

Climate Technologies

Industry-Academia: Innovations and Technology Transfer

Anil Wali

BITS BioCyTiH Foundation (BITS Pilani), India

Manilla

14.7.2025

University / R&D Roles

Beyond ...

- Education
- Research
- Knowledge spread

Today, the roles include...

- ✓ Resource Mobilization
- ✓ Technology Commercialization
- ✓ Collaboration with industry
- ✓ Entrepreneurship
- ✓ National / Global Challenges
- ✓ Public Service



Measure of successful R&D

- Generation of new knowledge
- Technology commercialization
- Social and economic benefits

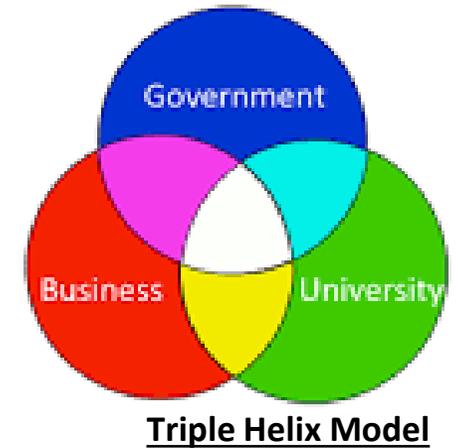
Stakeholders in the innovation process

- Universities, R&D scientists and Technology Transfer officials
- **Entrepreneurs**, Start-ups, Risk capital
- Industry *Incubation route (TBI)*
- Tech adopters, Downstream producers
- Regulatory Authorities
- **Consumers**

Tech. Transfer: Sharing / moving knowledge, skills, know-how, IP etc. between various entities e.g., individuals, organisations or institutions.
Movement, sharing, dissemination, collaboration, cooperation, licensing, JVs etc.

Innovation and Development

- **Commercialization of Research** – research translation, spin-offs, IP licensing for development etc.
- **Innovation and Economic Growth** – innovation clusters, TBIs, new markets etc.
- **Collaboration and Open Innovation** – open source, knowledge sharing platforms, SME support etc
- **Access to Resources** – Funding, Technical Assistance etc
- **Societal Impact** – solutions for pressing societal and environmental challenges: licensing, startups etc
- **International cooperation** and development aid (often facilitated by UN and multilateral bodies)
- **Joint ventures and public-private partnerships**



Industry-academia partnerships:

- Joint Research Projects
- Consulting / Contract R&D
- Internships & Apprenticeships
- Curriculum Development
- Entrepreneurship development
- Knowledge Exchange

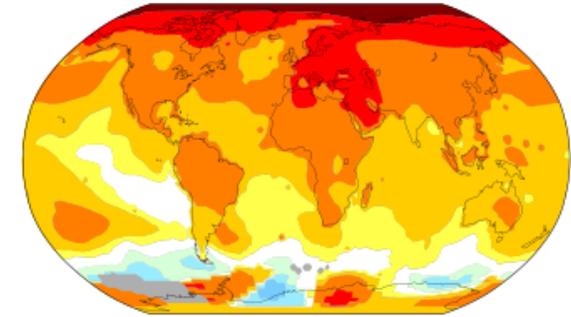
IP Management in a Univ.

- IP Policy framework
- IP Awareness
- Technology Transfer Office
- Revenue Sharing
- Conflict Resolution
- Monitoring

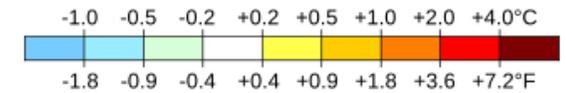
The Climate Crises.... challenges

[Changes in surface air temperature "GISS Surface Temperature Analysis \(v4\)". NASA. Retrieved 12 Jan. 2024](#)

Temperature change over the past 50 years



Trend from 1973 to 2023



UN News Centre, 2015



- **Climate change is leading to a range of interconnected issues like:**
- **Extreme Weather Events** – heatwaves, droughts, floods, wildfires etc.
- **Food & Water Insecurity** – agriculture production, water scarcity etc.
- **Human Health Impacts** – weather extremes, pollution, diseases etc.
- **Displacement & Migration** – rising seas, storm surges, social tensions etc.
- **Biodiversity Loss** – ecological change, disturbed plant and animal lives etc.
- **Economic Disruption** – in agriculture, tourism, industry, transport etc.

Biodiversity – our strongest natural defence against climate change

The Earth's land and the ocean serve as natural carbon sinks, absorbing large amounts of greenhouse gas emissions. Conserving and restoring natural spaces, and the biodiversity they contain, is essential for limiting emissions and adapting to climate impacts...UN

Climate Resilience Solutions-1 Development/deployment/investment

University research is a major source of climate innovation. Many technologies are built on foundational research from academic collaborations with industry and Govt agencies etc.

Agricultural Technologies

- **Crop varieties:** Seeds that can withstand water scarcity and extreme temps. is vital for food security.
- **Irrigation systems:** Technologies like drip irrigation, micro-sprinklers etc. minimize water usage while increasing crop yields.
- **Precision techniques:** Sensors, data analytics, GPS etc. optimize resource (water, fertilizer, pesticides etc.) usage.
- **Soil practices:** No-till farming, cover cropping, and composting etc. improve soil health and water retention

Energy Technologies

- **Renewable solutions:** Solar, wind, and other energy technologies reduce reliance on fossil fuels and greenhouse gas emissions.
- **Smart grids:** Optimize energy distribution and consumption while enhancing grid stability and efficiency.
- **Storage solutions:** Batteries and pumped hydro storage improve the reliability of renewable energy sources.
- **Green hydrogen :** Technologies for producing hydrogen from renewable energy sources for fuel and industrial applications

Climate Resilience Solutions-2 ... development / deployment / investment

Water Management

- **Water harvesting and storage:** To collect and store rainwater and stormwater runoff for later use.
- **Desalination technologies:** Energy-efficient methods for converting seawater into freshwater.
- **Advanced wastewater treatment:** To recycle and reuse wastewater for various purposes.
- **Smart water metering and distribution:** For effective management of water distribution and minimization of leaks.

Miscellaneous

- **Climate modelling and forecasting:** Advanced models to predict future climate scenarios and potential impacts.
- **Early warning systems:** To provide timely alerts for extreme weather events.
- **Climate-resilient infrastructure:** Designing / constructing robust buildings, transportation systems etc.
- **Carbon capture and storage:** Developing technologies to capture CO₂ emissions from industrial sources.
- **Use of novel technologies:** AI/ML, CPS etc for specific equipment, systems and projects.

Adoption Challenges...

- **Upfront costs:** Some climate-resilient technologies can be expensive to implement, requiring significant investments.
- **Knowledge and skills gap:** Insufficient skilled personnel to operate and maintain climate-resilient technologies.
- **Policy and regulatory barriers:** In some cases, this may hinder the adoption of climate-resilient technologies.
- **IPR and Technology Transfer:** Particularly a barrier w.r.t. developing nations (now changing) as much of the advanced cleantech IPs reside with developed countries.
- **Collaboration and partnerships:** Fostering partnerships among universities, governments, businesses, and communities is crucial for effective technology transfer and implementation of technology solutions.

Adoption of green technologies ought to be driven by impact and not upfront costs.....



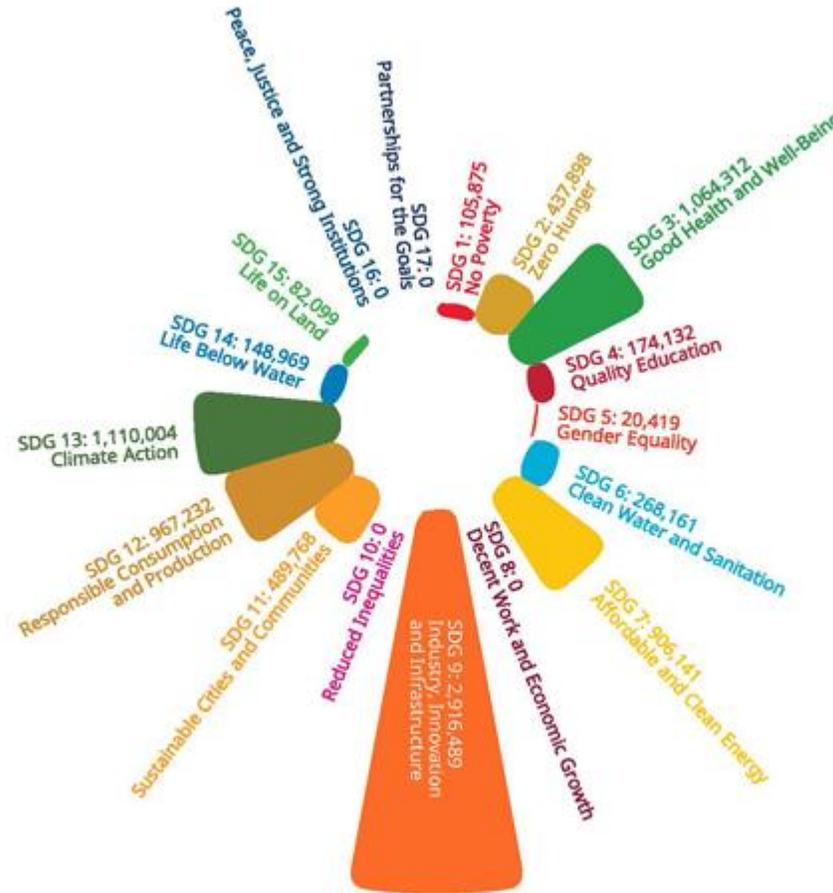
The essence of modern economic growth is the increase in the stock of useful knowledge and the extension of its application. The economic growth of every nation is inextricably linked to the successful international transfer of technology.

.... DJ Teece, 1977

Inventions and SDGs

Patents –

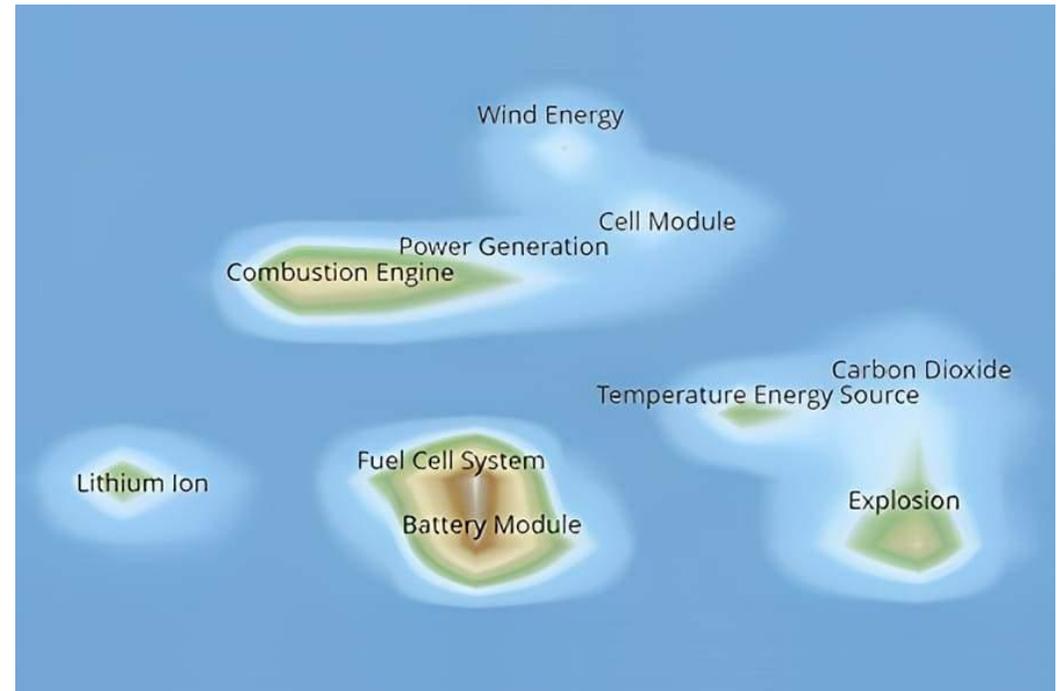
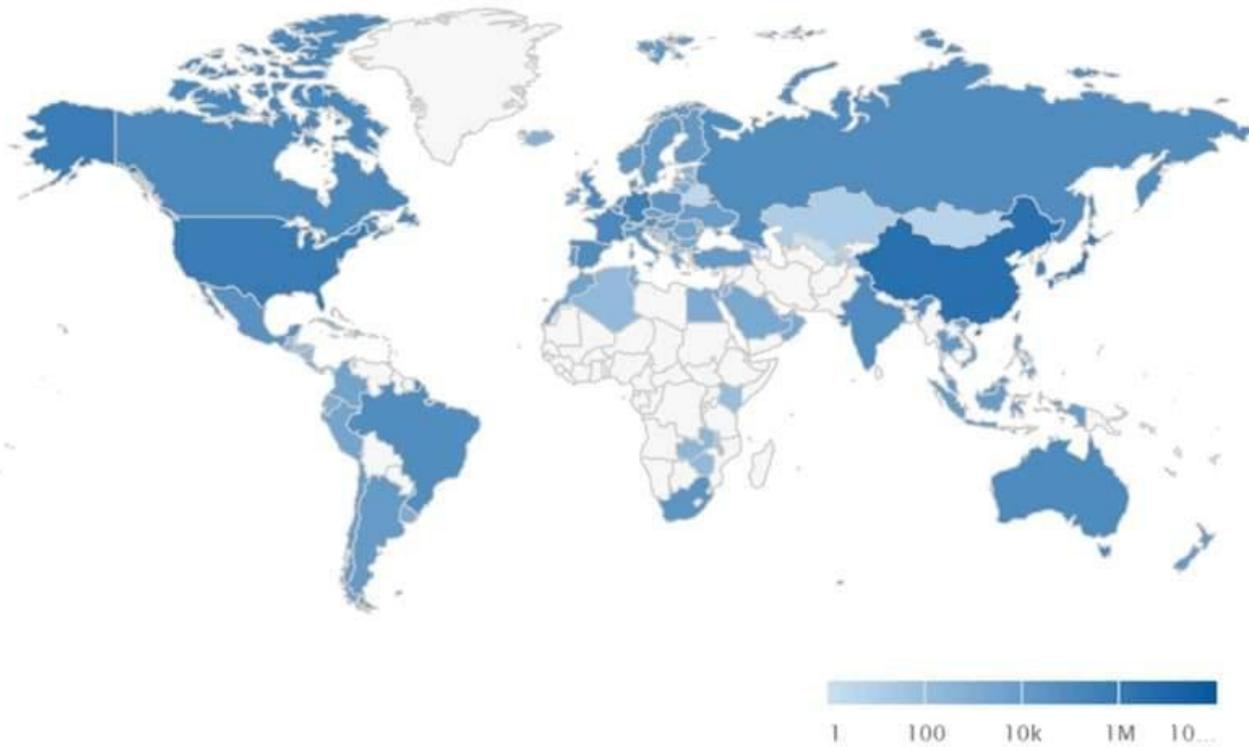
- a strong indicator for S&T output and for tracking innovations
- Represent 13 of the 17 SDGs
- **About 1 in 3 patents now relate to SDGs**
- SDG9 (I,I & I) leads, 2.9m active patent families
- SDG7 (Clean Energy) 0.9m
- SDG13 (Climate Action) 1.1m



The current number of active patent families associated with each of the 17 SDGs that cover relevant technologies. Source: WIPO, based on patent data from PatentSight, January 2024

Fight against Climate Change

Geographical Distribution of Patents for Combating Climate Change



Patent distribution in technological areas. Shades of blue - an absence or low production, while darker brown shades represent a higher density of patents.

Universities advancing Net Zero ...

Academic institutions often serve as living labs for energy technologies

- ETH Zurich strives to become climate neutral by 2030. In 2006 it resolved to gradually replace its natural gas heating with an experimental energy efficient and sustainable underground storage system (Anergy Grid)
- **Synheliion** started at ETH Zurich as a “crazy” idea to reverse combustion. In 2019, the researchers demonstrated the entire thermochemical process chain under real field conditions in a solar mini refinery. It is now working with industry partners to scale its production of carbon-neutral solar fuels compatible with the existing global fuel infrastructure. Over a period, they aim to de-carbonize the transportation industry to cover roughly 50% of Switzerland’s jet fuel demand.
- **Climeworks** emerged out of the same renewable energy lab at ETH Zurich. It has raised \$650 million in equity to accelerate its direct air capture technology that pulls CO₂ from the air and safely stores it deep underground. Climeworks endeavours to capture a billion tons of carbon dioxide by 2050. Following a successful pilot in Switzerland, they launched “Orca”, the world’s first and largest direct air capture and storage plant in Iceland in 2021.

World Economic Forum 2023



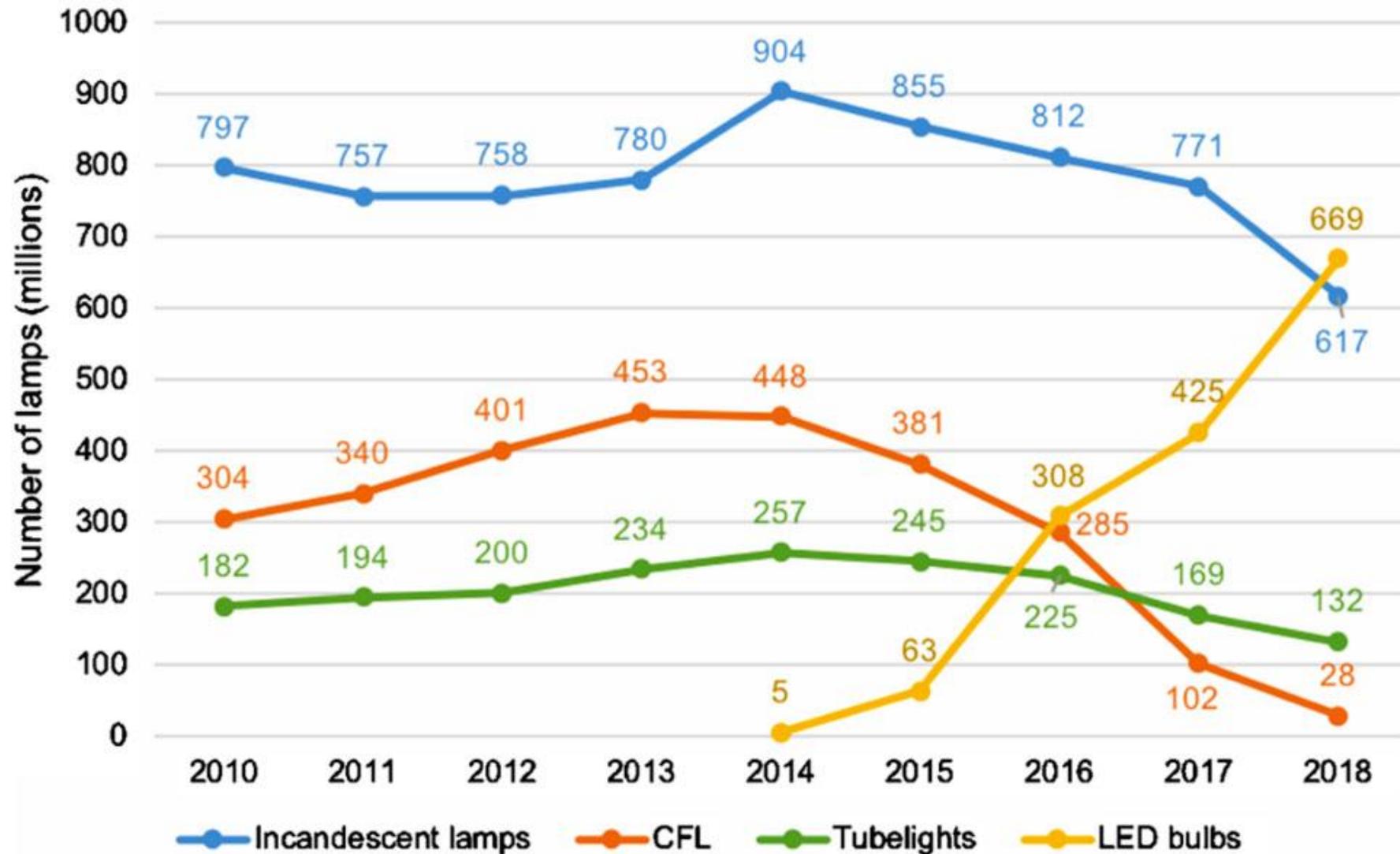
Climate Tech Startups ... examples

- **Northvolt** – manufacturer of sustainable Li-ion batteries.
- 2016
- Sweden
- \$13.8B Debt Financing
- **Form Energy** – develops and commercialises a low-cost renewable energy storage system.
- 2017
- Somerville, MA
- \$965M Grant
- **AMP** – AI-powered robotic system to recycle waste
- 2014
- Louisville
- \$175M (Series C)
- **Sylvera** – uses AI & satellite imagery to measure carbon emissions.
- 2020
- London, UK
- \$95M (Series B)

LED lighting and energy-efficient appliances - India

- A successful example of climate technology commercialization in India is the widespread adoption of LED lighting and energy-efficient appliances, driven by government initiatives and private sector participation. Significant energy savings, reduced greenhouse gas emissions, and cost reductions.
- Schemes:
- The **Unnat Jyoti by Affordable LEDs for All (UJALA)** - a key driver in the mass adoption of LED bulbs, replacing less efficient incandescent bulbs.
- The **Street Lighting National Program (SLNP)** - aimed at replacing traditional streetlights with energy-efficient LEDs. As of 2024, over 13 million LED streetlights have been installed across the country, resulting in annual energy savings of approx. 9 billion kWh.
- *The government also incentivized the use of energy-efficient appliances like refrigerators and air conditioners through various schemes and campaigns.*
- There is further potential for technology transfer in areas like smart grids, advanced HVAC systems, and other energy-efficient technologies

Scaling up of innovative low-carbon technologies : majorly needed to tackle climate change



Lighting market trends in India (2010-2018) showing a 130-fold expansion of the LED lighting market. Source: Lighting Industry Data in India 2010-2018 ([ELCOMA](#))

India's startups: *cleantech examples*

- **Chakr Innovation**

- A Co. founded by IIT Delhi alumni in 2016 uses a cutting-edge technology to capture emissions from diesel generators and converts pollution-causing particles into a base pigment for black inks and paint.
- **India's 1st Type Approved Retrofit Emission Control Device that reduces Particulate Matter, Carbon monoxide & Hydrocarbons emissions by over 70%.**
- **Dual fuel kit allows a diesel generator set to operate on a mixture of gas and diesel fuel**



15 patents

AtomBerg

- AtomBerg – Co. founded in 2012 (IIT Bombay incubated startup) disrupted the traditional ceiling fan market by replacing induction motors with energy efficient BLDC motors, leading to significant energy savings.
- Initially B2B.
- Later expanded to the B2C market through online and offline channels
- 35000+ retailers & over 10 M customers
- Large scale adoption by established competitors



Induction motors are workhorses, known for their ruggedness and ability to handle high power and torque, but they can be less efficient and require more maintenance. BLDC motors are the energy-efficient choice, offering high performance in a smaller package and with a longer lifespan; they come with a higher initial cost and more complex control systems

Profile of a comprehensive TTO

Essence of Agenda

- Add economic value to academic knowledge
- Promote and engage in goal oriented R&D and undertake cooperative programs with industry.
- **Ensure that promising research findings do not lose out due to inadequacies in research design/resultants, deficiencies of delivery systems or lack of economic incentives**
- **Bring in commercial perspective to technology transfer**
- Motivate faculty to address market oriented issues.

Functional profile

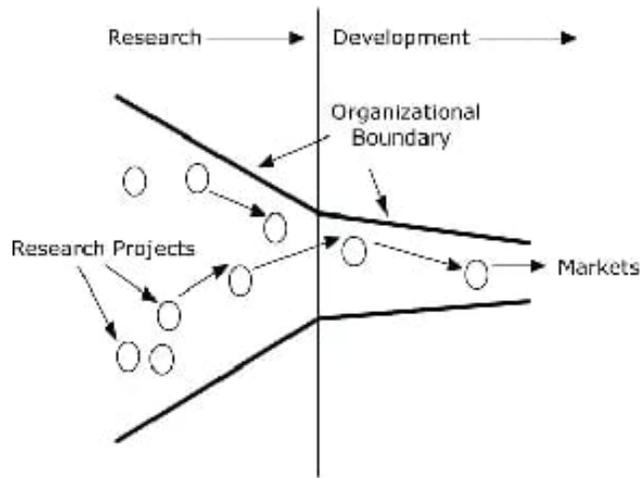
- Research partnership and consultancy
- IPR Management
- Technology Licensing
- Entrepreneurship & Business Incubation
- Professional Development Programs
- Outreach to business & community
- Enable consortium / international projects
- Organization of a Research Park



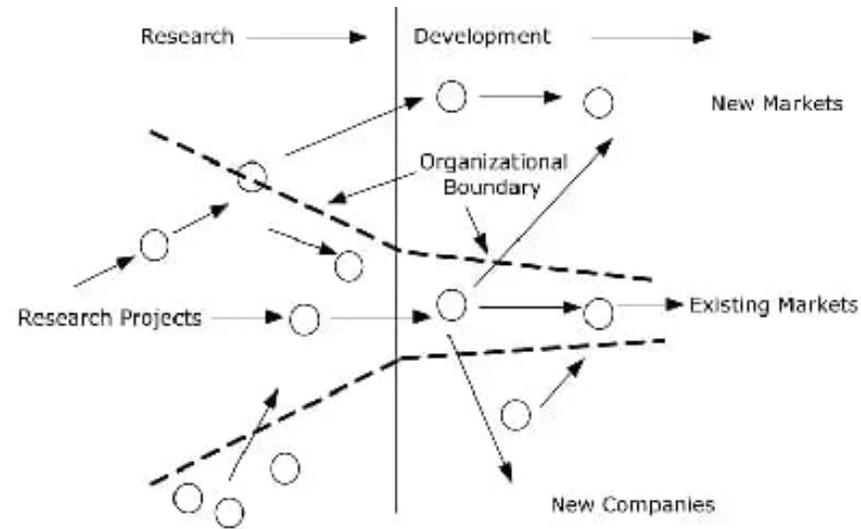
Open Innovation...

In today's information-rich environment, companies can no longer afford to rely entirely on their own ideas to advance their business, nor can they restrict their innovations to a single path to market.**the traditional model for innovation-- which has been largely internally focused, closed off from outside ideas and technologies--is becoming obsolete. Emerging in its place is a new paradigm, "open innovation," which strategically leverages internal and external sources of ideas and takes them to market through multiple paths.....**

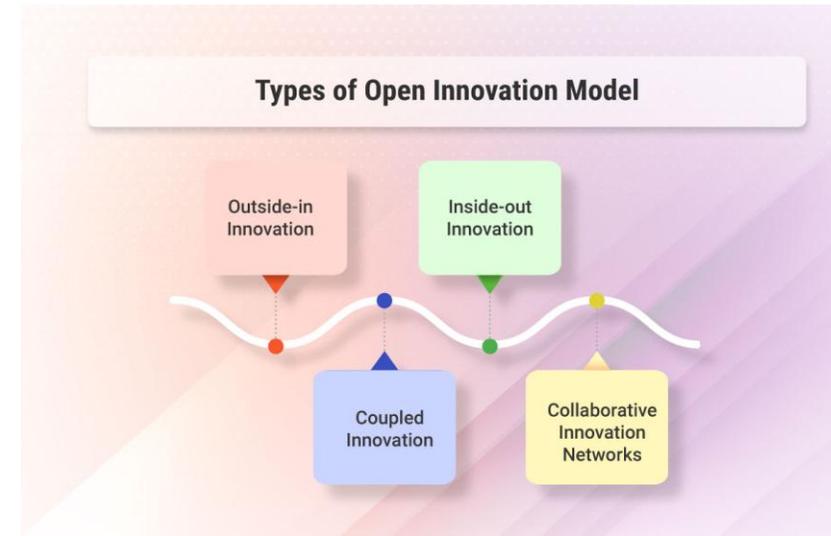
Prof Henry W. Chesbrough, Harvard



Closed Innovation



Open Innovation



IDEASCALE, Nick Jain, July 14, 20

Advantages

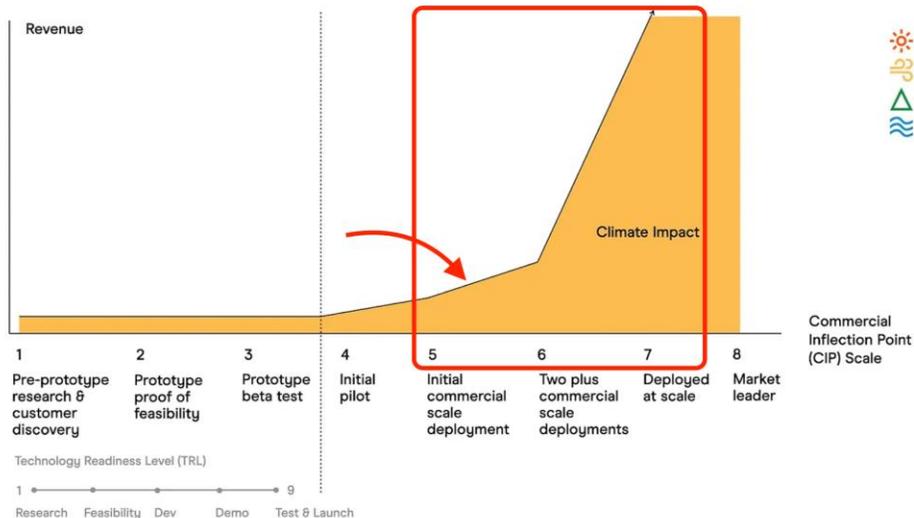
Access to a broader pool of ideas / expertise
Faster time to market / Reduced R&D costs
Enhanced competitiveness / agility

Challenges

IP Concerns / QC and integration
Cultural / organisational barriers
Right partners
Managing the innovation process

Commercial Potential of Technologies

- Existing pain point
- Market need
- Competitive landscape
- Radical innovation / disruptive
- Incremental innovation
- Adoption probability
- Technology maturity
- Supply chain



Elemental Excelerator (Impact investment platform) has developed a climate-tech-friendly - Commercial Inflection Point (CIP) to capture major milestones from ideation to mass market adoption

TRL-5-7 is the Sweet Spot for Climate Tech Investors

- TRL 1-3: Basic Research and Concept:** Initial scientific research, identifying potential applications, and establishing proof of concept through experiments and analytical studies.
- TRL 4-6: Proof of Concept and Prototyping:** Validation of components and processes in laboratory environments, building prototypes, and demonstrating them in relevant environments.
- TRL 7-9: Pilot Testing and Commercialization:** Testing prototypes in operational environments, building integrated pilot systems, and ultimately deploying the technology in its final form



.....The Saturday Climate Insider

Startups ... sing

The Asia-Pacific region is a hotbed of innovation, nurturing a thriving startup culture across its diverse economies. With 159 startup ecosystems ranked in the global top 1,000, this dynamic region offers a fertile ground for entrepreneurial endeavors

Asia is home to the world's second largest start-up scene - 23% of all venture capital (VC) investments in 2021-23. **..China and India story**

Despite their rapid growth, start-up ecosystems in Asia remain below their potential in terms of density - average ~ 3 start-ups per 100 000 inhabitants, compared to ~ 40 on average in OECD countries. Four distinct ecosystems: India, Indonesia, Thailand and Vietnam, where start-ups are opening opportunities for more innovative and inclusive development pathways.

Social inclusion and environmental impact are priorities for start-ups. India is relatively more specialized in renewables than other Asian countries, featuring the highest share of renewable energy start-ups (1.6%), on par with China, and above the regional average of 0.9%.

...OECD 2025

Top Ecosystems of Asia Pacific in the Global Startup Ecosystem Index 2023

Regional rank	City	Country	Global Rank	Rank Change (from 2022)	Total Score
1	Beijing	China	6	0	99.019
2	Shanghai	China	7	0	67.567
3	Bangalore	India	8	0	64.232
4	New Delhi	India	13	0	44.560
5	Tokyo-Yokohama Area	Japan	14	1	44.067
6	Shenzhen	China	16	2	35.292
7	Singapore City	Singapore	20	2	33.448
8	Seoul	South Korea	24	1	31.081
9	Mumbai	India	25	-8	30.154
10	Jakarta	Indonesia	29	3	24.073
11	Hangzhou	China	35	-5	21.057
12	Hong Kong	China	36	0	20.184
13	Sydney	Australia	38	0	19.121
14	Melbourne	Australia	42	0	16.554
15	Guangzhou	China	45	6	14.297
16	Taipei City	Taiwan	46	1	14.208
17	Nanjing	China	69	88	8.986
18	Bangkok	Thailand	74	25	8.619
19	Pune	India	78	12	8.482
20	Kuala Lumpur	Malaysia	87	1	8.095

Thanks

anilwali@outlook.com