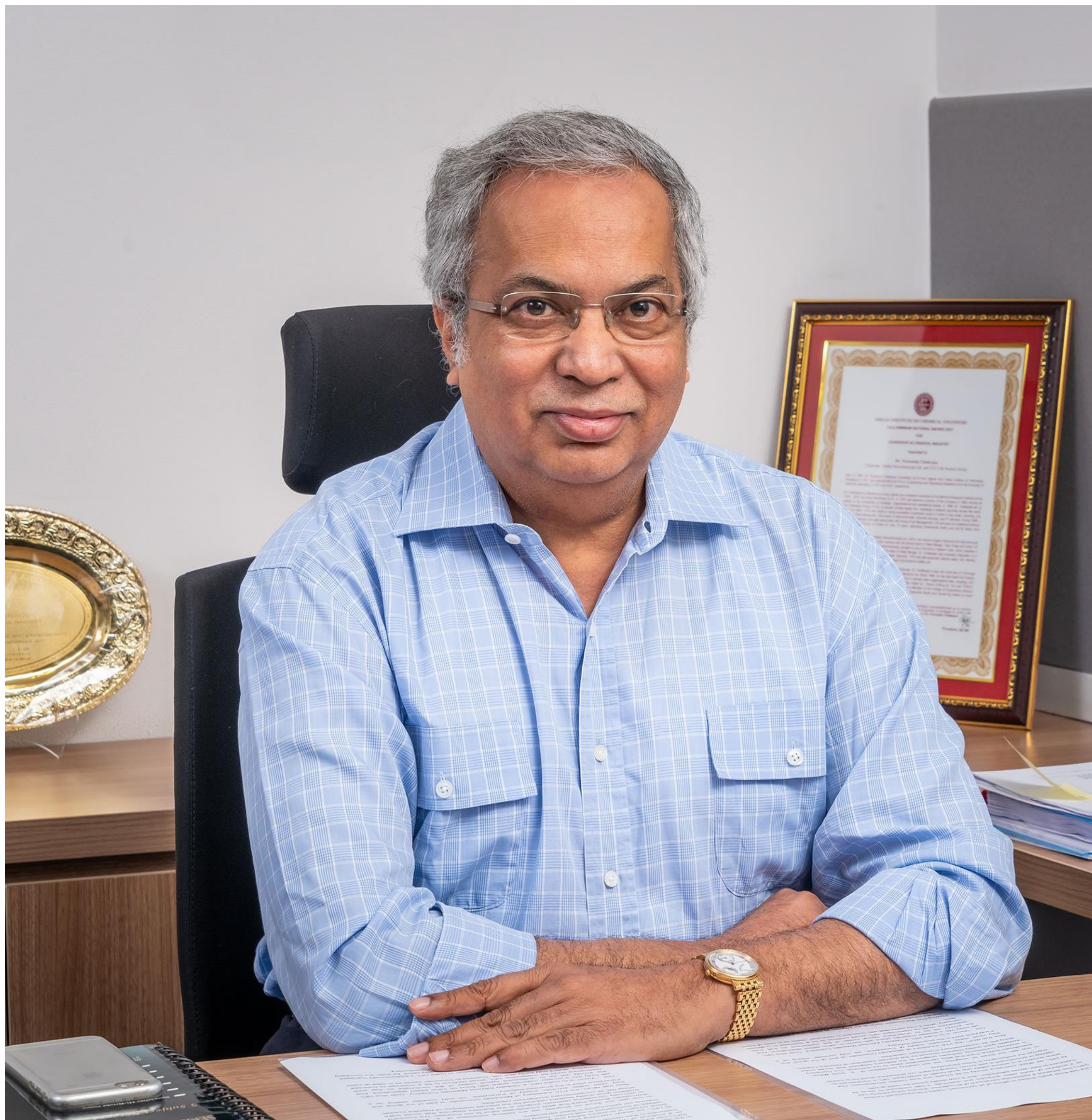
TCG CREST, a not-for-profit organization, has been founded by TCG in 2019 to unleash the true potential of India's scientific talent in collaboration with global institutions.

05

TCG CREST aspires to pursue excellence in research and education in niche as well as cross-disciplinary areas for solving challenging problems of societal significance.

Group Companies





Vision of TCG CREST

TCG CREST aspires to be a world-leading research institute that unleashes the untapped and true potential of human talent. As an institution, TCG CREST is dedicated to the three K's

- Knowledge Creation
- Knowledge Application
- Knowledge Dissemination

The focus is on creating a strong network with highly-reputed knowledge centres throughout the world

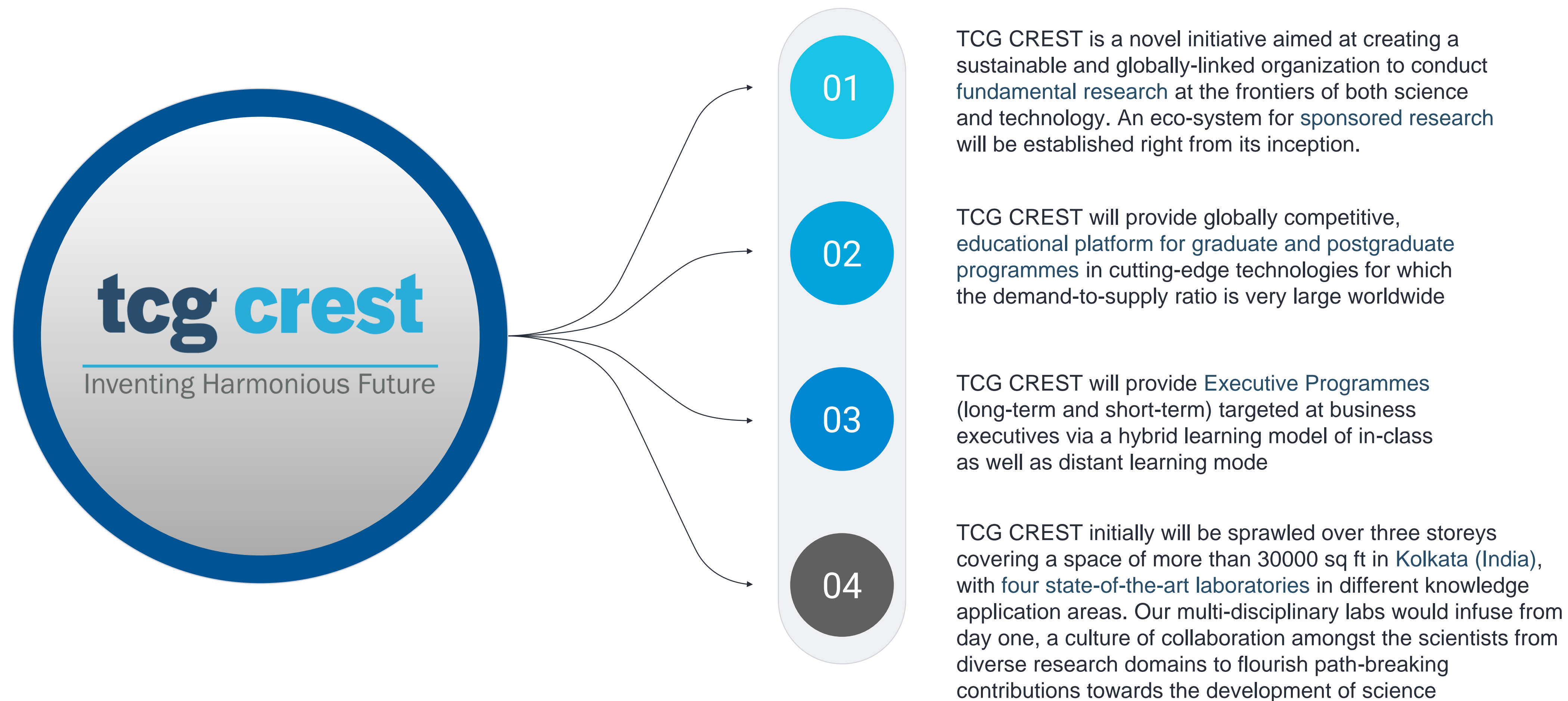
- Universities
- Research Institutions
- Technology-driven Global Corporate Entities
- Academic Communities

The goal is to inculcate a strong culture of continual knowledge exchange through

- Research
- Student Exchange
- Faculty Exchange
- Joint Projects
- Collaborative Workshops
- Participative Seminars
- A Host of Classroom Interactions

www.tcgcrest.org

Overview of TCG CREST

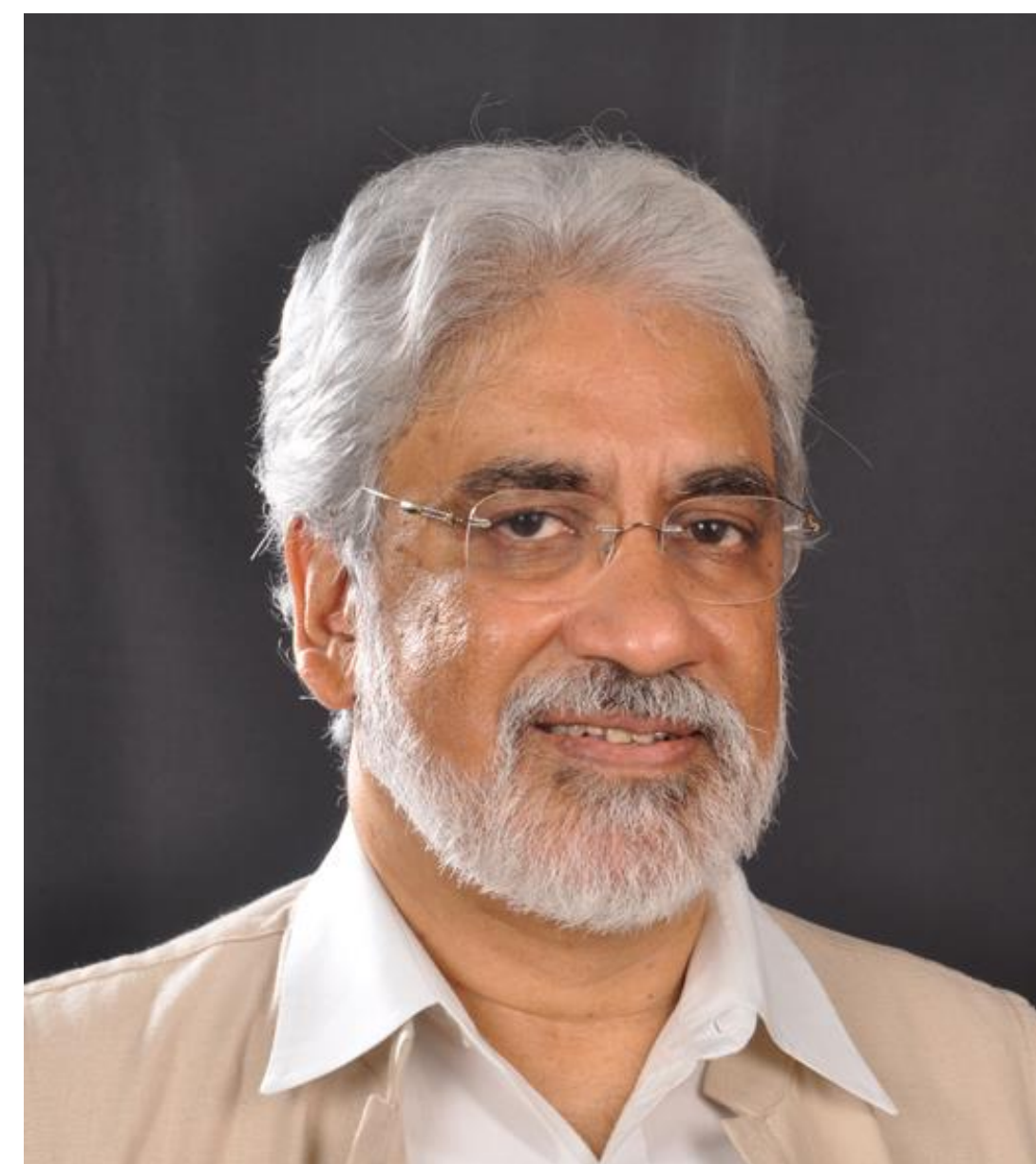


TCG CREST Board of Directors



Dr. Purnendu Chatterjee
Founder & Chairman of TCG CREST

Founder and Chairman of
The Chatterjee Group (TCG)
Member of the Governing Board of
The Indian School of Business (ISB)
Former Partner of McKinsey & Co.



Dr. Sabyasachi Bhattacharya
Director of TCG CREST

C.V. Raman Professor, Ashoka University
Former Director and Distinguished
Professor, Tata Institute of Fundamental
Research (TIFR)
Former Acharya J.C. Bose Distinguished
University Professor at
Presidency University, Kolkata

TCG CREST Board of Directors



Dr. S. Shankar Sastry

Professor of Electrical Engineering and
Computer Science & Bioengineering

Faculty director of the Blum Center for
Developing Economies at UC Berkeley

Former Director of the Information
Technology Office at DARPA

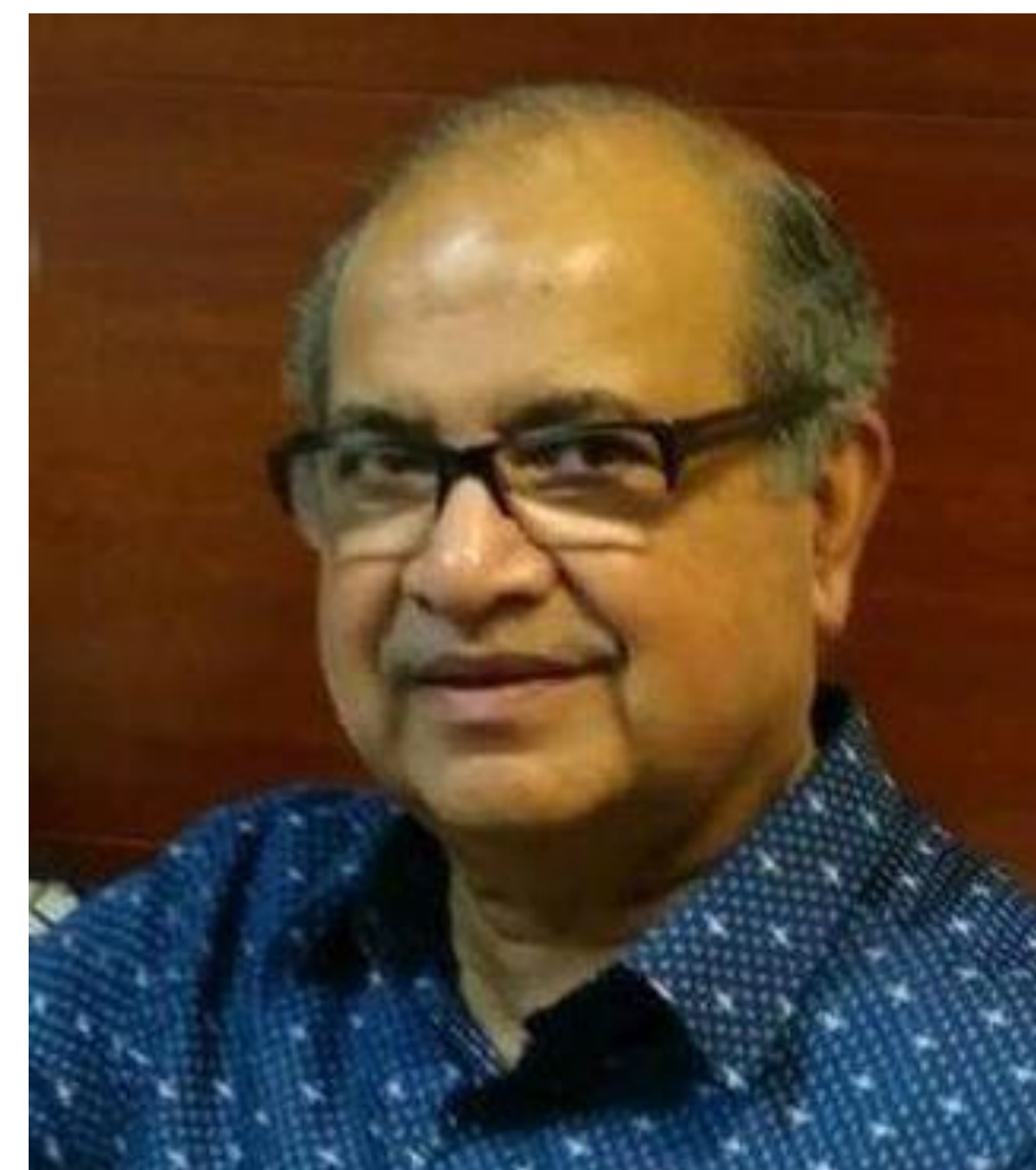


Swapan Bhattacharya

Managing Director at TCG Lifesciences

Member of the Board in Biotechnology
Committees of US-India Business Council

Member of Confederation of Indian
Industries (CII) and Federation of
Indian Chambers of Commerce
and Industry (FICCI)



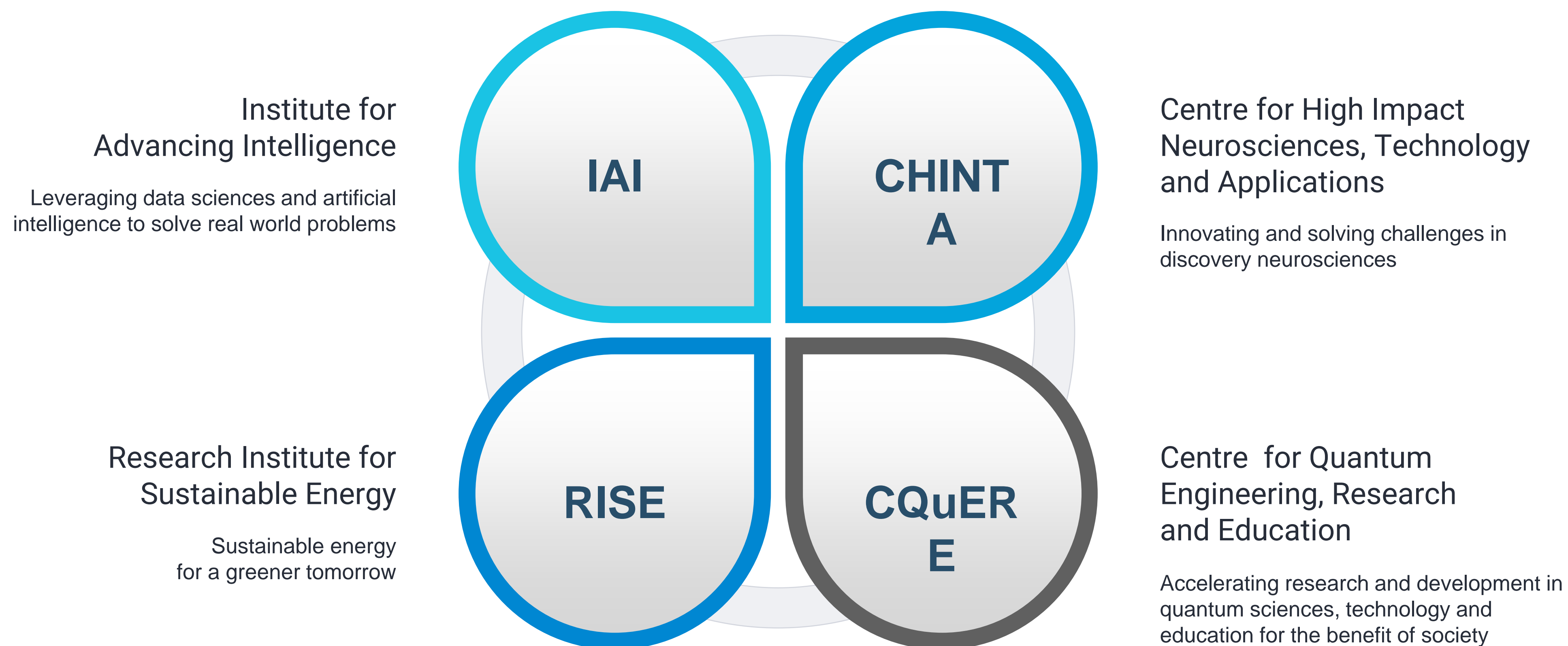
Kishore Bhattacharya

Director of the Board in multiple TCG
Companies since 1995

Actively involved in setting up operations
of TCG in India since its inception

Main domain areas include: Hydrocarbon,
Life Science, Hi-tech Infrastructure and
Bio-tech Applications

TCG CREST Research Centres



Research Partners



Chennai Mathematical Institute (CMI)

Founded in 1989, CMI is a centre of excellence for research and education in mathematical sciences. Since 1996 it has been an autonomous institution. The Mathematics and Computer Science research groups of CMI are amongst the best in India. TCG CREST offers Master's and PhD programmes jointly with CMI.



The Centre for Quantum Technologies (CQT)

CQT of the National University of Singapore was established in December 2007 as Singapore's first research centre of excellence. CQT today has more than 100 physicists and computer scientists to explore the quantum nature of reality and the fundamental limits of information processing. TCG CREST and CQT have an agreement to undertake joint research projects to foster academic collaborations.



Indian Institute of Science Education and Research (IISER), Pune

IISER, Pune was founded in 2006 by the Government of India as an autonomous, research-intensive institute. It is a unique initiative to integrate teaching and research. IISER, Pune has state-of-the-art research facilities in physics, chemistry, biology, mathematics, earth & climate sciences, humanities and social sciences. TCG CREST and IISER, Pune jointly offers Master's and PhD programmes.

Projects, Programmes & Focus



Beyond R&D and academics, TCG CREST shall proactively engage in projects and programmes of topical interests that impact humanity, dedicated to Knowledge Creation, Knowledge Application and Knowledge Dissemination.

For instance, keeping the COVID-19 pandemic in sight, RISE and IAI are

Developing an antiviral body lotion

Creating a COVID-19 bio-bank

Working on pandemic-related analytical insights



TCG CREST shall remain focused on creating strong networks with reputed knowledge centres of the world – universities, research institutions, technology-driven corporations and academic communities.



Engrained in its DNA, a culture of knowledge exchange, student exchange, faculty exchange, joint projects, collaborative workshops, participative seminars and intense academic interactions.

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Inventing Harmonious Future

Centre for High Impact Neurosciences, Technology and Applications (CHINTA)

Innovating and solving challenges in discovery neuroscience

Background and Vision of CHINTA

Background

Neurodegenerative and Neuropsychiatric diseases
are global public health threats

Drug therapies to prolong, maintain and improve
quality of life are required urgently

Failures to discover new medicines reflect

Bottlenecks at pivotal stages
of drug development

Absence of interdisciplinary approaches
in neuroscience discovery

Vision

Translational Neuroscience
from discovery to delivery

Interdisciplinary by necessity

Seek opportunities for translating research
into multiple domains

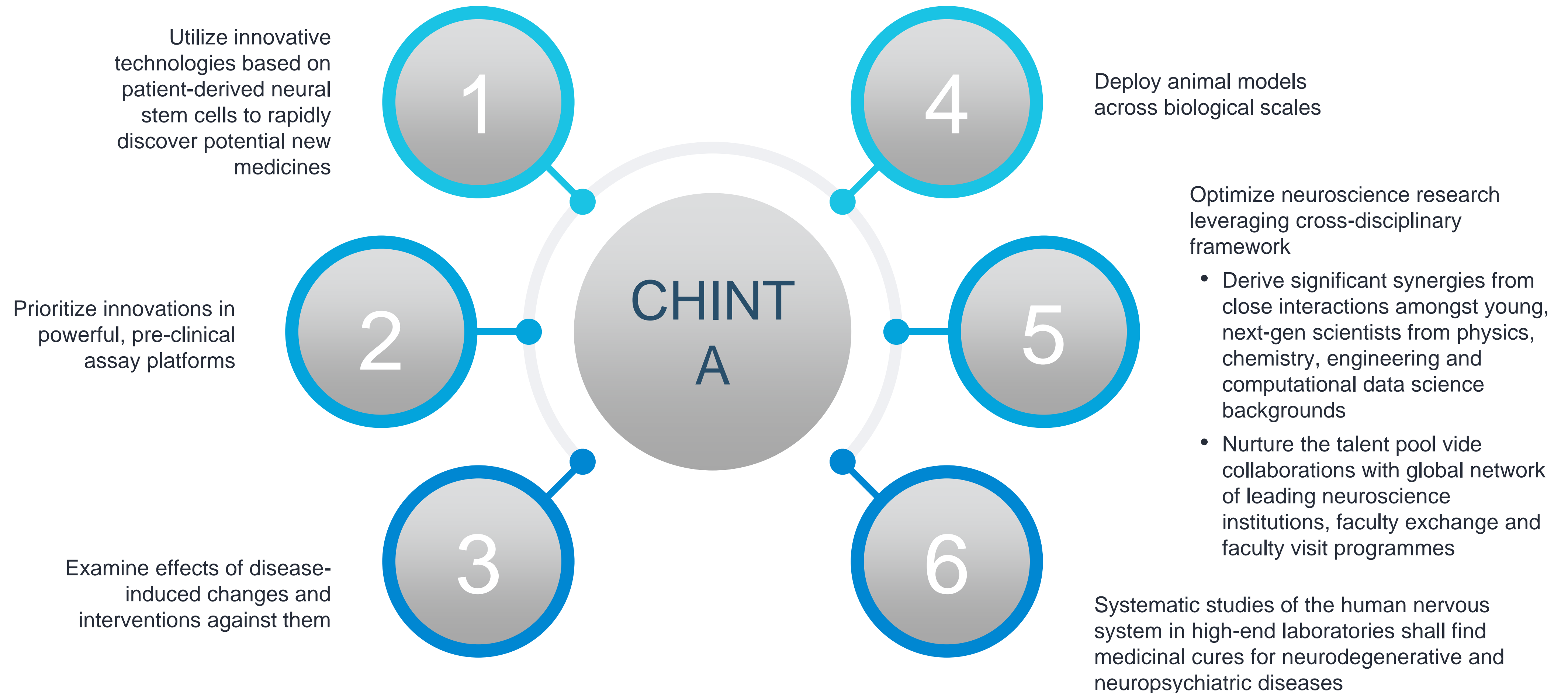


Prof. Sumantra Shona Chattarji
Director – CHINTA

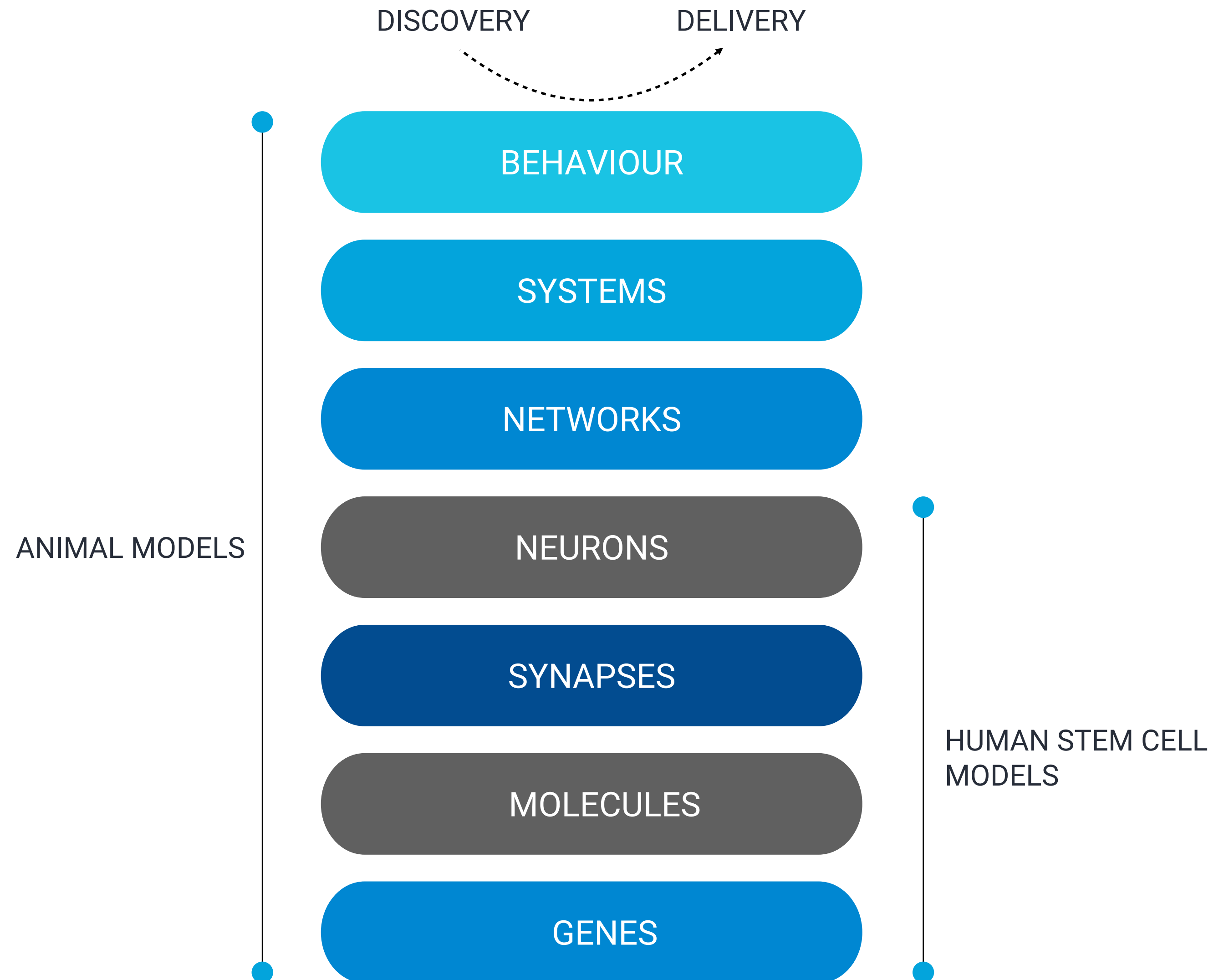
Received his Master's Degree in Physics from the Indian Institute of Technology, Kanpur and went on to do a PhD in Neuroscience from Johns Hopkins University and Salk Institute. After postdoctoral research in Yale University and MIT, he started his own laboratory at the National Centre for Biological Sciences, Tata Institute of

Fundamental Research, Bangalore, in 1999. His research has shown that prolonged stress leaves its mark by enhancing both the psychological and structural basis of synaptic connectivity in the amygdala, thereby triggering the emotional symptoms observed in stress-related psychiatric disorders.

Goals & Objectives of CHINTA

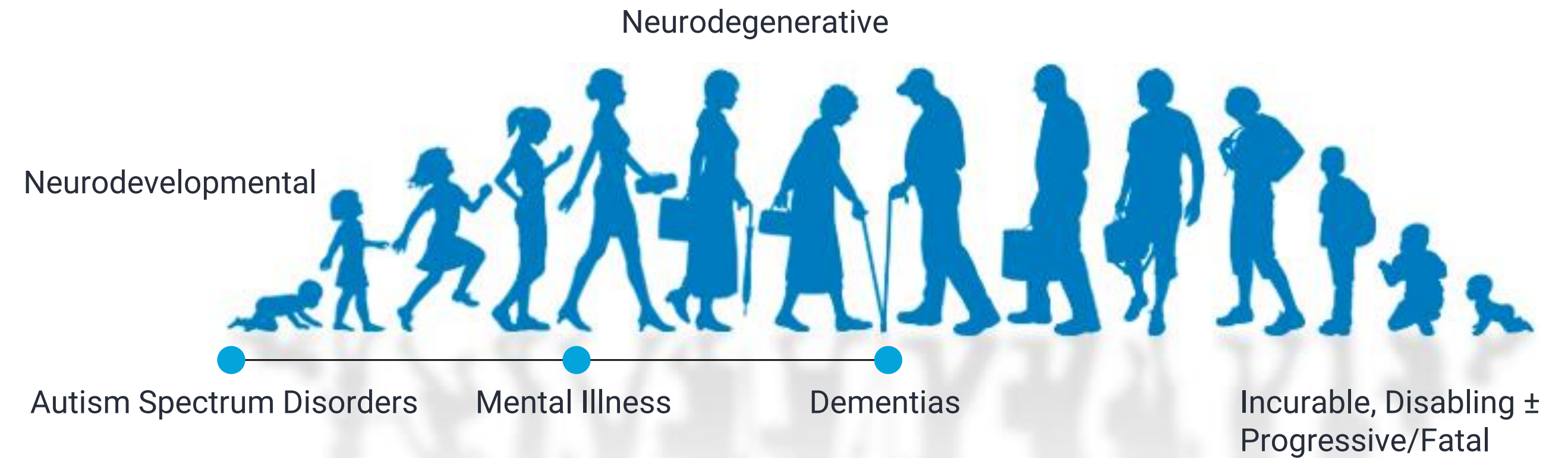


Core Scientific Priorities of CHINTA



NEUROLOGICAL DISORDERS ACROSS THE LIFE-COURSE

Neurological Disorders



NEURODEVELOPMENTAL

(ASD/ID)

1. MIND Institute/UC Davis
2. Kolkata: IAC, Apollo#
3. Mumbai: Ummeed, FX Society
4. Chennai: MNC/KVR, CMC Vellore
5. Univ. of Edinburgh
6. Ashoka University*

DEEP PHENOTYPING

(Psychiatry#/Neurology^/Psychology*)

- A) Identify Affected Individuals
- B) Clinical Diagnosis
- C) Behavioural Characterization
- D) Neural Characterization
- E) Blood/Genetics

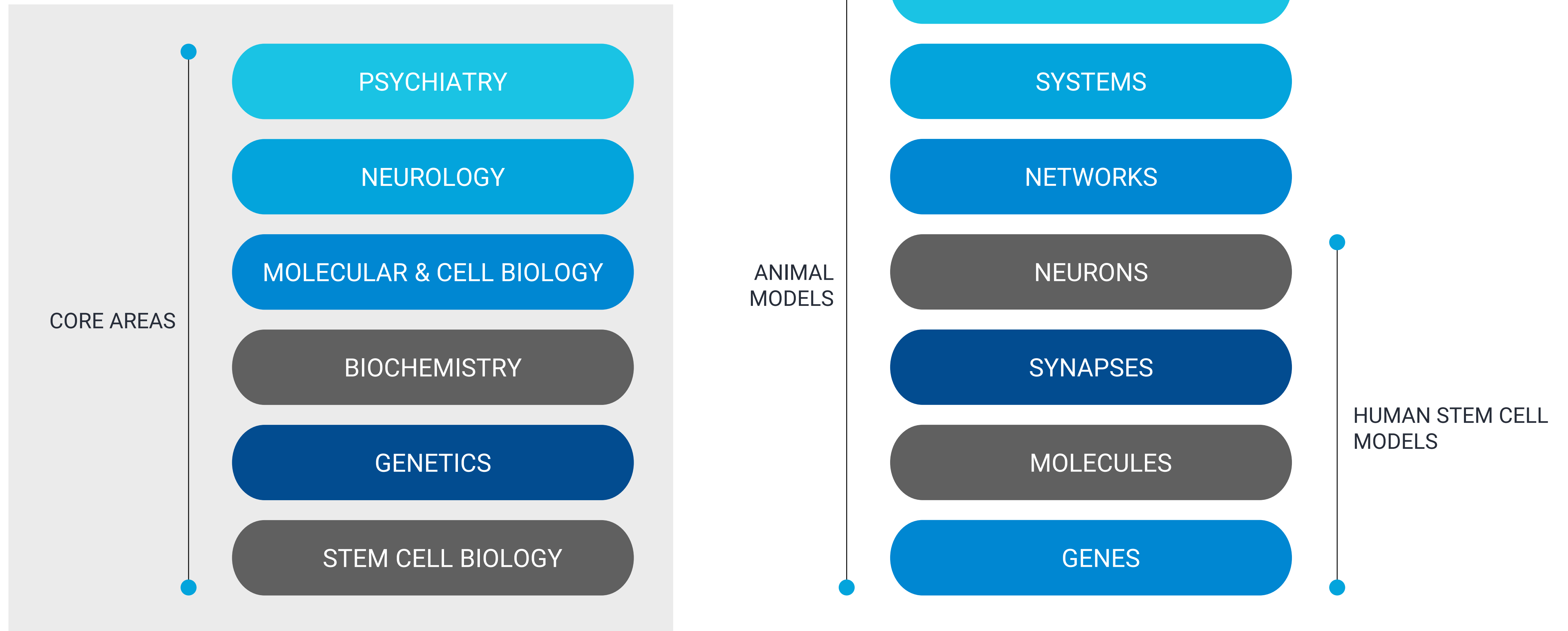
NEURODEGENERATIVE

(AD/PD/ALS)

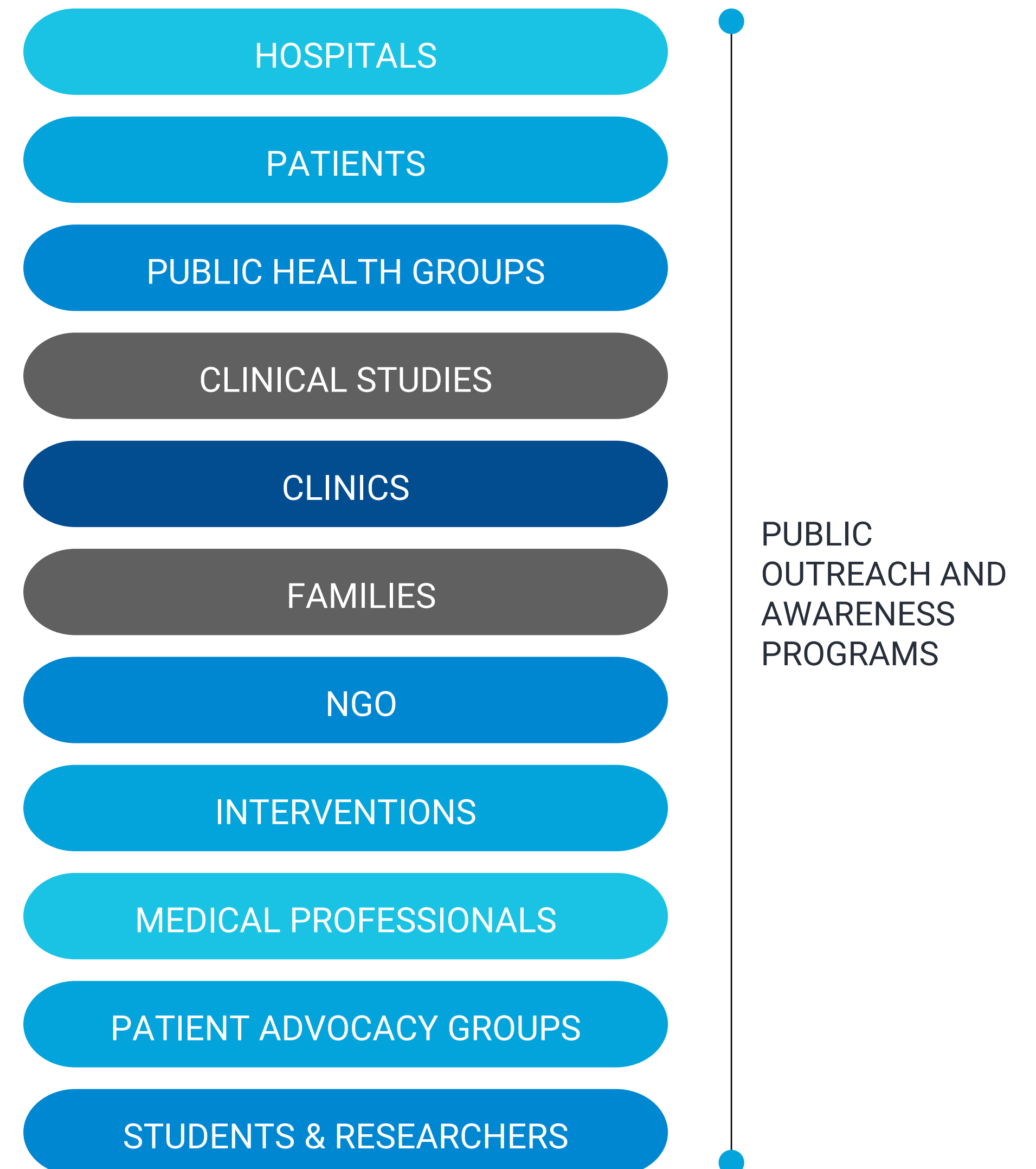
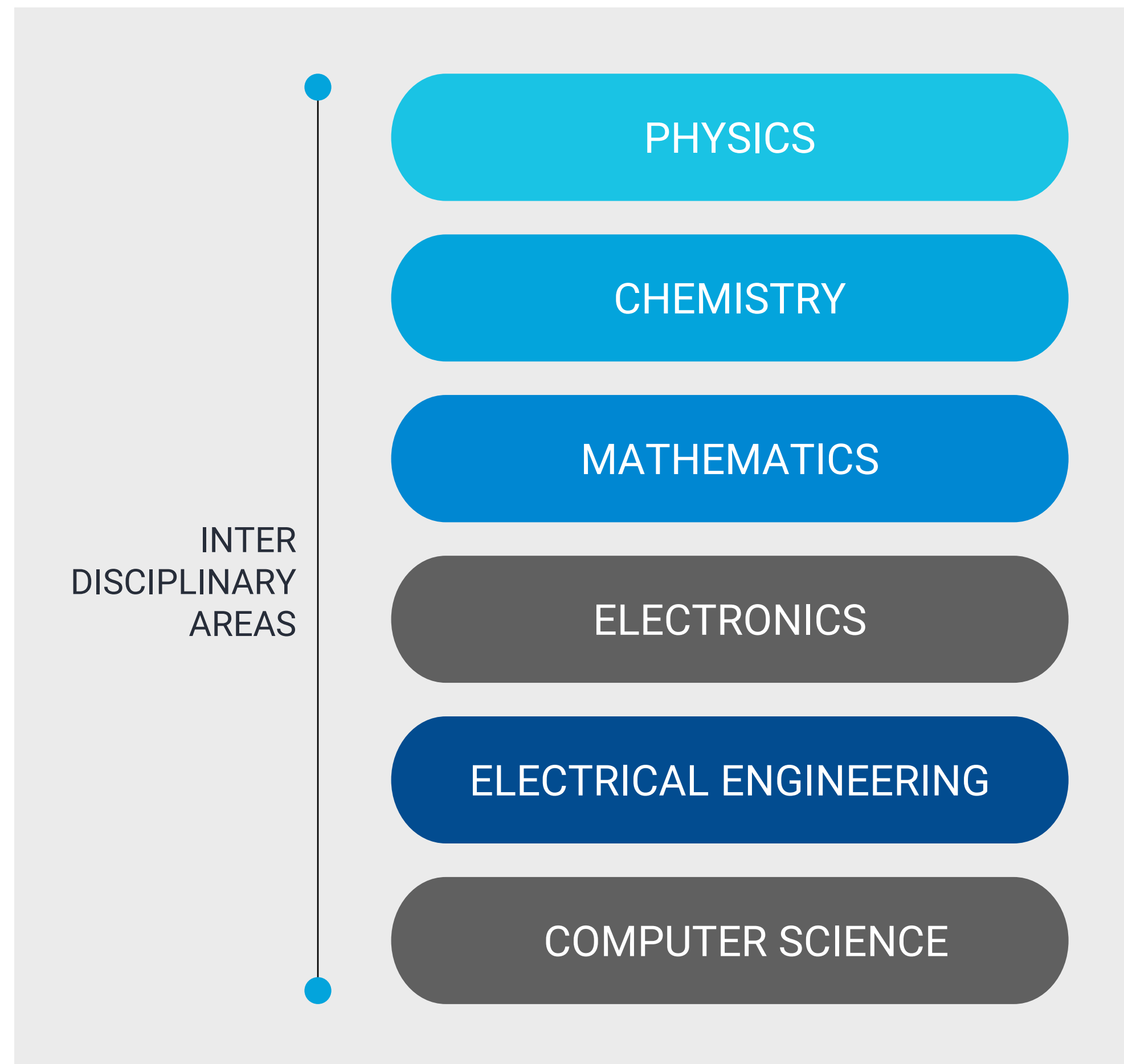
University of Edinburgh
Kolkata: INK^

Patient-derived neural stem cells,
assay platforms for drug discovery
in Indian samples

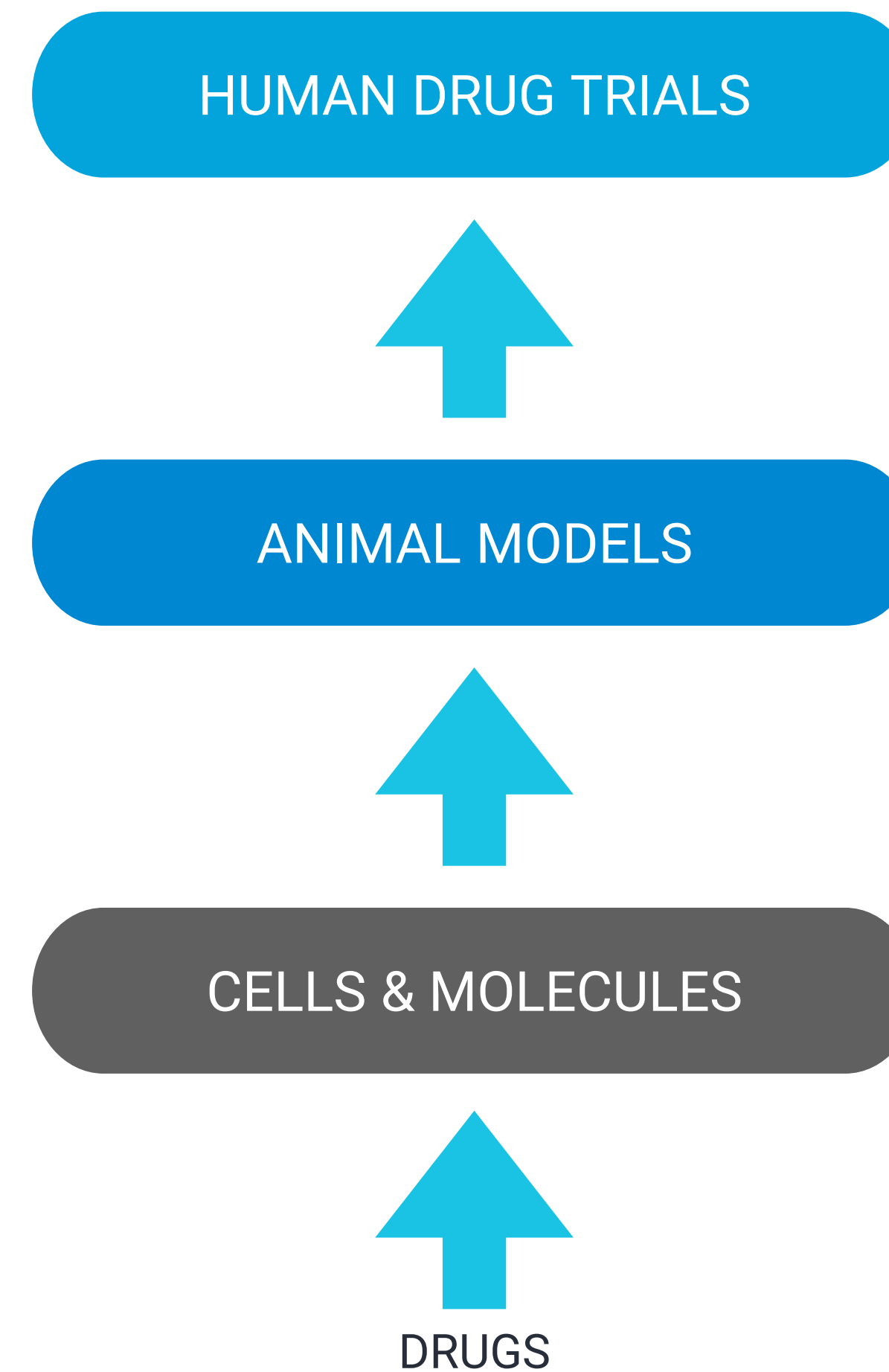
Focus Areas of CHINTA



Focus Areas of CHINTA

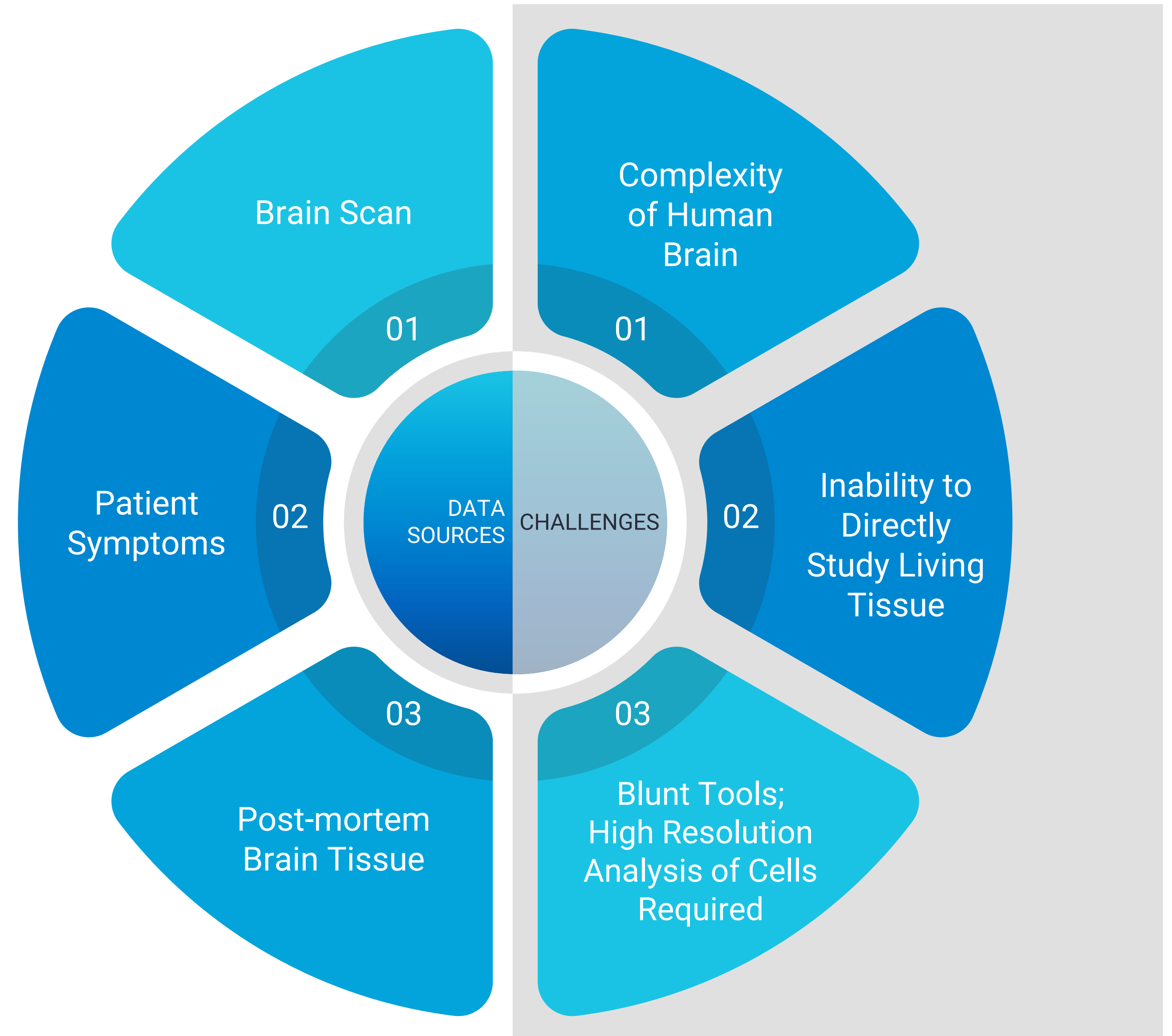


Factors Contributing to Failure to Deliver New “Brain” Medicines

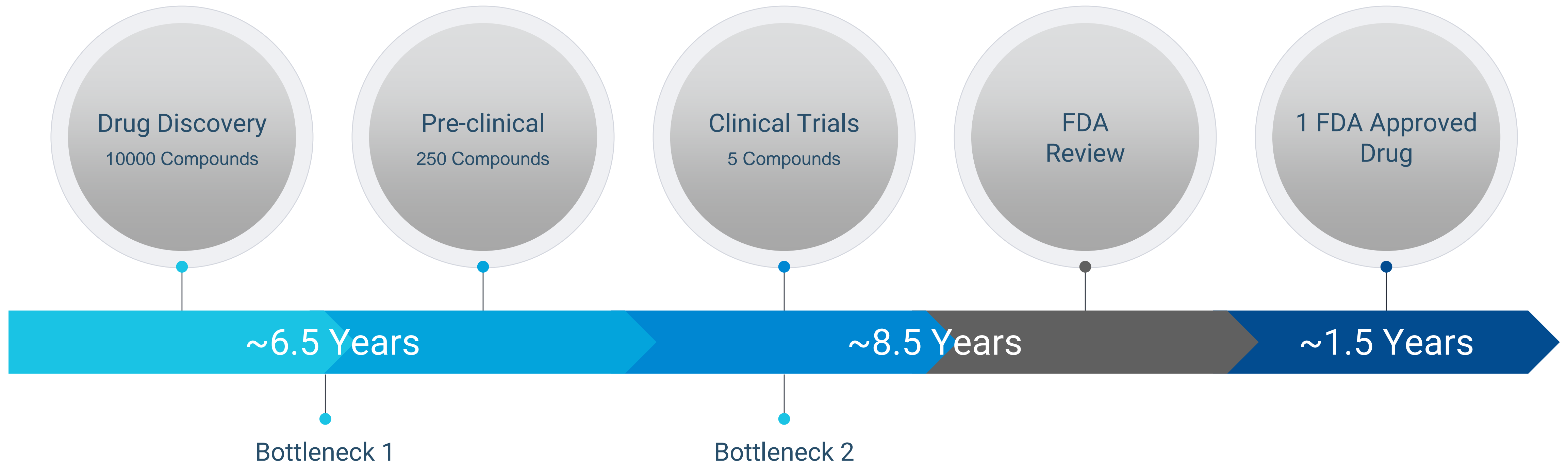


LIMITATIONS OF RODENT SYSTEMS TO ACCURATELY MODEL BRAIN DISEASES

Factors Contributing to Failure to Deliver New “Brain” Medicines

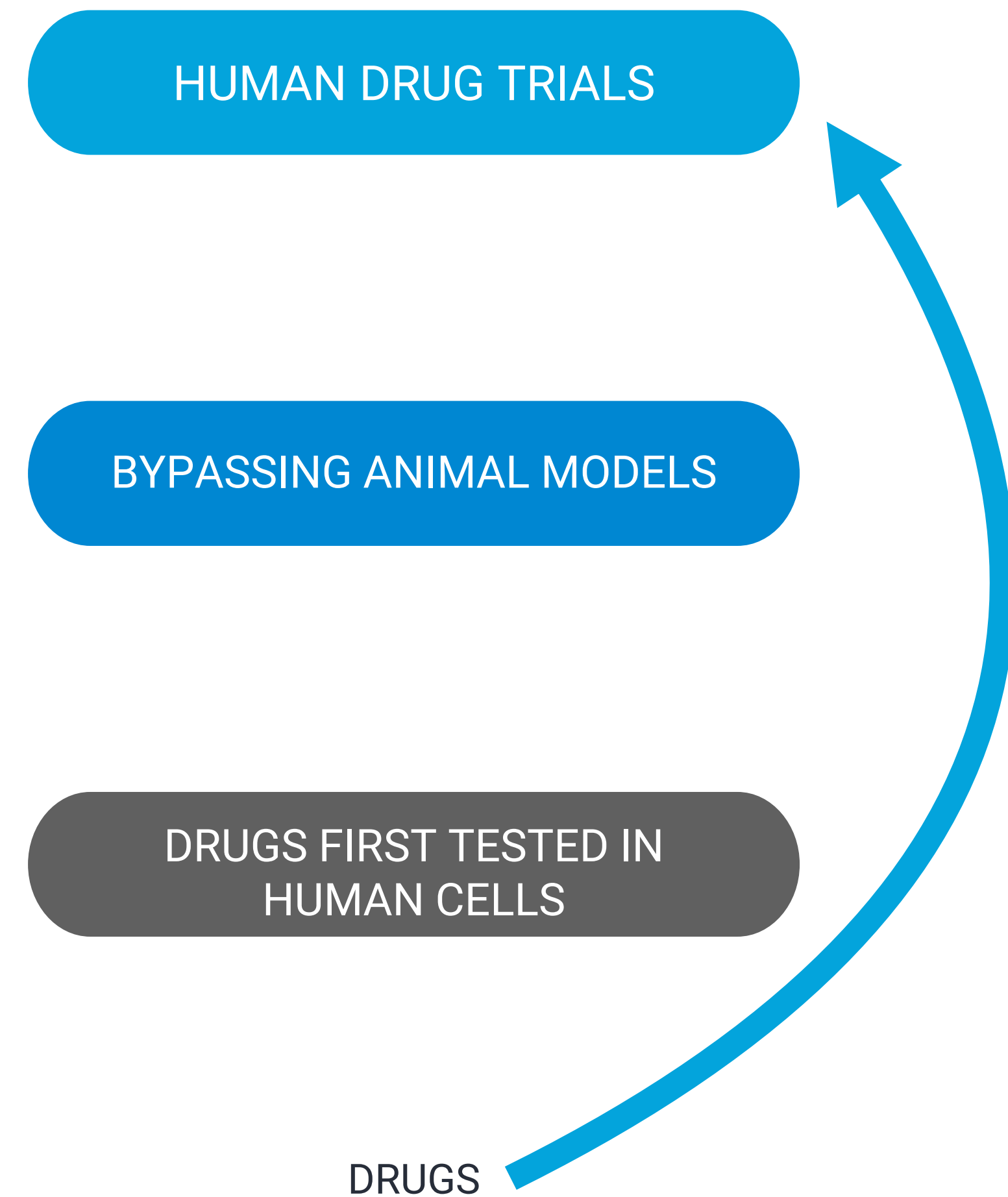


Factors Contributing to Failure to Deliver New “Brain” Medicines



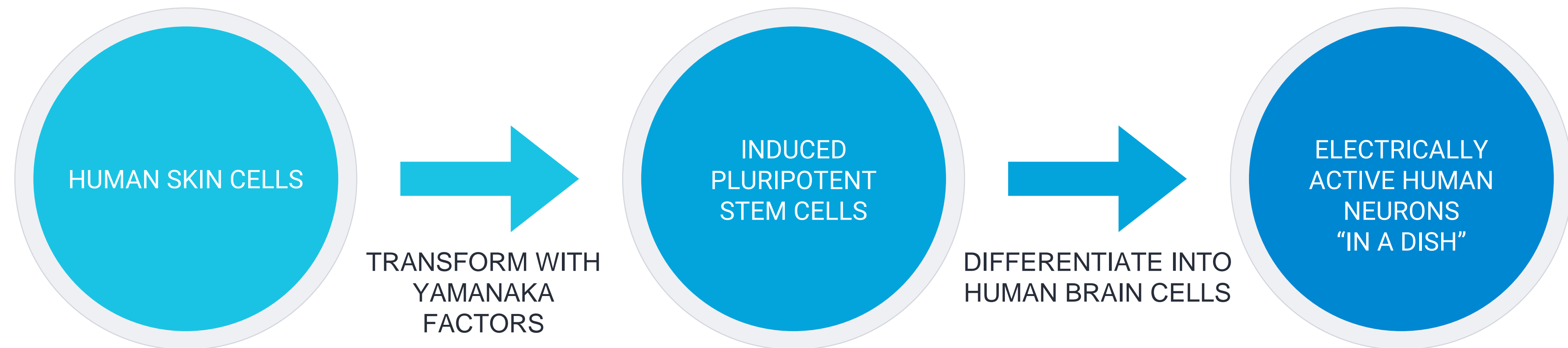
TIMELINE FOR DRUG DISCOVERY AND DEVELOPMENT

CHINTA's Proposed Path to Faster Delivery of Brain Medicines



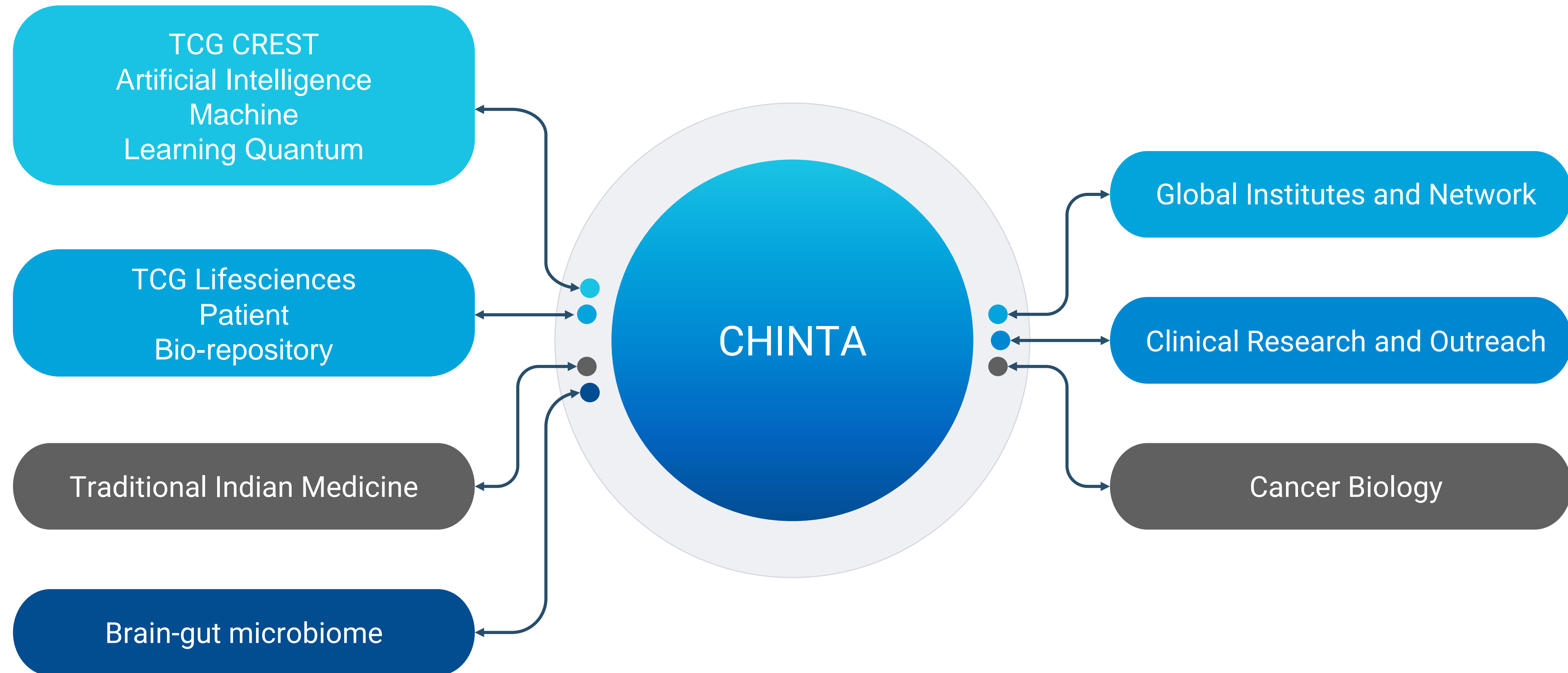
PROPOSED WAY TO OVERCOME THE PROBLEM

CHINTA's Proposed Path to Faster Delivery of Brain Medicines

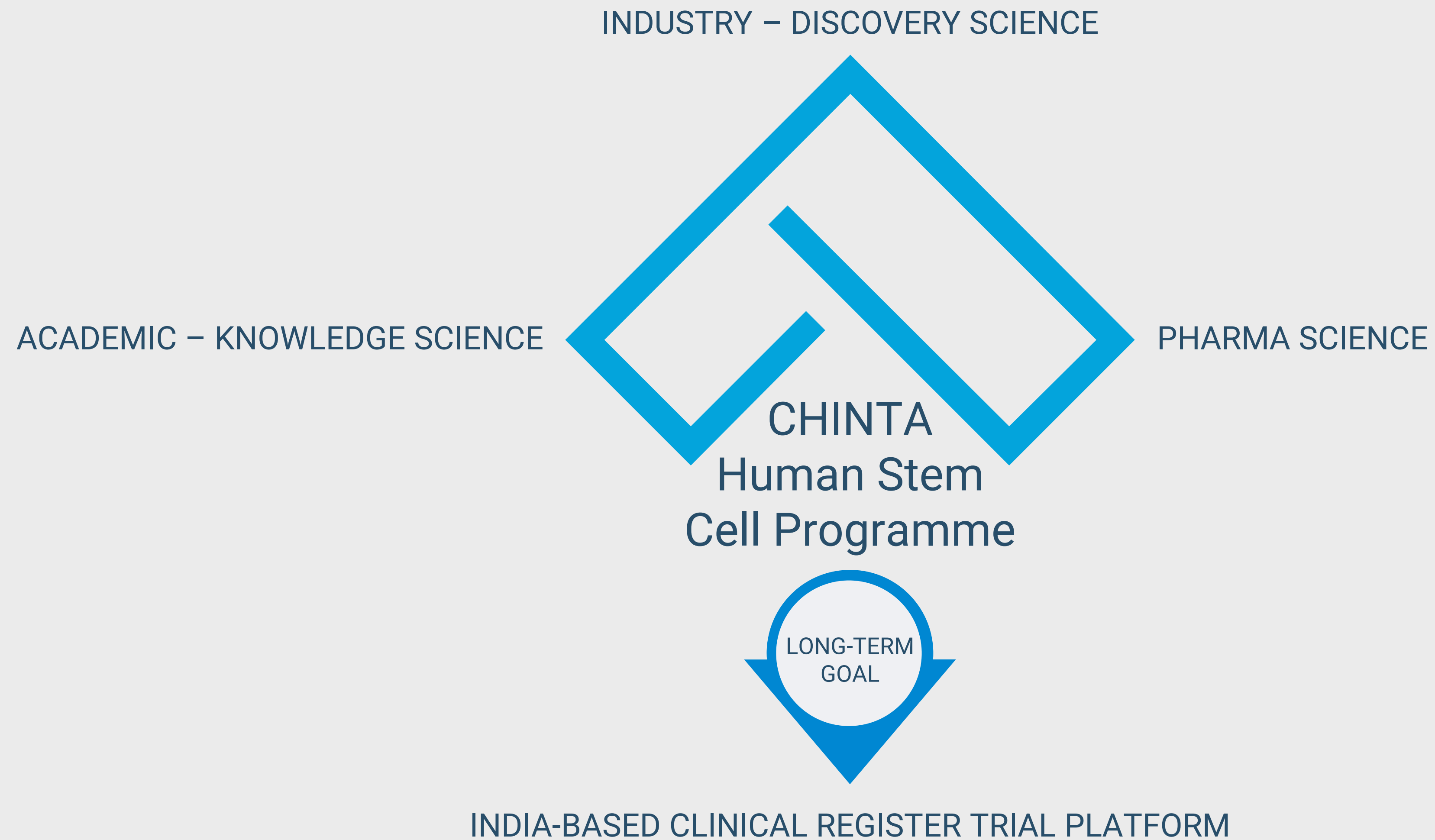


GENERATING BRAIN CELLS FROM HUMAN SKIN CELLS

CHINTA – Collaboration Network



CHINTA – Path Forward



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Inventing Harmonious Future

Institute for Advancing Intelligence (IAI)

Data Driven Intelligence and AIML to solve real world problems

Vision of IAI

Vision

- Establish itself as an autonomous, self-funded, world-class Centre of Excellence for Data-driven Intelligence, Artificial Intelligence & Machine Learning (AI & ML)
- Relentlessly provide best-in-class learning environment for research in quantitative, computational, technological and analytical streams
- Galvanize mastery in modern techniques for application in traditional areas like finance, logistics, healthcare, neurosciences, cyber security, cryptography, robotics, legal informatics, recommendation engines, natural language processing, video analytics, image processing, computer vision and many more
- Embrace Life Long Learning – empower knowledge workers to remain in sync with the interminable transformation of technology
- Inculcate a strong culture of collaboration – continual knowledge exchange through joint research projects, faculty exchange, student exchange with leading universities, research institutes and corporate entities of the world



Prof. Rajeeva Laxman Karandikar
Director – IAI

Prof. Rajeeva Laxman Karandikar is a Fellow of the Indian Academy of Sciences and Indian National Science Academy. An M.Stat (1978) and PhD (1981) from the Indian Statistical Institute (ISI), Calcutta, he was a postdoctoral research scholar at the University of North Carolina, Chapel Hill. In 1984 he returned to ISI, Delhi and became a professor. In 2006, he moved to Cranes Software International as Executive Vice President for analytics. In 2010 he joined the Chennai Mathematical Institute as its

Director. His research interests include several areas of probability theory, filtering theory, option pricing theory, psephology in the context of Indian elections and cryptography. In 1999 he was awarded the prestigious S.S. Bhatnagar Prize in Mathematical Science. Apart from authoring two books, he has several important papers published in leading international journals on mathematics and statistics.

How IAI will be different?

1

Blend statistical ideas developed over a century with AIML algorithms - encourage faculty, researchers and students to actively explore such possibilities

2

Steer the institutional DNA away from pushing domain specific data through AIML engines for surmising outcomes

3

Explore and understand specific domains
Appreciate from where the data is coming from to choose the right variables
Apply pertinent statistical techniques
Develop and select well-founded algorithms
Obtain explicable and meaningful conclusions

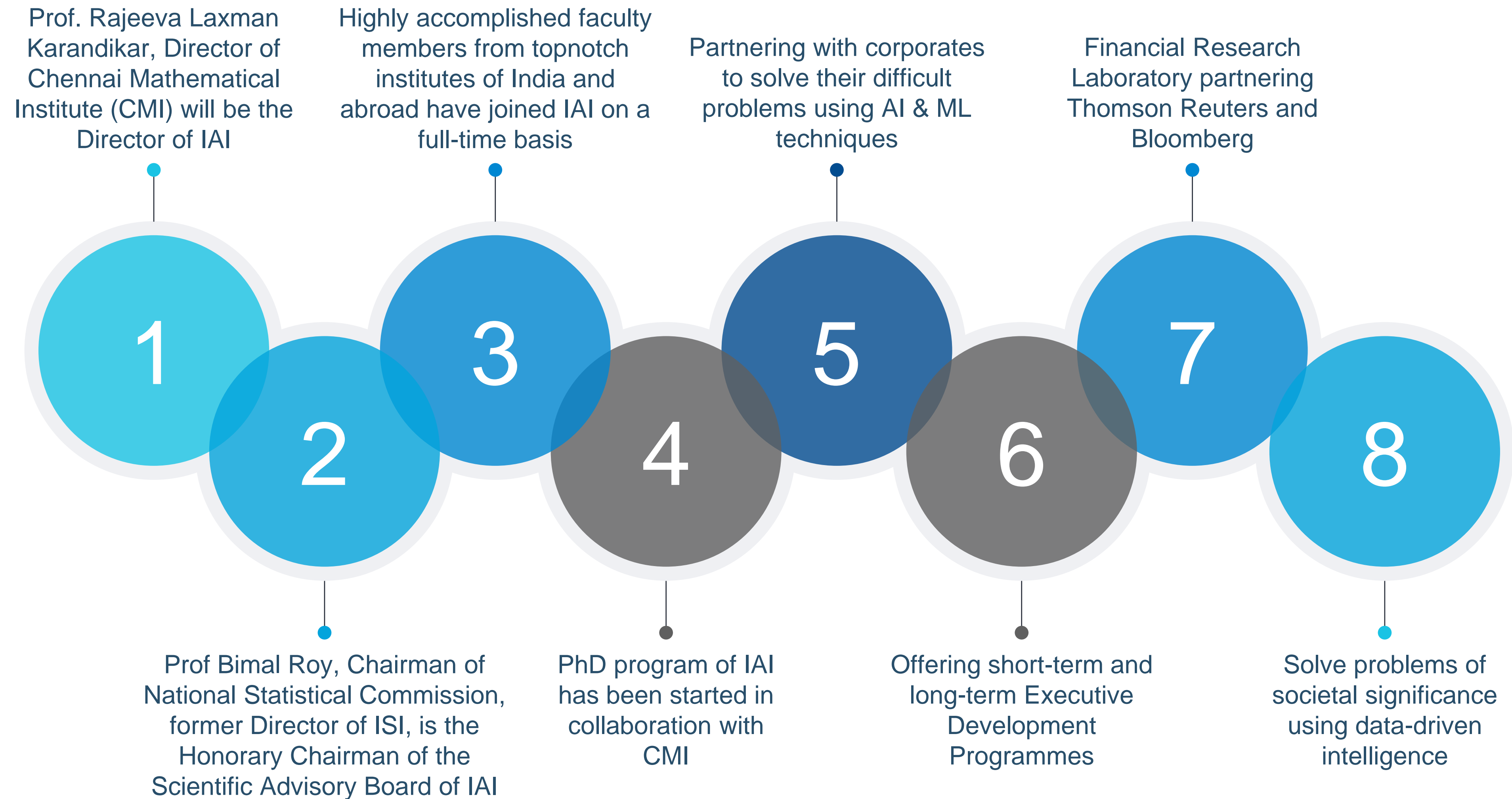
4

Focus on a new class of AI Tools to yield Explainable AI (XAI) algorithms – clearly the future of AI (Regulators won't trust AI tools if they can't be explained)

5

Other focus areas
AI based secure solutions for the post-quantum world
Cybersecurity of critical infrastructure like banking and power with AI & ML tools

Overview of IAI



Academic & Research Programmes

01

PhD programme
in Data Driven
Intelligence in
collaboration with
CMI

02

One-year intensive
diploma programme
to create industry
ready business
analytics
professionals

03

Sponsored research with
focus on analytics in
(1) Cyber Data & Cyber
Traffic
(2) Financial Data
(3) Cryptography including
Quantum Cryptography
(4) Translational
Neurosciences
(5) Robotic Process
Automation

04

Pro-bono research
to solve difficult
problems for direct
benefit of society like
(i) Air Quality
(ii) Underground
Water (iii) Soil
Erosion (iv) Water
Quality (v) Disaster
Management (vi)
Stampede Control

05

Executive
Development
Programmes

Short-duration: 4 to 6 days
focused on (1) Science of
Data-driven Decision Making
(2) Business Applications of
AI & ML (3) Business
Forecasting Analytics
(4) Digital & Social Media
Marketing Analytics
Long-duration: for working
executives who want to re-
tool themselves – 7 to 9
months with short bursts of 3
to 4 days of online classes,
home tasks, projects, thesis
and examinations

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Inventing Harmonious Future

Research Institute for Sustainable Energy (RISE)

Sustainable Energy for a Better Future Through Excellence in
Research, Education, Outreach and Collaboration

Vision of RISE

Vision

High-end and cutting-edge research in clean energy
as well as IP creation

Excellence in higher education
and capacity building

Technology development aligned
with National Mission

Product-targeted industry interactions
encouraging start-ups

National and international collaboration and co-operation
with leading institutes and scientists around the globe

Constant eye on potential
societal impact

National and international data-based
trend analysis – cost, human development,
urban vs. rural markets and businesses

Sustainable Nation Building



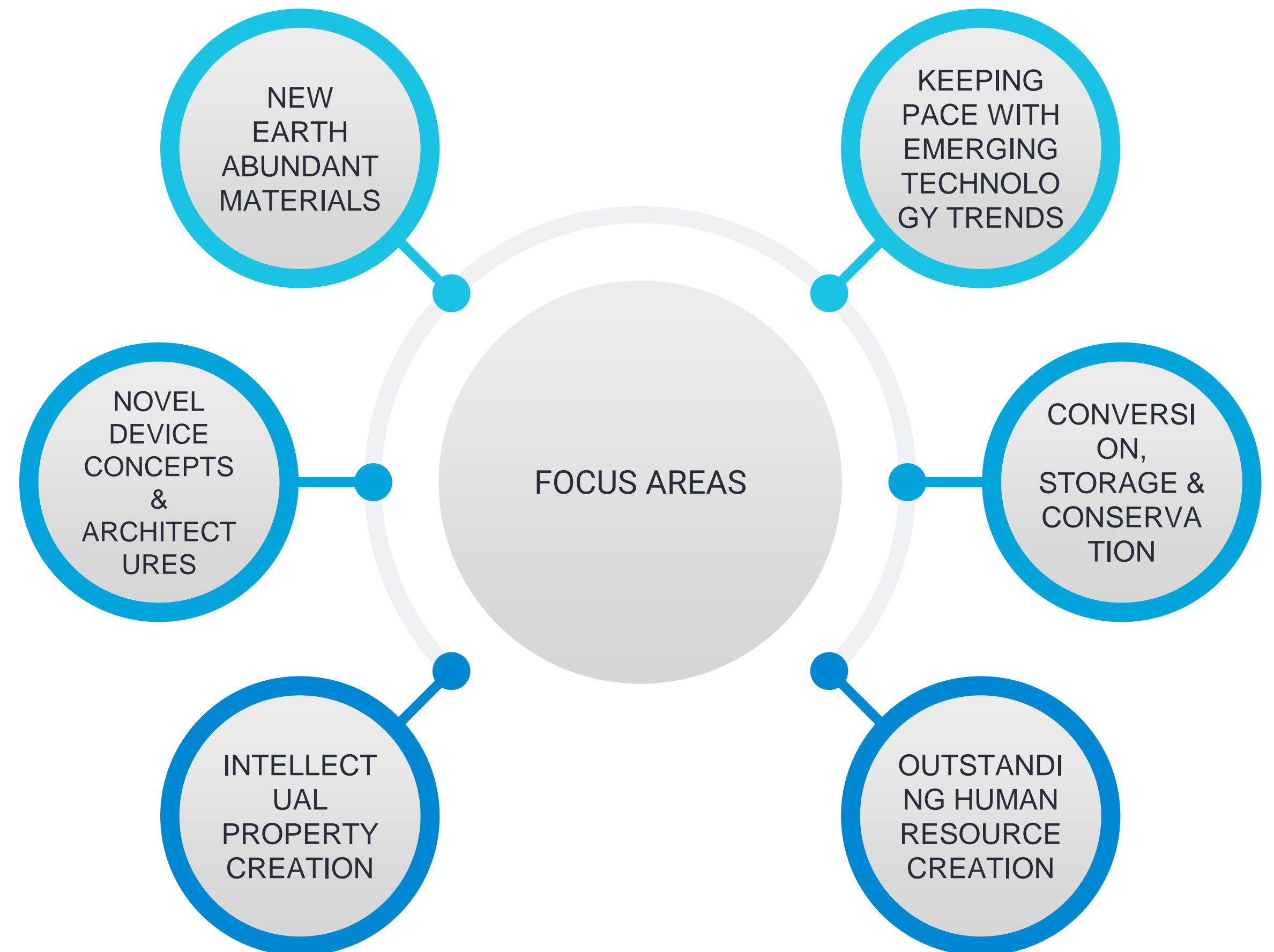
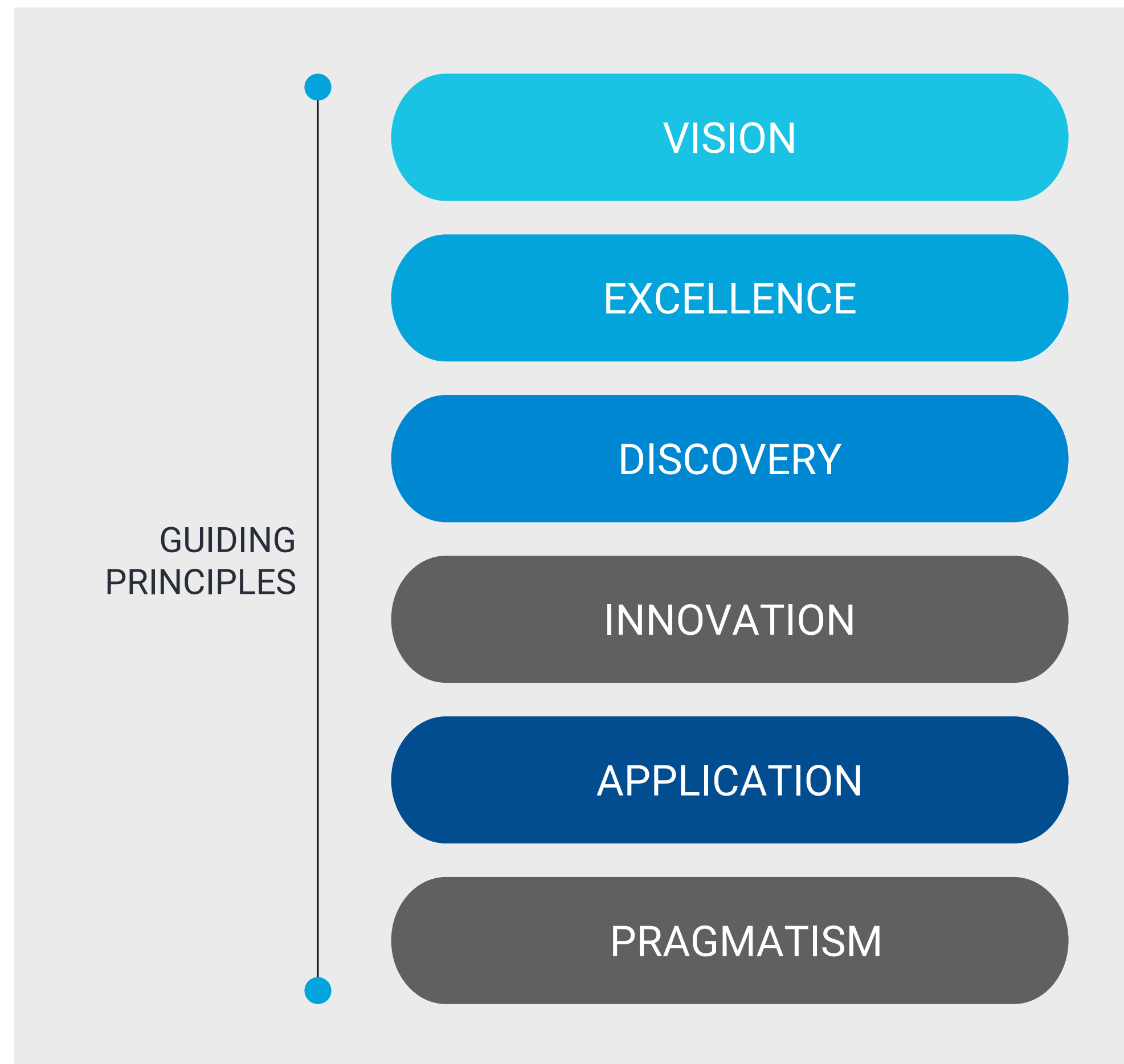
Prof. Satishchandra Ogale
Director – RISE

Prof. Ogale was the Chair of Physics at Pune University prior to joining the Department of Physics and Center for Superconductivity Research, University of Maryland as a Senior Research Scientist (1996-2006). He was the first Ramanujan Fellow of DST at the National Chemical Lab where he was the Chief Scientist until 2015, when he left. In 2019, he was selected for the coveted Raja Ramanna Fellowship of the Department of Atomic Energy. He is now

the Professor Emeritus of IISER-Pune, apart from being the Director of RISE. Prof. Ogale has worked in several fields like CMR Manganites, High-temperature Superconductors and Spintronics. His current research focus is on developing new materials for clean energy harvesting, storage and conservation. He has co-authored about 500 research publications and has nine granted US patents.

Objectives of RISE

THE SUSTAINABILITY EQUATION: RENEWABLE ENERGY = CLEAN ENVIRONMENT + GOOD HEALTH



Opportunities

CONVERSION

GenNext Solar Cells
Solar Water Splitting for Hydrogen
CO₂ Reduction
Green Fuels

STORAGE

New Battery Chemistries
Super-capacitors
Hybrid Devices

CONSERVATION

Solid State Lighting (LEDs)

CLEAN ENERGY RESEARCH

Metal Oxides
Sulfides
Semiconductor QDs
Hybrid Perovskites Polymers
MOFs
COFs
Small Molecules
Dyes
Ionic Liquids
Gels
Organometallics
Inorganic Materials
Low Dimensional Materials

Functional High Surface Area Carbon, Metal Oxides/Sulphides,
Conducting Polymers, Mesoporous Materials,
Engineered Hetero-junction Systems and Interface Science

Initial Research Focus

BATTERIES AND ULTRA- CAPACITORS KEY FOCUS

Solid State Batteries
 Flexible Batteries
 Thin Film Batteries
 Li- & Na-ion Batteries; enhanced
 performance in Coin & Pouch Cells
 Novel and Scalable Synthesis of
 Battery Materials
 Battery Systems for Electric Mobility
 Battery Systems for Grid Scale Storage
 Dynamic Analysis of National and
 International Trends in Battery
 Materials, Chemistries, Device
 Architectures and Applications

HYDROGEN ENERGY

Hydrogen Generation Schemes
 Hydrogen Storage
 Hydrogen Transportation
 Fuel Cell Materials
 Fuel Cell System Components
 Novel Catalysts based on Earth
 Abundant and 2D Materials for
 Oxygen Evolution Reaction (OER)
 & Hydrogen Evolution Reaction (HER)
 New Materials for Membranes and
 Gas Diffusion Layer
 Weight, Cost, Performance and
 Application Domain Analysis

CO₂ REDUCTION & CLEAN FUELS

Evaluation of Schemes for CO₂
 Reduction, Interface Engineering
 & Identification of Challenges
 Computation Surface Science of
 Molecular Adsorption Phenomena
 and Energetics for CO₂ Activation
 Development of Novel Catalysts, Photocatalysts,
 Electrocatalysts for CO₂ Conversion to Clean Fuels
 Studies on Specific Crystal Facets, Nanomaterials
 (Metal Oxides, Sulfides, Nitrides),
 Nanocomposites, 2D Materials (Chalcogenides,
 g-C₃N₄, Layered Double Hydroxides
 and MXene Phases)
 System Design, Cost and Safety
 Considerations for Realistic Applications

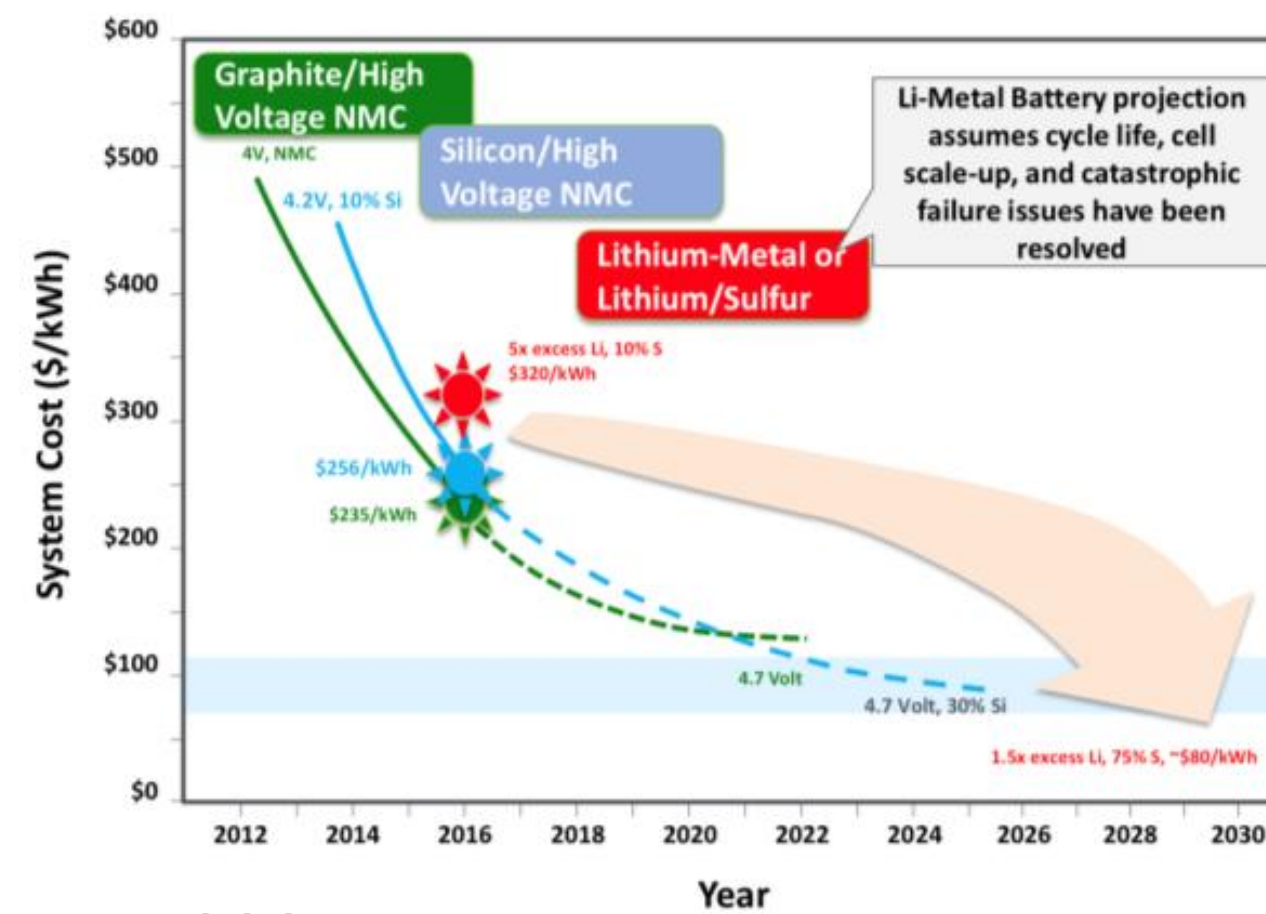
Primary Challenges

ENERGY

COST

SAFETY

SUSTAINABILITY

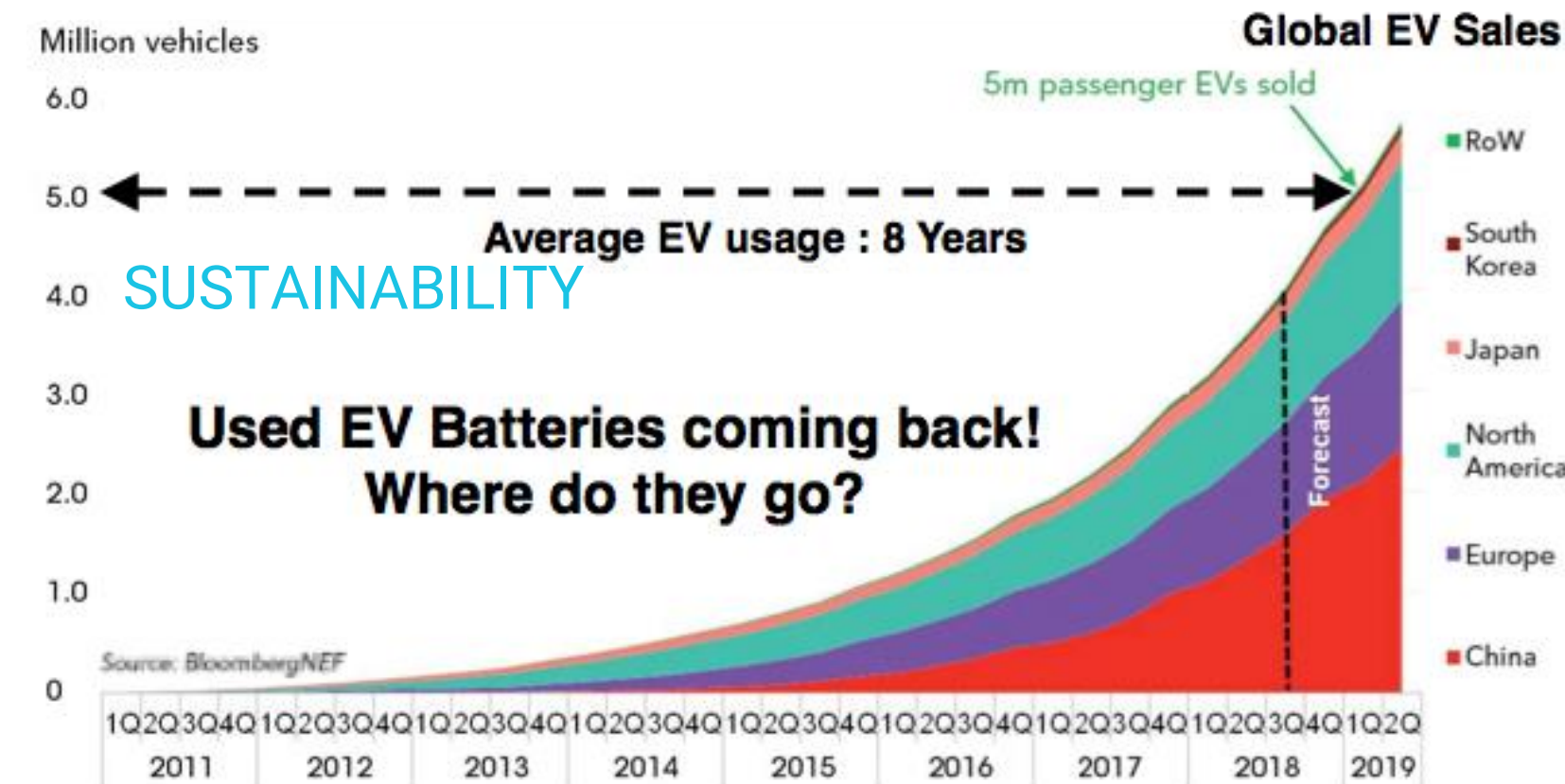


COST

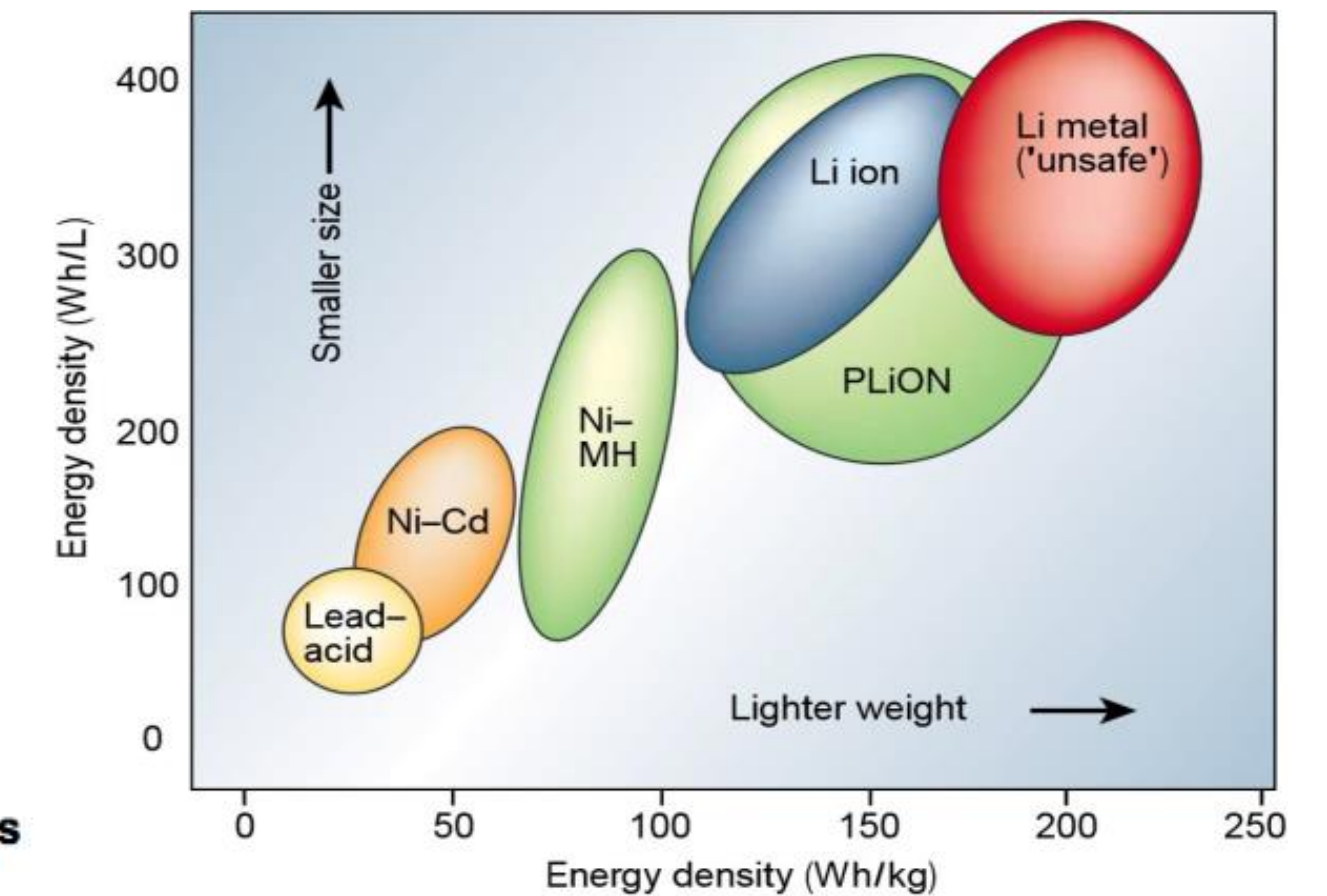


Asia / East Asia

New Delhi firefighter killed, 19 injured, as battery factory collapses after major blaze **SAFETY**

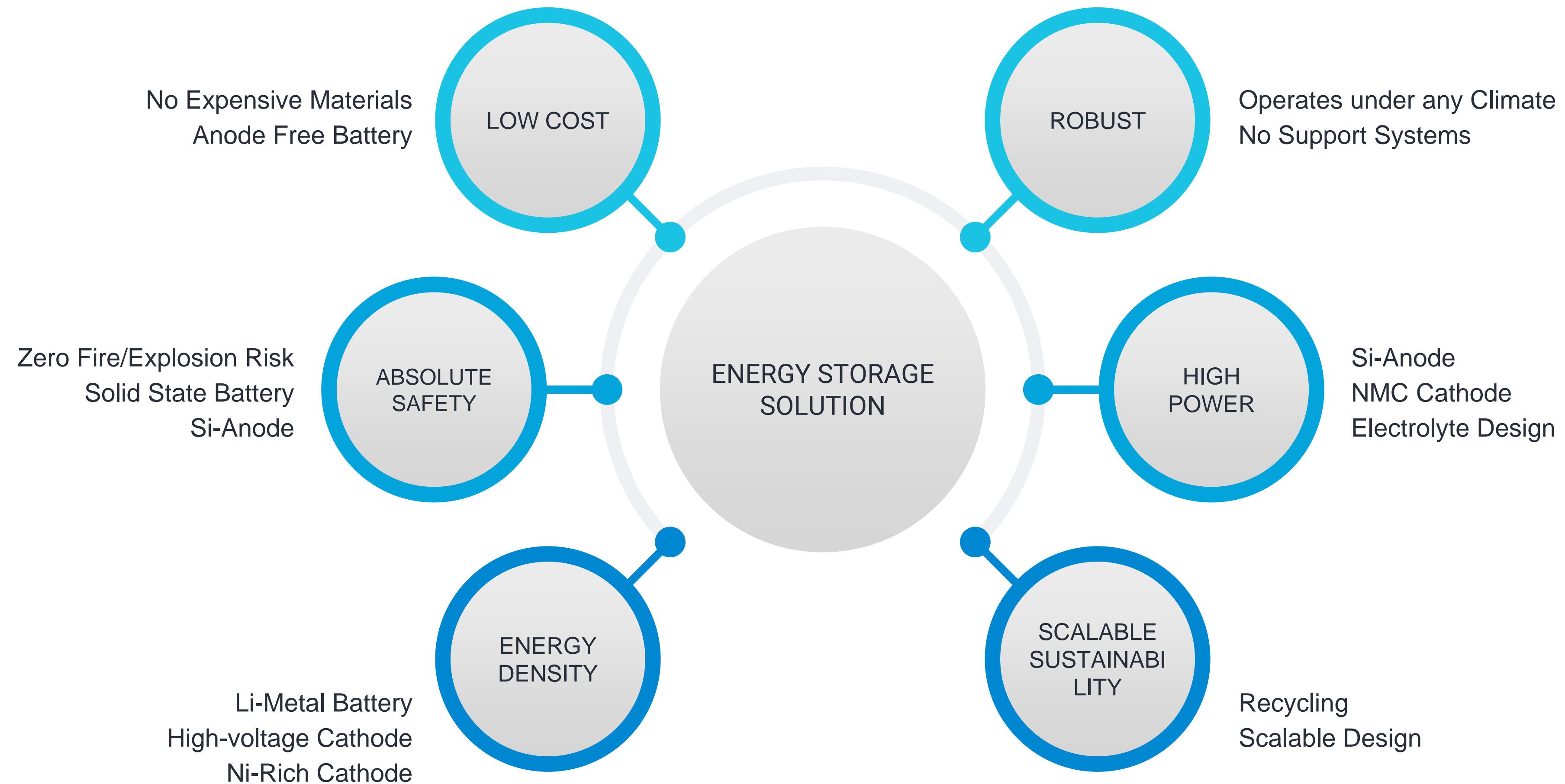


SUSTAINABILITY



ENERGY DENSITY

RISE Energy Storage Solution



Goals, Challenges, Domains and Deliverables

MAJOR GOALS

Li metal in LE: 400 Wh/kg energy density; 80% capacity retention after 500 cycle

Solid State Battery: energy density 350 Wh/kg; 80% capacity retention after 500 cycle

Si enabled cost effective fast charging (20 min): Energy density of 220 Wh/kg; 70% capacity retention after 500 cycle

CHALLENGES

Thick Cathode loading of 4mAh/cm²

Thinning down the SE layer thickness.

Electrolyte design for Li metal and Si anode.

Bottleneck of interfacial charge transfer limitation

1 Ah Pouch cell production.

APPLICATION DOMAINS

EV and hybrid EV

Consumer electronics

Defense

Aerospace

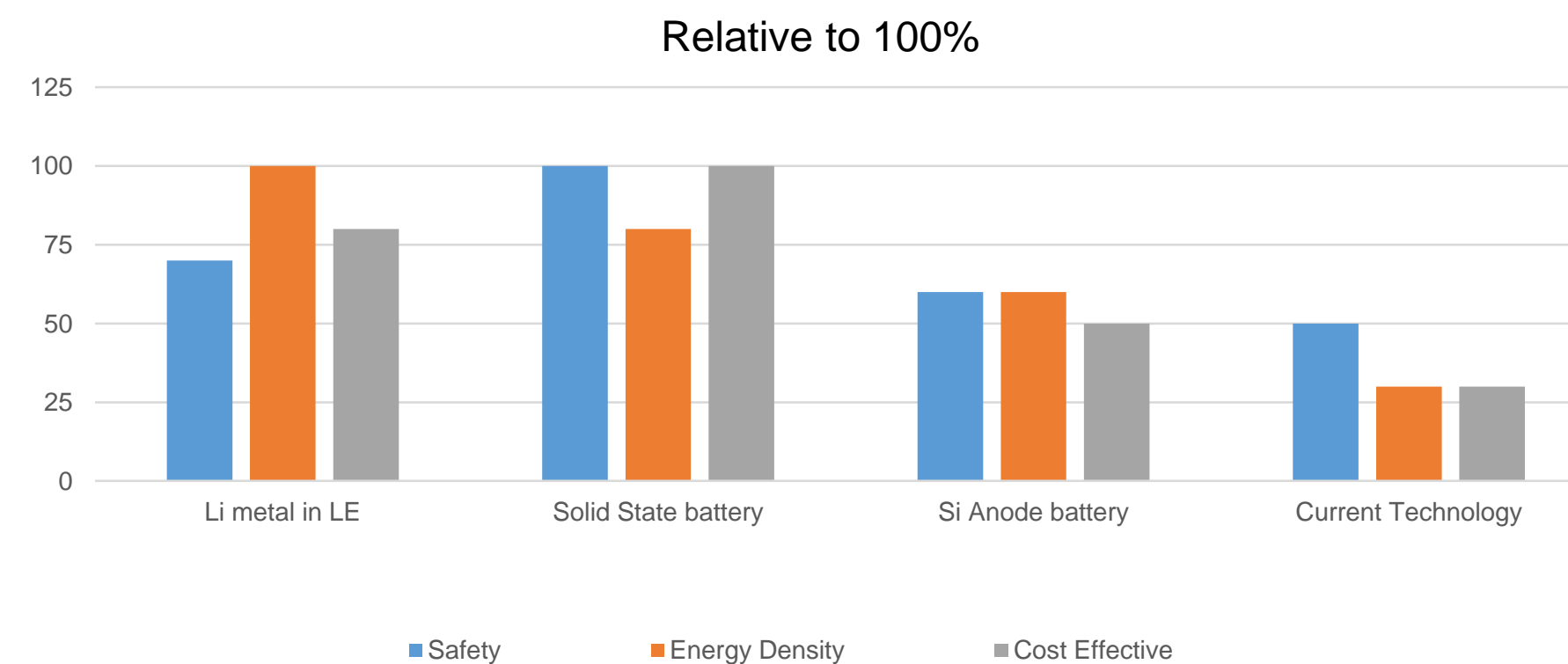
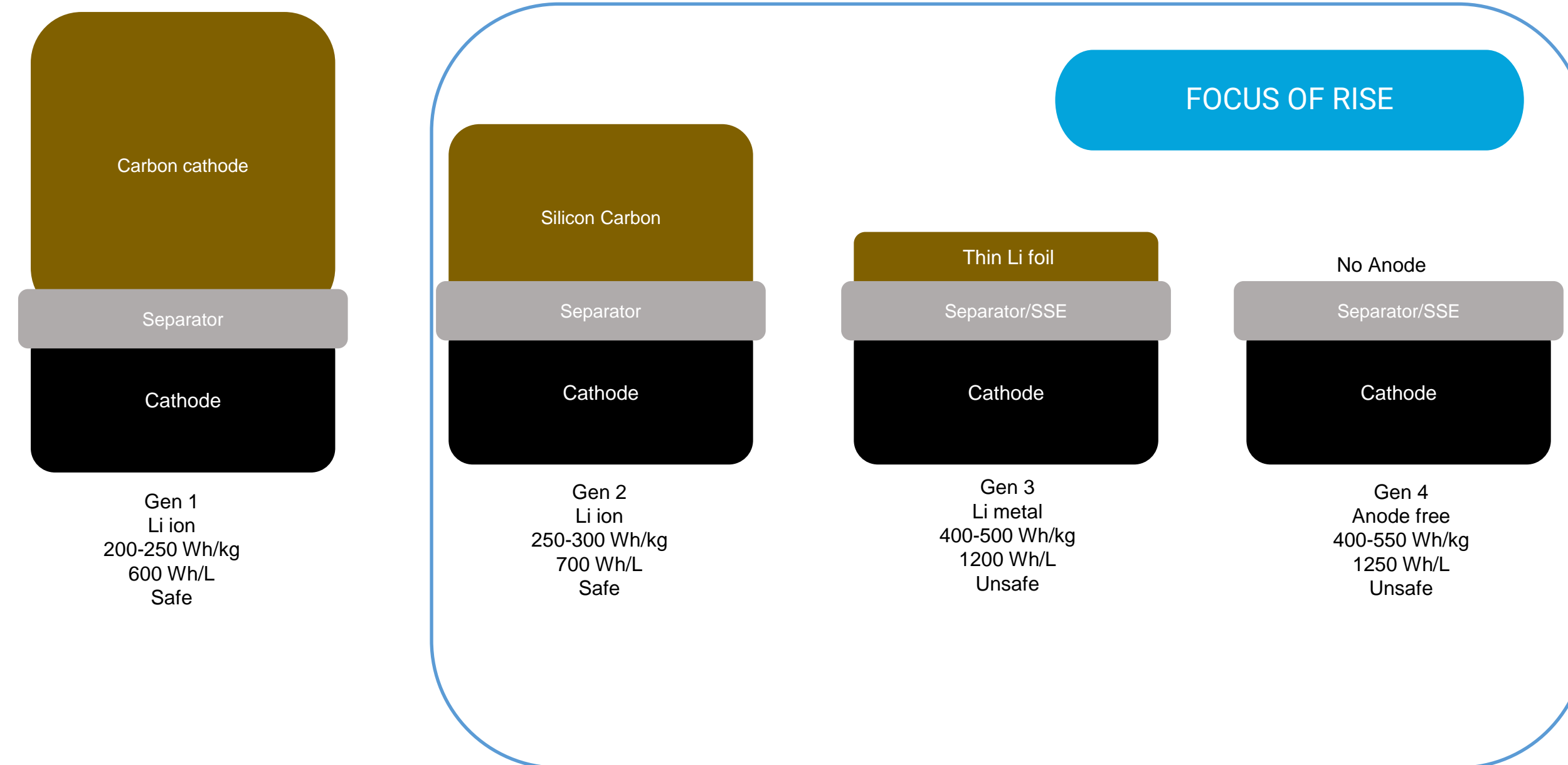
DELIVERABLES

High Impact article

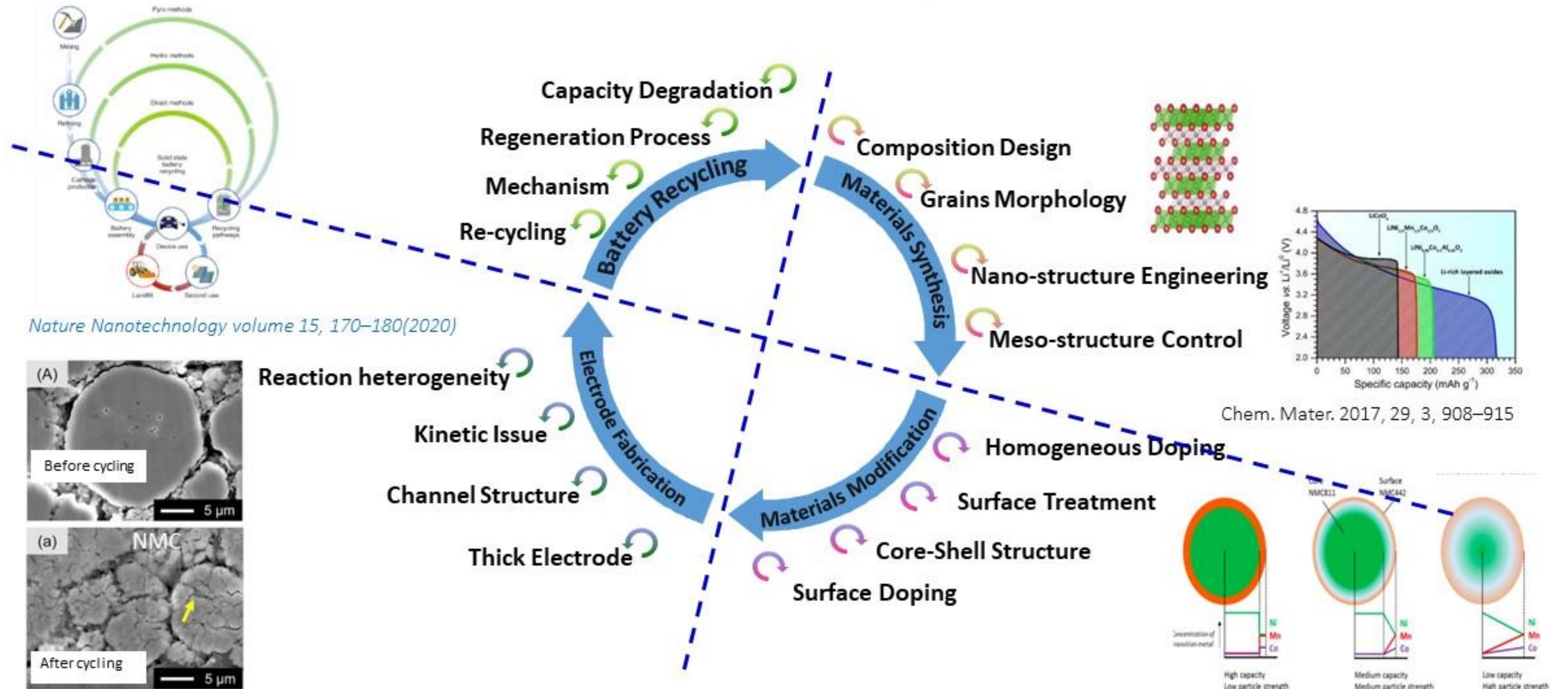
Patent

Startup

Goals, Challenges, Domains and Deliverables



RISE Strategy



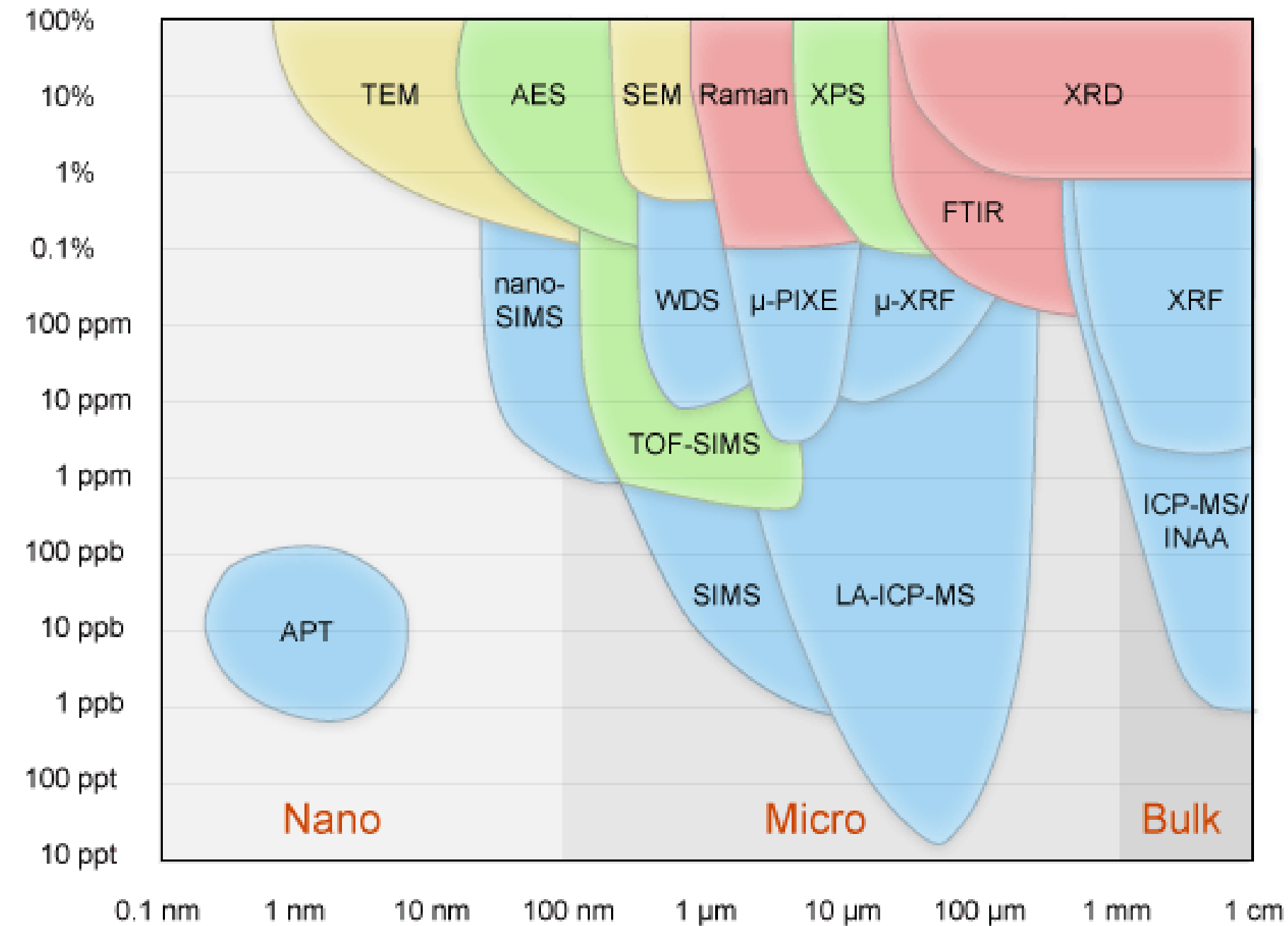
Nature Nanotechnology volume 15, 170–180(2020)

Chem. Mater. 2017, 29, 3, 908–915

Journal of The Electrochemical Society, Volume 166 Number 3

https://www.energy.gov/sites/prod/files/2018/03/f49/FY2016_APR_Advanced_Batteries_R%26D_Part-3of5-opt.pdf

Characterization Challenges and Sustainable Energy Lab



REQUIRES
CAREFUL
EXPERIMENTAL
DESIGN

Spatial Resolution
Energy Resolution
Detection Limit
Bulk vs. Local Observation
Dynamic States & Changes
E Beam & X-ray Sensitivity
Destructive / Non-destructive
Sample Transfer & Contamination
Buried Under Electrolyte

AT RISE

State-of-the-art characterization tools – XRD, XPS, Raman, XPM, Dual Beam Microscope – for measurements at different lengths and time domains

Tools integrated with operando measurement – heating, electrochemical cycling, passing gas, pressure and the like to acquire dynamic information

Integration of tools with glove box for reliable data collection avoiding contamination

Five glove box integrated solid state pouch cell assembly – a first in India

Cryo Gallium based Dual Beam Microscope for tomographic analysis of beam sensitive materials, such as Lithium and Sodium – a first in India

Collaboration with several Laboratories across the world (UCSB, UCSD, UCB, NCL, IISER, IITs) for characterization

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Inventing Harmonious Future

Centres for Quantum Engineering, Research and Education (CQuERE)

Quantum leaps for the benefit of society

Vision of CQuERE

Vision

“If you want to make a simulation of nature, you’d better make it quantum mechanical.”

Richard P. Feynman

Nobel laureate in physics (1965)

“What is really exciting about quantum computing is that we have good reason to believe that a quantum computer would be able to efficiently simulate any process that occurs in Nature.”

John Preskill

Richard P. Feynman Professor of Theoretical Physics

California Institute of Technology

Our vision is to establish CQuERE as a world class research centre on quantum science and technology by creating a stimulating research environment within the centre and bringing together the best of academia and industry.



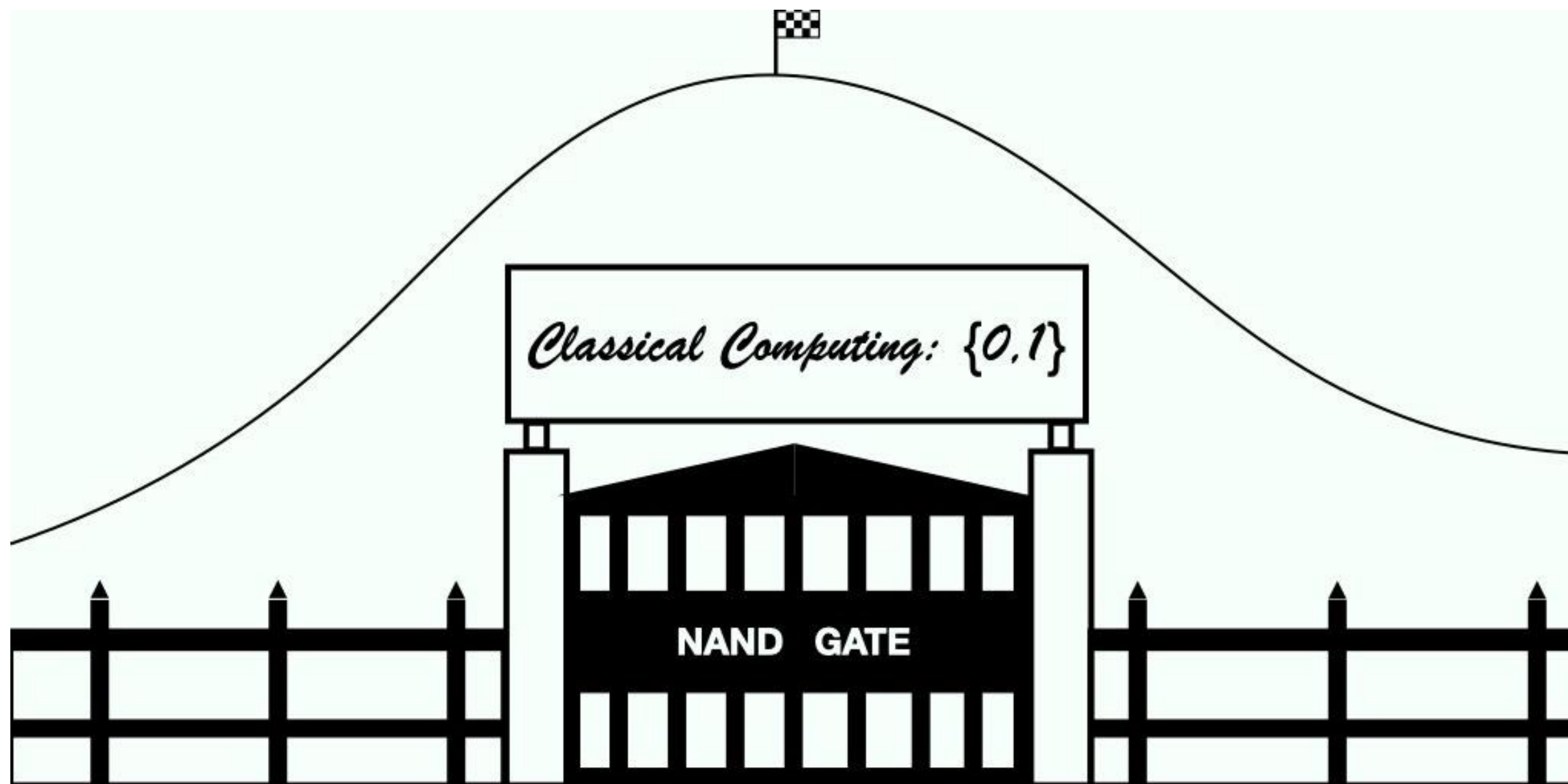
Prof. Bhanu Pratap Das
Director – CQuERE

A B.Sc (Hons.) from IIT Kharagpur, Prof. Das received an MS (1976) and a PhD (1981) from the State University of New York at Albany. After Postdoctoral fellowships at UC, Riverside and Max Planck Institute for Quantum Optics, Munich he held faculty positions at Colorado State University, Utah State University, Oxford University and IIT Bombay before joining the Indian Institute of Astrophysics (IIA), Bangalore in 1993 where he spent 22 years. He left IIA as Distinguished

Professor in 2015 to join as Professor of Physics at the Tokyo Institute of Technology, Japan. Prof Das' research field is quantum many-body theory of atoms and molecules and its applications to fundamental physics and quantum computing. He is a Fellow of the American Physical Society for his seminal contributions to the theory of parity and time-reversal violations in atoms in the context of probing the Standard Model of particle physics.

Classical vs Quantum Computation

SPEED-UP IN MOLECULAR CALCULATIONS COULD FIND APPLICATIONS FROM PROBING FUNDAMENTAL PHYSICS TO DRUG DESIGN

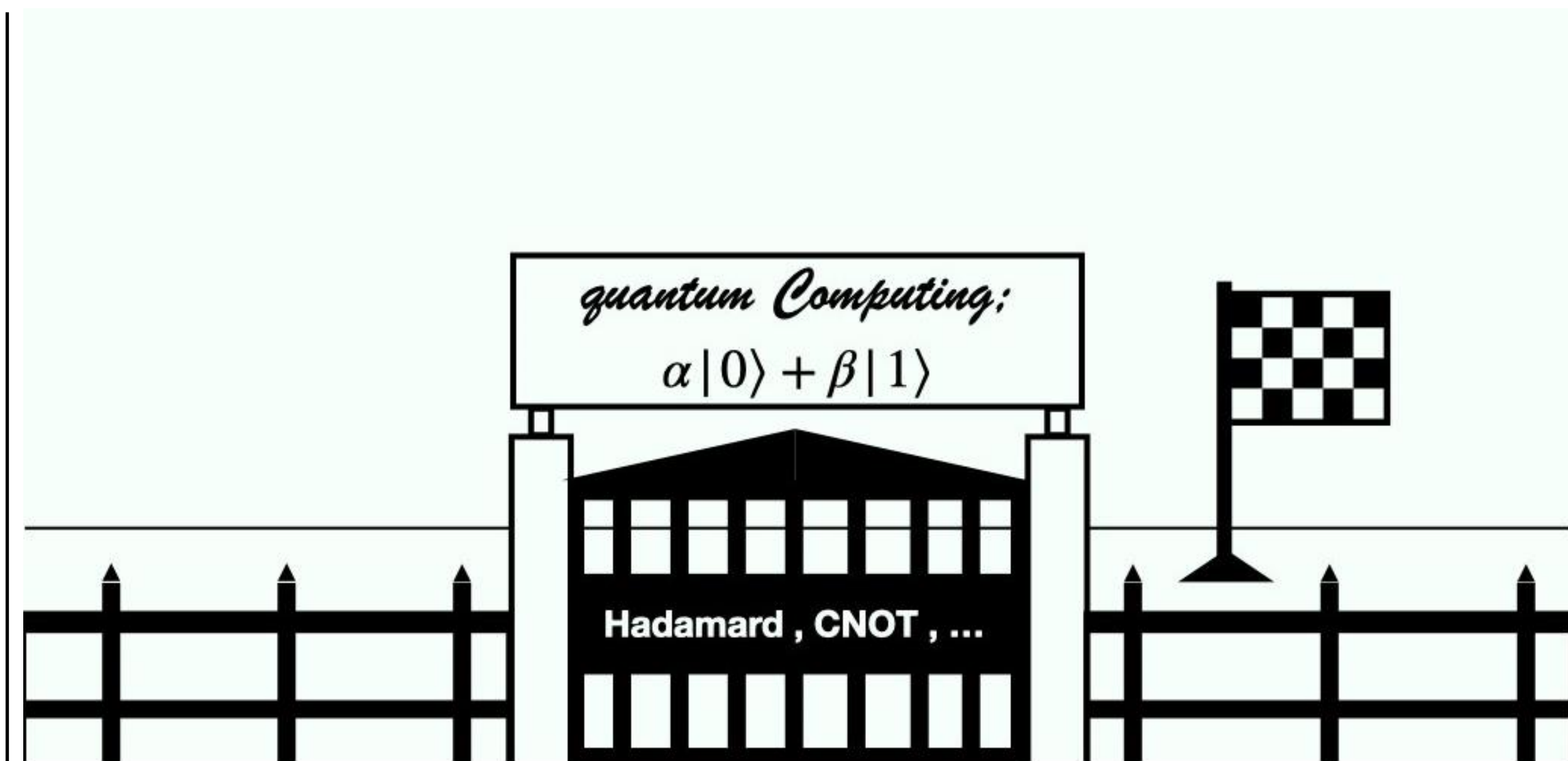


Classical Computing

Information is represented by bits.

A bit could be 0 or 1.

Computations use classical gates.



Quantum Computing

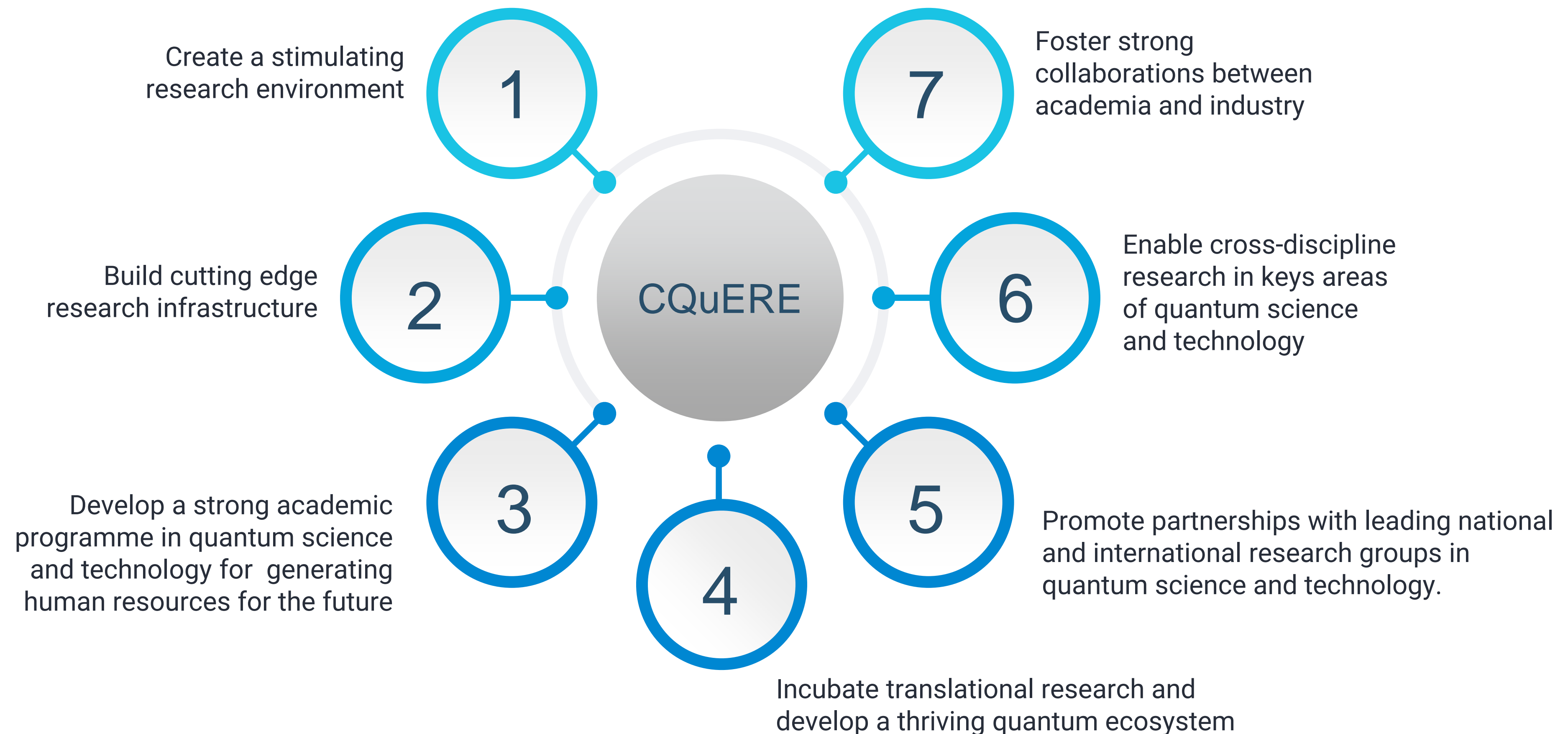
Information is represented by qubits.

It is a linear combination of 0 and 1.

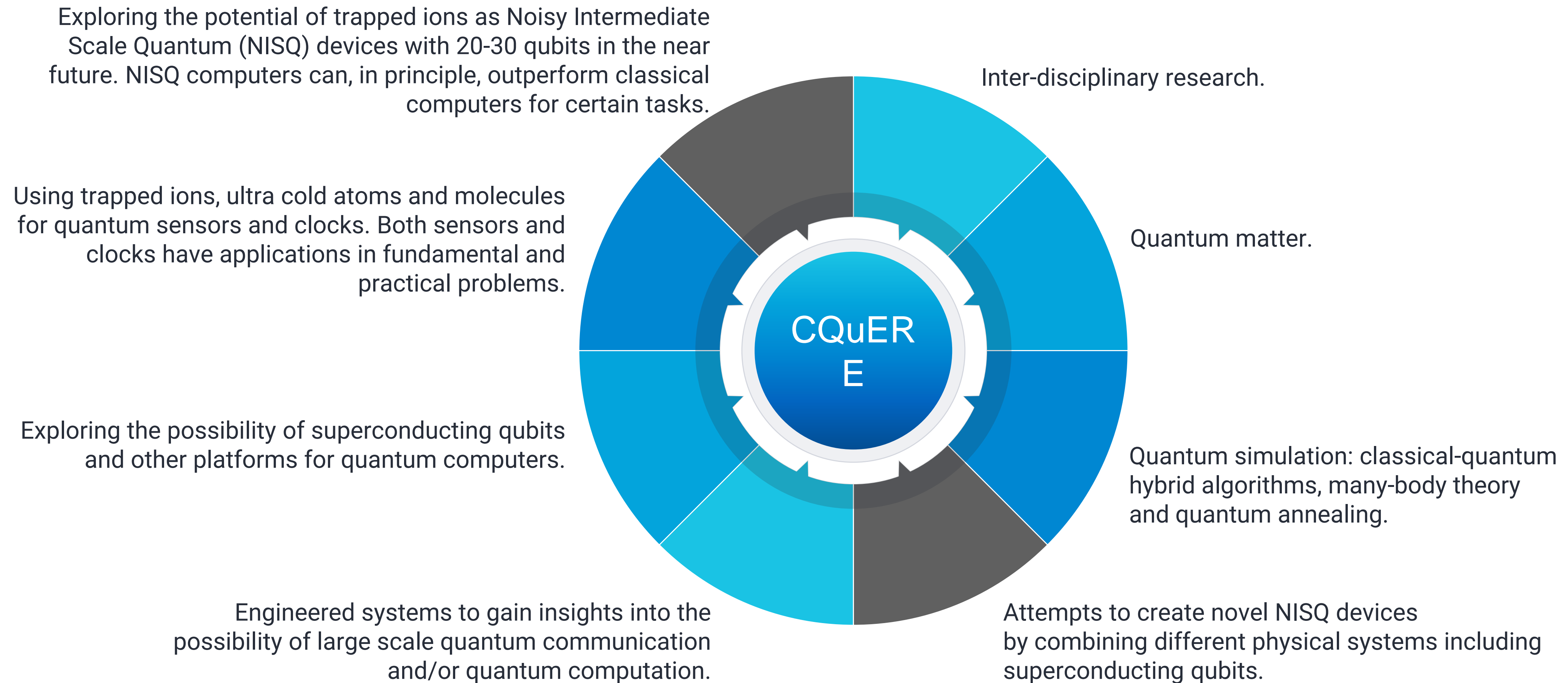
Computations could employ quantum gates.

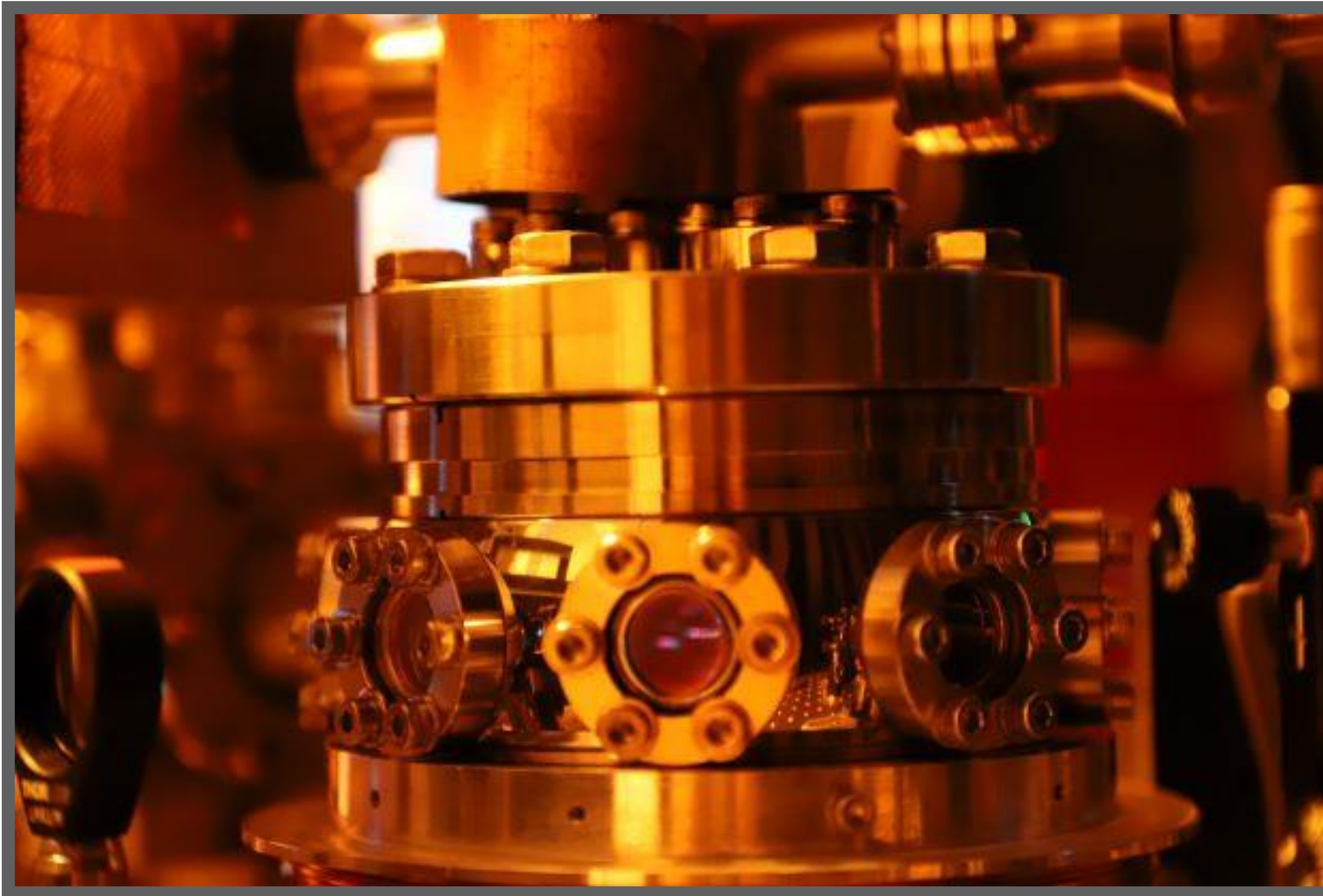
Goals & Objectives of CQuERE

AS THE FIRST CENTRE IN INDIA DEDICATED TO QUANTUM SCIENCE AND TECHNOLOGY, CQUERE WILL AIM TO



Research Areas





Ion Trap Technology

A combination of ultra-high vacuum, radio-frequency electronics and precision laser optics.
Ion Trap: A leading hardware for quantum computing, simulation and sensing.

Opportunities

CQuERE offers PhD and postdoctoral/visiting programmes in quantum science and technologies.

Prepares doctoral students and postdoctoral researchers for a career in research, both in academia and industry.

A unique research experience
Meeting of experiment and theory, Academia and industry.
Blend of young and an experienced faculty
Student internships from universities IITs, IISERs and participation in projects carried out at the centre.

Contributing to the creation of a pool of young scientists in quantum science and technology.

Collaborations

ACTIVE COLLABORATIONS GLOBALLY AS SCIENCE AND ADVANCED TECHNOLOGY HAS NO BOUNDARIES
BRINGING TOGETHER EXPERTS FROM INSTITUTES IN AND OUTSIDE INDIA

CENTRE FOR QUANTUM TECHNOLOGIES, SINGAPORE

INDIAN INSTITUTE OF TECHNOLOGY, DELHI

PHYSICAL RESEARCH LABORATORY, AHMEDABAD

INDIAN INSTITUTE OF TECHNOLOGY, BOMBAY

OSAKA CITY UNIVERSITY, OSAKA, JAPAN

INDIAN INSTITUTE OF TECHNOLOGY, GUWAHATI

OPEN TO FUTURE COLLABORATIONS ON RESEARCH AREAS PURSUED AT CQuERE

www.tcgcrest.org

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