

MISSION INNOVATION

Accelerating Clean Energy Innovation in India



सत्यमेव जयते

Department of Biotechnology
Ministry of Science and Technology

14 September 2016



Overview of Mission Innovation : Department of Biotechnology ,M/o Science and Technology

- Dr. Renu Swarup, Senior Advisor, DBT, New Delhi



Department of Science and Technology, M/o Sci &Tech

- Dr Sanjay Bajpai, Advisor, Department of Science and Technology, Ministry



Ministry of New and Renewable Energy

- Ms Varsha Joshi, Joint Secretary, MNRE



Ministry of Power

- Mr. P. D. Hirani, GM (NETRA), NTPC

Question and Answer Session



- All on One Stage -- Leaders of 20 Countries Representing over 80% of Global Clean Energy R&D Investment Agreed to Support a *Joint Statement* on Innovation
- Each Country Supported a Doubling of Governmental Clean Energy R&D Investment over Next Five Years (www.mission-innovation.net)
- Gov't Investment was Complemented by a Private Sector Initiative led by Bill Gates, the Breakthrough Energy Coalition (www.breakthroughenergycoalition.com)



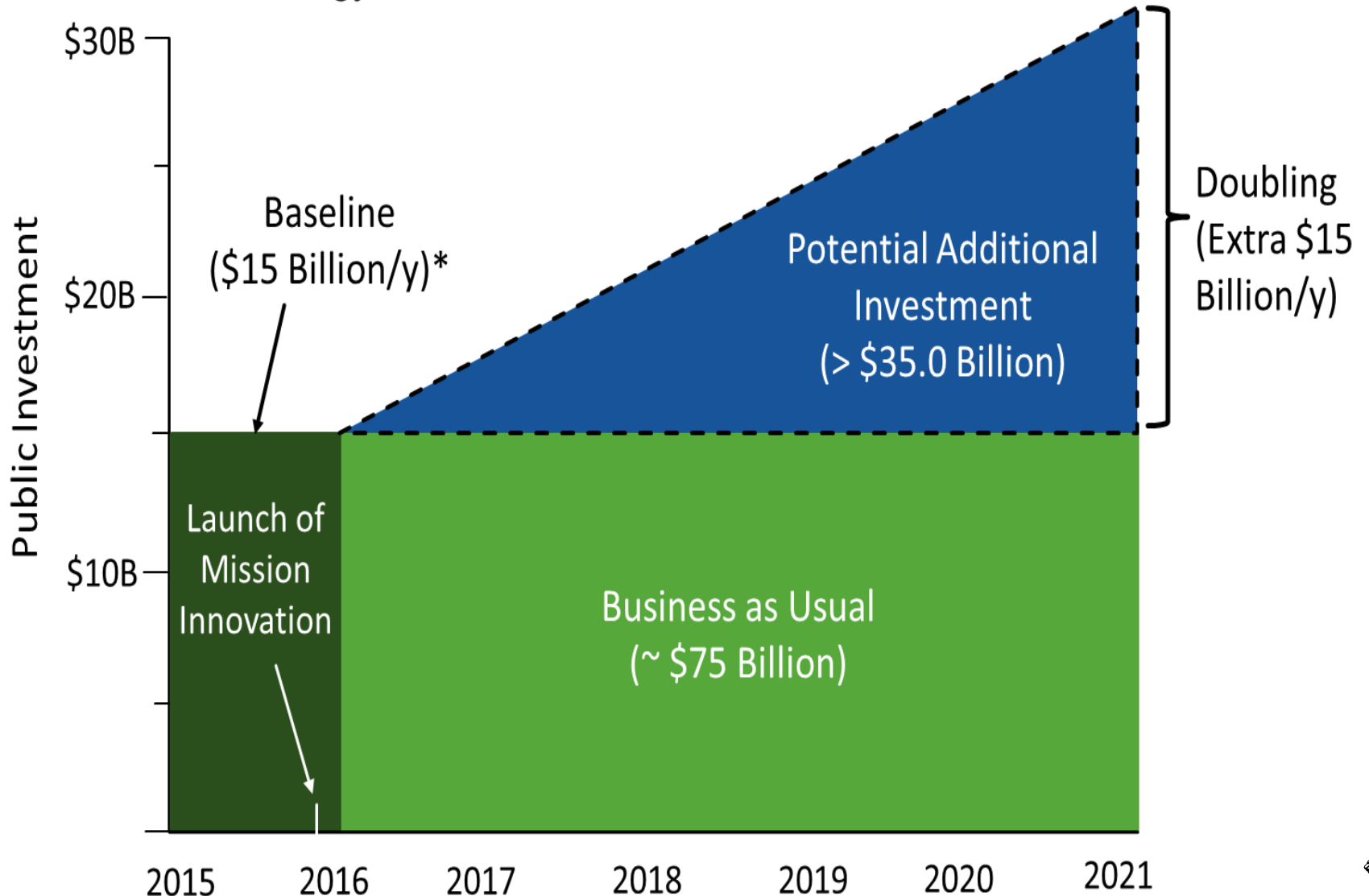
➤ Mission Innovation Countries Represent:

- 5 Most Populous Countries
- 60% of the World's Population
- 68% of the Total Greenhouse Gas Emissions
- 82% of Global GDP
- 75% of the CO₂ Emissions from Electricity
- Well over 80% of Government Investment in Clean Energy R&D

- Announcement of Clean Energy R&D [Doubling Plans and Priorities](#)
- Addition of European Union as 21st Member; Netherland & Finland also joined as Member
- Governance and administration outlined in [Enabling Framework](#)
- Compilation of technology roadmaps and meta analysis
- Business and Investor Engagement [Opportunities](#)
- See the [summary video](#) and [full livestream video](#) of the Ministerial
- Beginning of webinar series..... Next up is France on 20 October 2016



Clean Energy R&D Investment Chart for Mission Innovation



- The preparatory meeting of Mission Innovation was held in Beijing China on 18th March, 2016-Draft program & Country Targets discussed

- Mission Innovation Ministerial Meeting was held on 1-2 June, 2016 at San Francisco, USA-Country Document and Joint Research Collaborations & Opportunities announced

- India is formally a member of Steering Committee and following 2 subgroups
 1. Business and Investor Engagement Subgroup (Private sector)
 2. Joint Research and Capacity Building

Contents of the Presentation

1. Areas of Clean Energy Research Demonstration and development
2. Policy
3. Initiatives & Current Status
4. Various Ongoing Schemes
5. Breakthrough/Major Achievements
6. Collaboration with Industries
7. International Collaborations (Bi/Multilateral)
8. Proposed New Activities and Major Targets
9. Investment Opportunities

Identified Priority Areas for India

- Industry & buildings
- Vehicles & other transportation
- Biofuels
- Solar, wind & other renewables
- Hydrogen & fuel cells
- Cleaner fossil energy
- CO₂ capture & storage (to be included)
- Electricity grid
- Energy storage
- Basic energy research

- Ministry of Science & Technology
 - Department of Biotechnology
 - Department of Science & Technology
 - Council of Scientific & Industrial Research
- Ministry of Power
- Ministry of New and Renewable Energy
- Ministry of Environment, Forests & Climate Change
- Ministry of Defence (DRDO)
- Ministry of Earth Sciences
- Ministry of Petroleum and Natural Gas
- Ministry of External Affairs

Clean Energy R&D Funding Baseline

Country	Baseline (Million currency as declared, per year)	Baseline Amount (Million US Dollars per year)
Australia	104 AUD	78
Brazil	600 BRL	150
Canada	387 CAD	295
Chile	4.1856 USD	4
China	25,000 RMB	3,800
Denmark	292 DKK	45
European Union	989 EUR	1,111
France	440 EUR	494
Germany	450 EUR	506
India	4700 INR	72
Indonesia	16.7 USD	17
Italy	222.6 EUR	250
Japan	45,000 JPY	410
Kingdom of Saudi Arabia	281.3 SAR	75
Mexico	20.71 USD	21
Norway	1132 NOK	140
Republic of Korea	490 USD	490
Sweden	134 SEK	17
United Arab Emirates	10 USD	10
United Kingdom	200 GBP	290
United States	6415 USD	6,415
TOTAL		14,690



Mission Innovation Clean Energy R&D Focus Areas

	AUSTRALIA	BRAZIL	CANADA	CHILE	CHINA	DENMARK	EUROPEAN UNION	FRANCE	GERMANY	INDIA	INDONESIA	ITALY	JAPAN	KINGDOM OF SAUDI ARABIA	MEXICO	NORWAY	REPUBLIC OF KOREA	SWEDEN	UNITED ARAB EMIRATES	UNITED KINGDOM	UNITED STATES	
INDUSTRY & BUILDINGS	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
VEHICLES & OTHER TRANSPORTATION	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●			●
BIO-BASED FUELS & ENERGY	●	●	●		●	●	●	●	●	●	●	●			●	●	●	●	●	●	●	●
SOLAR, WIND & OTHER RENEWABLES	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
NUCLEAR ENERGY	●	●	●		●												●		●	●	●	
HYDROGEN & FUEL CELLS	●	●	●			●	●	●	●	●			●	●		●	●				●	●
CLEANER FOSSIL ENERGY		●	●		●	●			●	●	●				●							●
CO ₂ CAPTURE, UTILIZATION & STORAGE	●	●	●		●	●	●	●	●				●	●	●	●	●			●	●	●
ELECTRICITY GRID	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●
ENERGY STORAGE	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●
BASIC ENERGY RESEARCH	●		●			●	●	●	●	●	●	●	●	●		●		●	●			●

Department of Biotechnology
Govt. of India

Indicators are for key areas of R&D investment, but do not imply a comprehensive representation of a country's full R&D portfolio.



सत्यमेव जयते

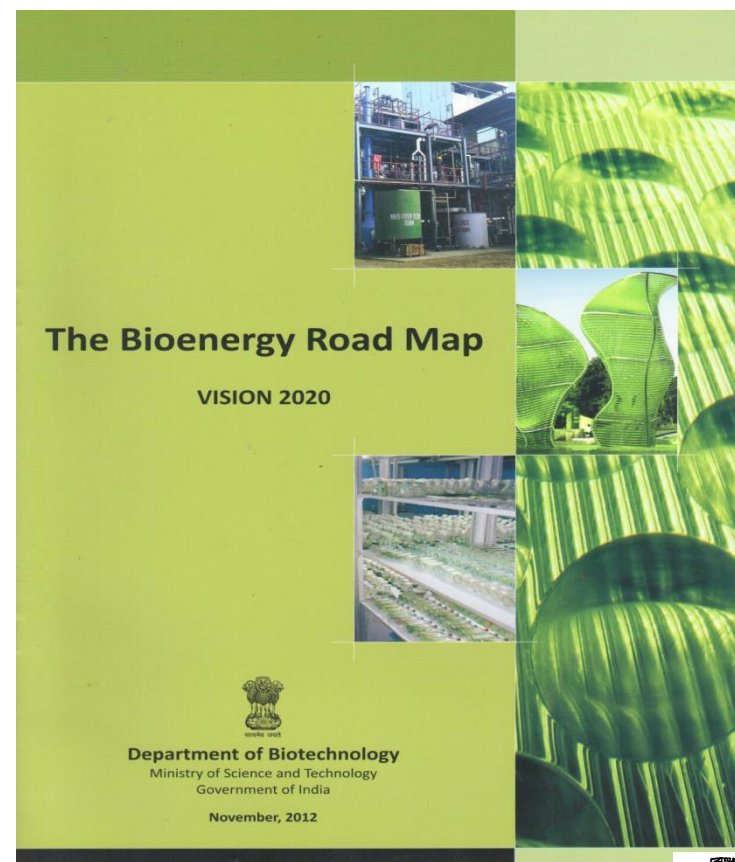
- National Biofuel policy & Target
- What are our Strategies
- Where are we?
- What are challenges?
- How do we address these challenges?

The Bioenergy Road Map

VISION 2020: Create a Biotechnology enterprise equipped with viable green and clean

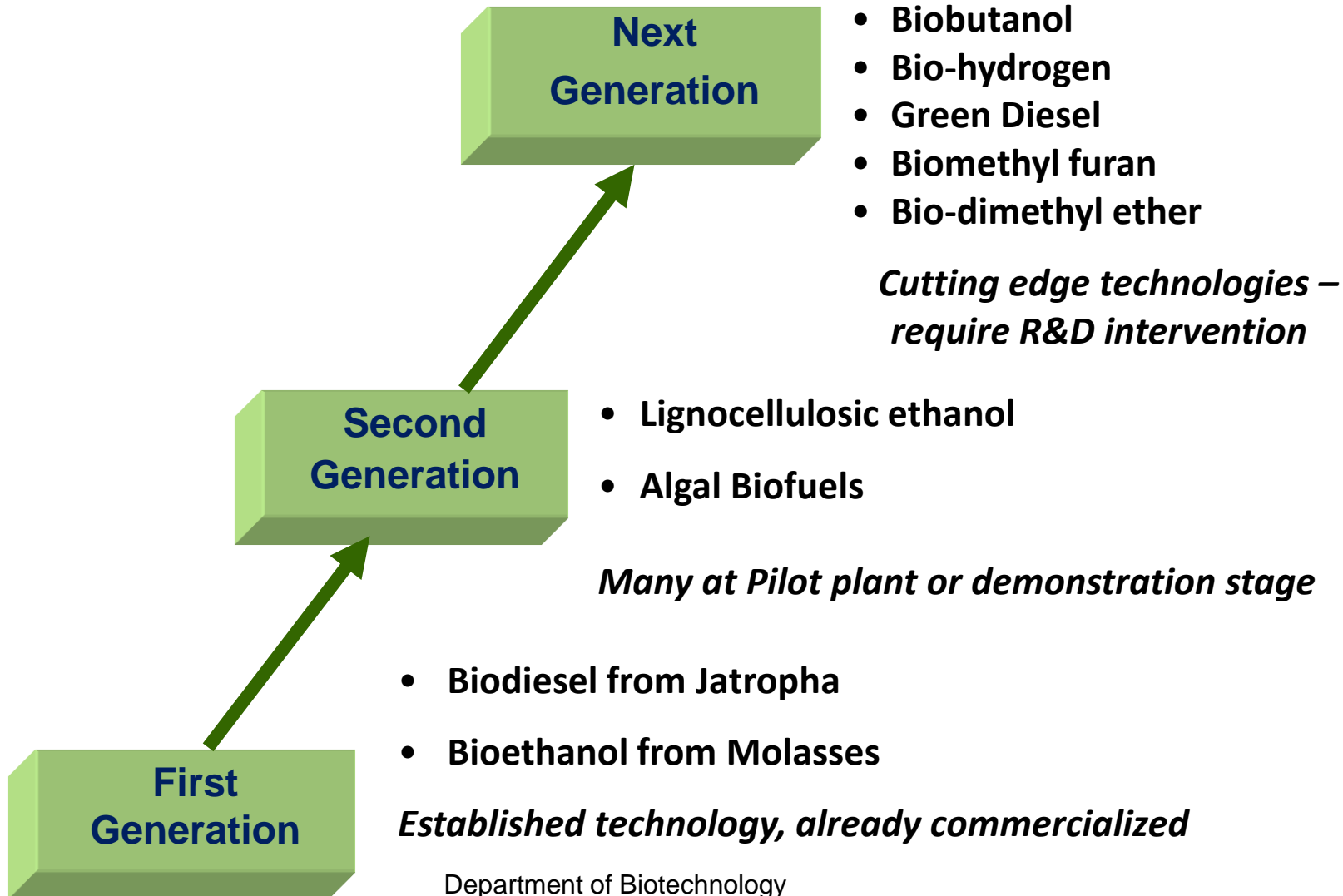
Goals and Targets:

- 20% blending of fossil fuel by 2020
- Commercially viable lignocellulosic ethanol
- An economically cost efficient system for Algal biofuel production
- Next generation biofuels from different biomass feedstock.



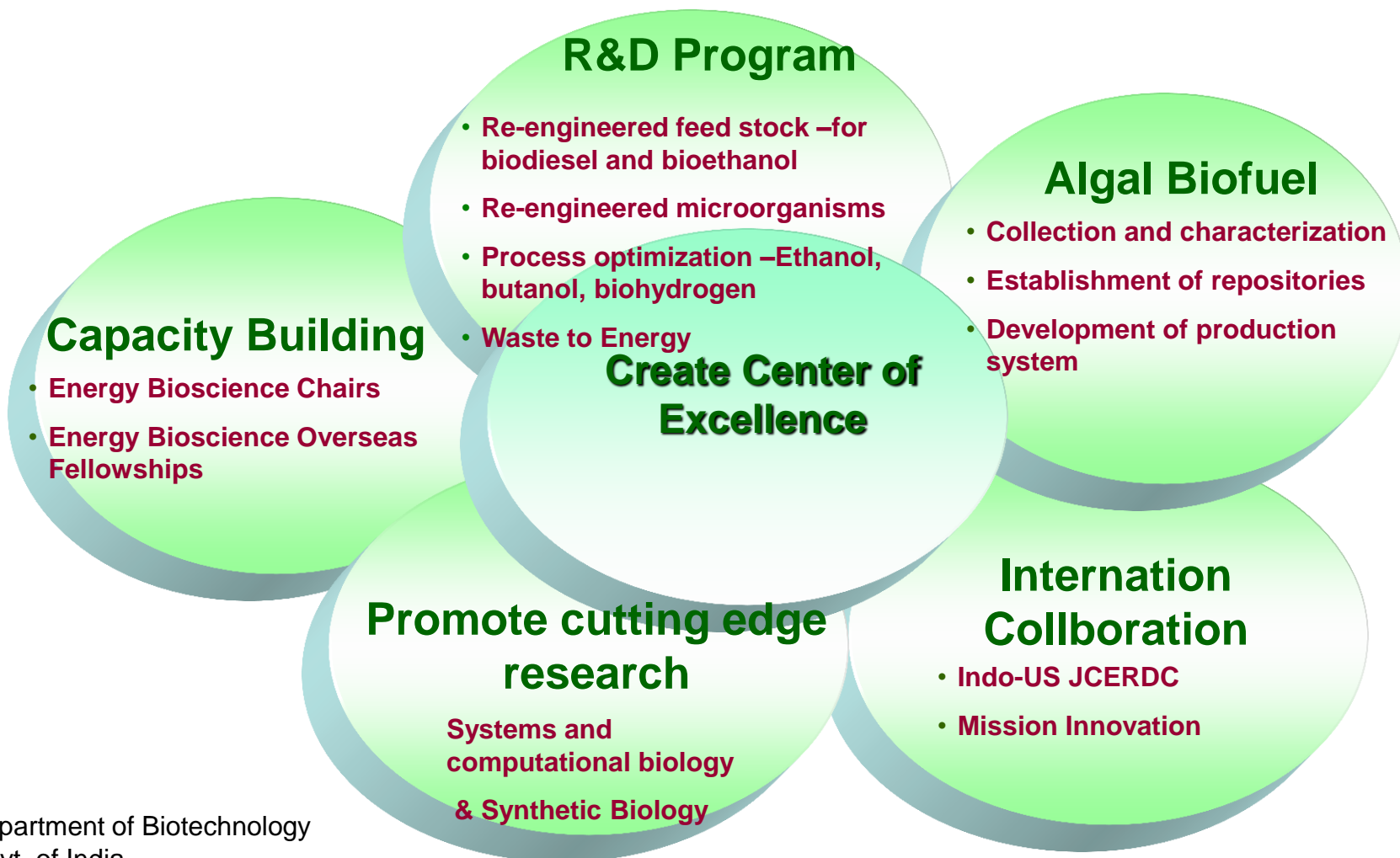
- 675 cr litre Bio diesel requirement by 2022 - Rs. 27000cr
Business
- 450 cr litre Bio ethanol requirement by 2022 - Rs. 23000 cr
Business
- Current Business: Rs. 650 cr
- By 2022 Business to grow - Rs. 50000 cr
- ***(equivalent to 7.5 Billion USD)***

THE BIOFUEL GENERATIONS



Department of Biotechnology
Govt. of India





Budget Allocation for National and International programs

Title: of Program /Project	Bioenergy Centers	R&D Projects	International Cooperation-	Capacity Building through Energy Bioscience Fellowship/Awards
Cost of Project	Rs. 80 Crores	Rs. 5.00 crores/year	Rs. 13.00 crores	Rs. 20.00 Crores
Duration	5 years (2013-2018)	3 years	5 years (2013-2118)	3 years
Key objectives	i)Cellulosic ethanol ii)Algal biofuel	i)Feedstock development- Jatropha, Microalgae ii) Improved production technologies through biotech routes-ethanol, butanol, hydrogen	1.India-US Joint Clean Energy Research and Development Center Project: Sustainable development of lignocellulosic advanced biofuel systems 2.India-UK BBSRC	1. Energy Bioscience Overseas Fellowship -To provide opportunities to young scientists of Indian origin to pursue research at home country 2.Energy Bioscience Chair -5 positions for Senior Scientists 2. B-ACER Awards -to nurture young scientist and Ph.D students by providing opportunity to have short term training in premier institutes in US
Current Status	Technologies are at demonstration level	Lab scale processes are ready	Ongoing Program with Joint Research Publications	
Collaborating Institute (National /International)	Government Institutes /Public Sector Undertaking	Various public and private academic/research institutes	1.Department of Energy US 2.BBSRC-UK	Premier Research Institutes in US would provide training to Indian PhD students and Young Scientists

1. DBT- ICT Centre for Energy Bioscience- Mumbai
2. DBT-IOC Centre for Advanced Bioenergy Research-Faridabad(*Partnership Center with Indian Oil Corporation Ltd*)
3. DBT-ICGEB Center for Advanced Bioenergy Research – New Delhi
4. DBT-Pan IIT Center for Bioenergy- Virtual Center among 5 Indian Institutes of Technology (5 IITs)

Multidisciplinary Centre with state-of-the-art facility for high tech R&D in enzyme technology; fermentation and bioprocess technology microbial genomics, proteomics, metabolomics
Many technologies developed and transferred to industry including 2G ethanol



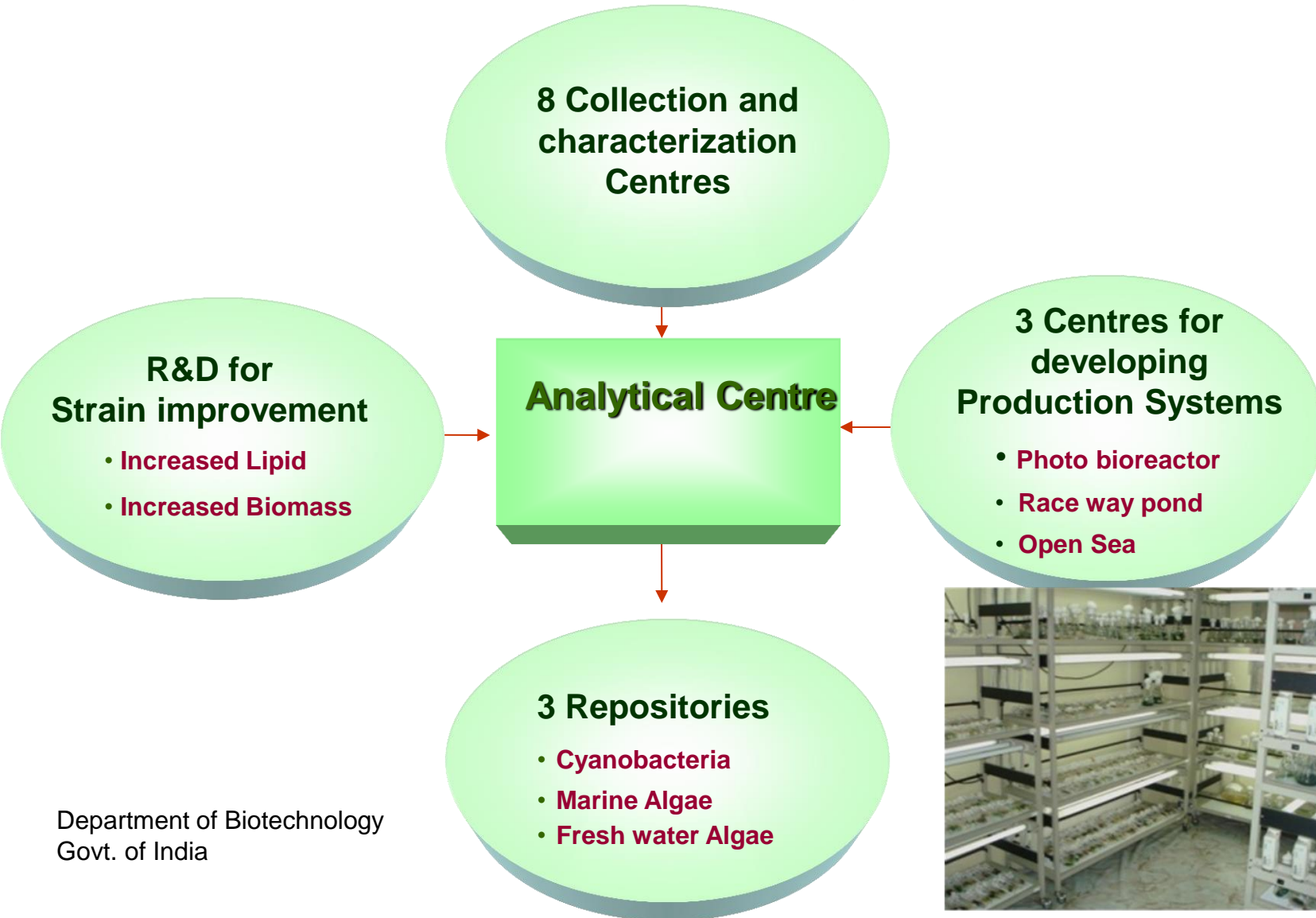
First national demo plant capacity 10 T biomass /day at IGL Kashipur.
Novel features-patent protected
Biomass agnostic, rapid and continuous, process.

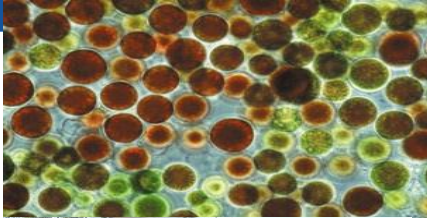
- Provide National capability of pilot level scale-up of developed technologies.
- Lignocellulosic based bio-fuels
- Novel biotechnological method for CO₂ mitigation
- Life cycle analysis



Algal Biofuels

A National Network involving 12 Laboratories





Current Scenario

Algae > Rs. 50/kg dry
Algal Biofuel > Rs. 250/L
Net Energy Ratio (NER) : Negative

Challenges

High water use
High cost of Nutrients
High Capital Cost of Efficient Photo-Bioreactors
High power consumption in growth & harvesting
High cost processing to Fuel

RDD&D Required: To bring down cost by five-fold

Use of robust, preferably marine, algae grown along sea coast
Design of Efficient Photobioreactors and Nutrient management for

- High productivity
- High tolerance to stress
- Low Capital cost
- Low energy consumption

Design of Efficient Harvesting & Conversion to Biofuels



Biofuel Production Technology

Biobutanol



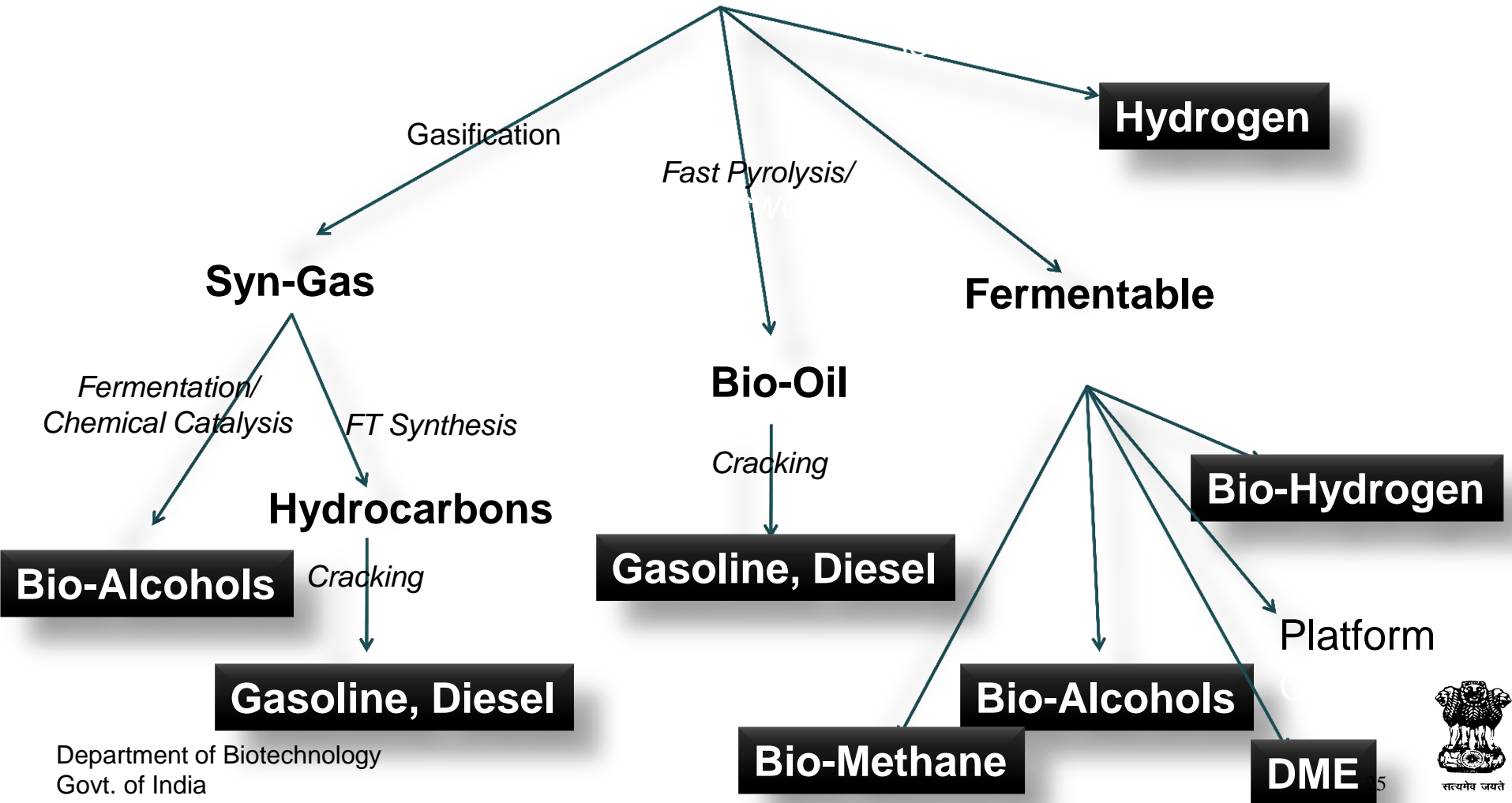
Department of Biotechnology
Govt. of India



Biohydrogen



Agricultural Biomass Biofuel Options



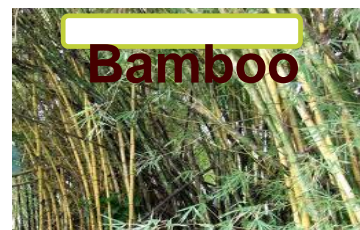
- National Chairs for scientists of eminence
- National Energy Bioscience fellowships for Re-entry
- Bioenergy Awards for Cutting edge Research (B-ACER)

- **Call for Proposals on 'Municipal Solid Waste to Energy' under Swachh Bharat Mission**
- **Next Generation Fuel**
- **Synthetic Biology for production of biofuels**

Synthetic biology offers potential for developing microbial systems that can perform one step conversion of renewable carbohydrates to desired hydrocarbons.

- **India-US Joint Clean Energy Research and Development Center (JCERDC) : in the area of Solar Energy, Energy Efficiency of Buildings and Second Generation Biofuel**
- **INDIA-UK (BBSRC) Collaboration has funded four (4) proposals under the programme “Sustainable Bioenergy and Biofuels” (SuBB)**

- Joint Initiative by GOI and DOE US
- **Priority areas**
 - Solar Energy, Energy Efficiency of Buildings
 - Second Generation Biofuels,
 - Smart Grid and Energy Storage- New Research Track
- The thrust is on cutting edge R&D for technology / process development



International Collaboration : New Initiatives

- **a. Joint call of proposals between DBT, India and BMBF, Germany. Under the joint call priority areas identified in field of Biotechnology are:**
 - Biotechnology for reuse of biodegradable urban solid waste.
 - Biotechnology for reuse of biogenic raw materials in agriculture.

- **b. Department is partnering with Geographical ERA-NET (INNO-INDIGO) under India-EU, S&T agreement. In collaboration with INNO-INDIGO Department is partnering in two joint calls on S&T and Innovation. Partner countries are Belgium, Estonia, Finland, Germany, Latvia, Portugal and Spain. Calls are in the area of:**
 - Bioeconomy.
 - Biobased energy



Scaling Bio-Entrepreneurship: Foundation for Sustainable Future



**Biotechnology Industry Research
Assistance Council**

A Government of India Enterprise

Biotechnology Industry Research Assistance Council (BIRAC) was established as a new Public Sector Undertaking by Department of Biotechnology (DBT), Ministry of Science & Technology, Government of India and registered on 20th March 2012 under the Companies Act, 1956 as a Section 25 Not for Profit Company (Now a Section 8 Company under the Companies Act, 2013)

Vision

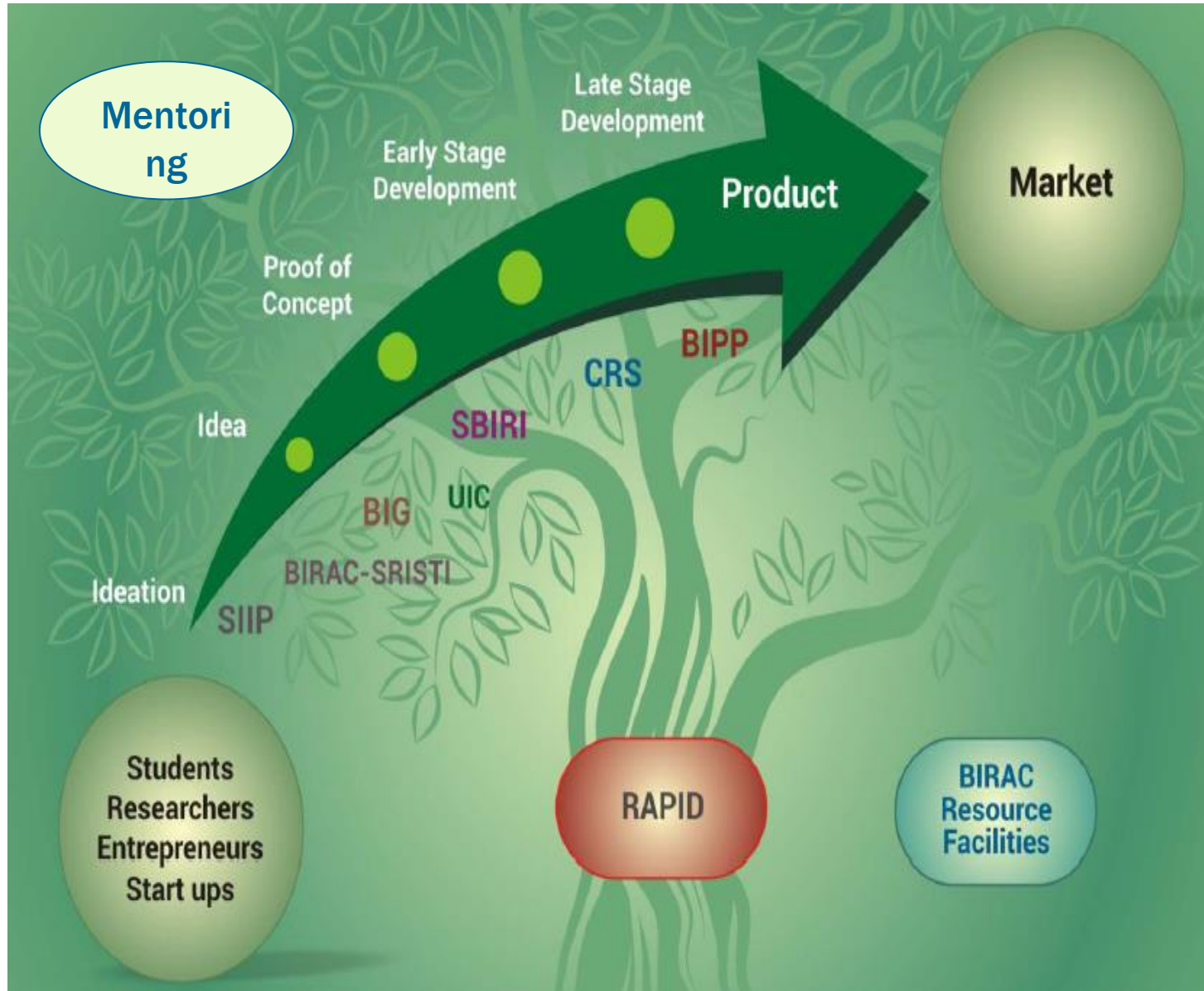
To Stimulate, foster and enhance the strategic research and innovation capabilities of the Indian biotech industry, particularly start ups and SME's, for creation of affordable products addressing the needs of the largest section of society

The Mission

Facilitate and mentor the generation and translation of innovative ideas into biotech products and services by the industry, promote academia – industry collaboration, forge international linkages, encourage techno entrepreneurship and enable creation and sustainability of viable bio enterprises



BIRAC's Role: Driving Product





Nurturing Innovations

- **SITARE (Students Innovations for advancement of Research Explorations)**
 - SRISTI- An initiative by BIRAC and IIM Ahmedabad
- **eYuva (Encouraging Youth for Undertaking Innovative Research through Vibrant Acceleration)**
 - *University Innovation Clusters (UIC)*
 - *SIIP (Social Innovation Immersion Fellowship)*
- **BIG (Biotechnology Ignition Grant)**
- **SPARSH (Social Innovation Programme for Products Affordable & Relevant to Societal Health)**

Early and Late Stage Funding

- **Small Business Innovation Research Initiative (SBIRI)**
- **Biotechnology Industry Partnership Programme (BIPP)**
- **Contract Research Scheme (CRS)**
- **BIRAC SEED Fund (Sustaining Enterprise and Entrepreneurship Development)**
- **BIRAC AcE Fund (Accelerating Enterprises)**

BIRAC BioNEST (BIRAC- Bioincubation: Nurturing Entrepreneurs for Scaling up Technology)

Mentoring and Capacity Building Programmes

BRIC (BIRAC Regional Innovation Centre):

BREC (BIRAC Regional Entrepreneurship Development Centre):

Our Partnerships

Nesta...

UNIVERSITY OF CAMBRIDGE
Centre for Entrepreneurial Learning
Judge Business School

Horticulture Innovation
Australia

WISH
Scaling up innovations
Transforming healthcare

BILL & MELINDA GATES foundation

Tekes

CEFIPRA

UK TRADE & INVESTMENT

DBT

Deity

DST

USAID
FROM THE AMERICAN PEOPLE

SRISTI
Society for Research and Initiatives for Sustainable Technologies and Institutions

World Health Organization

Liberté • Egalité • Fraternité
RÉPUBLIQUE FRANÇAISE

ABLE

MoFP

birac
Ignite Innovate Incubate

MoHFW

Grand Challenges in Global Health

AMBASSADE DE FRANCE EN INDE
FRENCH EMBASSY IN INDIA

C-CAMP
Centre for Cellular and Molecular Platforms

bpi france

SERVIR L'AVENIR

c d s a
Clinical Development Services Agency

BCIL

FICCI

ICAR

MNRE

ICMR

CII
Confederation of Indian Industry

wellcome trust

TISS
Tata Institute of Social Sciences

IKP
KNOWLEDGE PARK

ICRIL
Celebrating Sixty Years of Science

KIIT

ITT
FOUNDATION FOR INNOVATION AND TECHNOLOGY TRANSFER

MISSION INNOVATION

Accelerating the Clean Energy Revolution

Collaboration with Industries



ARDEE HI-TECH PRIVATE LIMITED
GROWTH THROUGH INNOVATION



Centre for Genome Research
Unravel the Mystery of Genome

Department of Microbiology
and Biotechnology Centre

सत्यं शिवं सुन्दरम्

The Maharaja Sayajirao University of Baroda



Department of Biotechnology
Govt. of India



Biofuels:

- Transformational Technology Platform for Biological Hydrogen at 10 tonnes scale.
- A 10 ton Lignocellulosic biomass/day processing plant to produce about 3000 Litre ethanol/day
- A Platform technology for expression of monocomponent cellulolytic enzymes
- Development of technology for biobutanol production at 1 L scale from lignocellulosic biomass.
- Project on complex seaweed polysaccharides to produce ethanol.
- Project on ethanol production from hemicelluloses using pentose utilizing yeast strains.
- Project to remove H₂S from biogas by way of recovering sulphur by redox reactions using chelated polyvalent metal ion.
- Project to set up a pilot plant for ethanol production from rice husk.

Waste to Energy Projects :

- Development of Anaerobic Membrane Bioreactor (AnMBR) for Waste to Energy Solutions
- Project on Biochemical Research & Development to Improve the Efficacy of a Dry, Thermophilic, Anaerobic Reactor
- Project on Sustainable, novel and, decentralized waste management solution
- Economical process for conversion of waste to green chemicals.
- Project on converting agri waste to energy by utilizing rice husks to produce Carbon-Coated Nanoporous Si/SiO₂ for Li-Ion Batteries
- Project on implementing an end to end facility for conversion of waste to lactic acid via methane
- Project to develop a modular, compact, completely sealed, automated, scalable and low-cost factory made appliance that could be installed at the source of waste generation
- Project on co-treatment of domestic septage and municipal solid waste landfill leachate using a dry thermophilic anaerobic digestion process



- The Prime Minister of India launched the “**Startup India**” initiative on January 16, 2016 . The **Action Plan for Start-up India** has a special mention for the Biotechnology sector. DBT along with BIRAC has been given the responsibility to implement the Startup India action plan



- **Bio-energy shall be a major contributor to energy pool**
- **Partnered Centers and Public Private Partnership is the key to meet the challenge**
- **International collaboration both bilateral and multi-lateral are encouraged**
- **In addition to Public funding, Private Sector Investment can play an important role to boost the sector**
- **Time bound, coordinated efforts will be essential to exploit this potential optimally**

*Thank you for your
attention*

