Promoting R&D and Competence Building for Sustainable Energy

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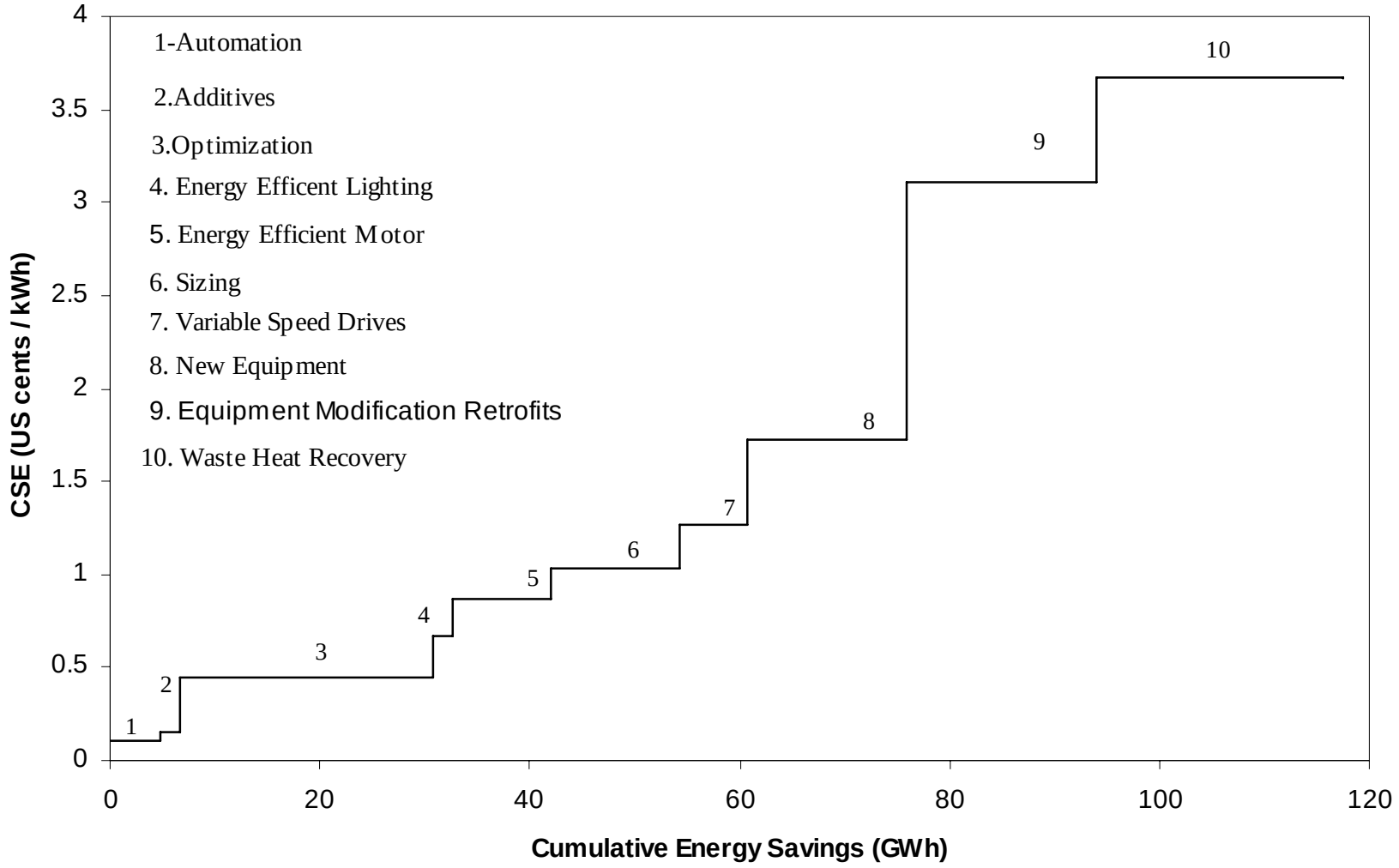
Need for R&D and Competence Building

- Present energy systems fossil fuel based
- Planning –" Supply focussed"
- Challenge – Provide Access to "convenient" energy services, GHG and climate change problem, affordable?, attractive to investors
- Paradigm shift – focus on energy services
- Technology development, R&D – cost reductions
- Future energy systems – different rules – new skill set

Energy Efficiency

- Significant growth in cement/ steel etc..
- Benchmarking – information sharing
- From best practice to “next practice’
- Pinch/ process integration/ heat pumps
- Need to evolve new processes
- Analytical inputs, technology development
- Dematerialisation/ Substitution

Conservation supply curve for electricity savings in cement industry-India



Biomass Energy Systems

Bio-char unit

Biodiesel vehicle

Biomass Gasifiers- Thermal application

Biomass Gasifiers- Engine-power generation

Bio-diesel

Bagasse Cogeneration

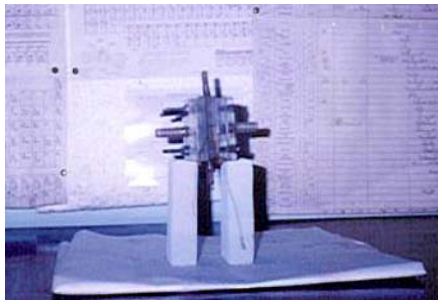
Bio-refinery

Updraft Gasifier Steel re-rolling Raipur

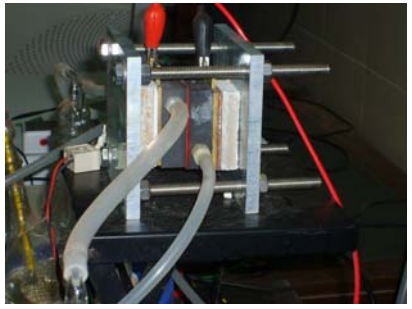
Updraft gasifier with catalytic cracker

Fuel Cells and Hydrogen

Hydrogen Motorcycles



Alkaline Fuel Cell



Methane Fuel Cell

Hydrogen 2& 3 wheelers

Hydrogen road map (MNRE)

500W-1 kW PEM Stack

Metal Hydride storage

Low cost electrodes,Flow fields, Membranes

Direct Methane fuel cell

Bio hydrogen , Microbial fuel cells

PEM Test Station

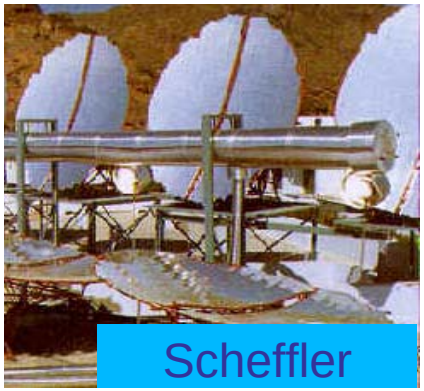
Bipolar Plate

Fuel Cell Research Facility

Solar Thermal

ARUN160 at Mahananda Dairy, Latur

- Solar Thermal for air drying,process heating
- MW Scale Plant – National testing, research facility
- Largest Solar cooking facility in world
- Selective Coatings
- Stirling Engine
- Steady state and Dynamic Testing
- Optimal system sizing and potential estimation



Evacuated glass tube solar air heater

Test Facility for thermosyphon systems

Wind Energy

14 m GFRP Wind Turbine blade (NAL)

IITB-GE- Control with upwind data

Low cost 500 kW m/c (NMITLI)

3D Wind mapping in Palghat gap

Improved control strategies, Generator design

Grid Integration

Hybrid Systems

Acoustic Antenna (CWET)

Generator designs - IITB

Small Hydro, OTEC

NIOT OTEC desalination

200 kW Chizami village, Nagaland

Wave powered desalination,

OTEC powered desalination

Small Hydro simulator

Hydro turbine laboratory

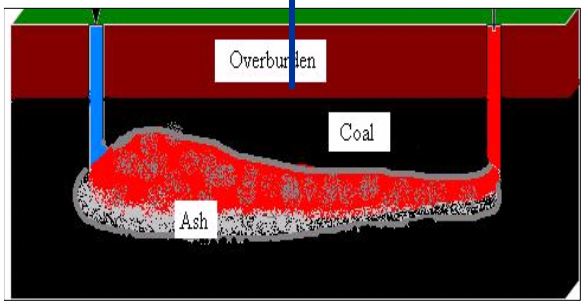
Realtime SHP Simulator AHEC, IIT Roorkee

Clean Coal

ONGC-IITB Research Facility

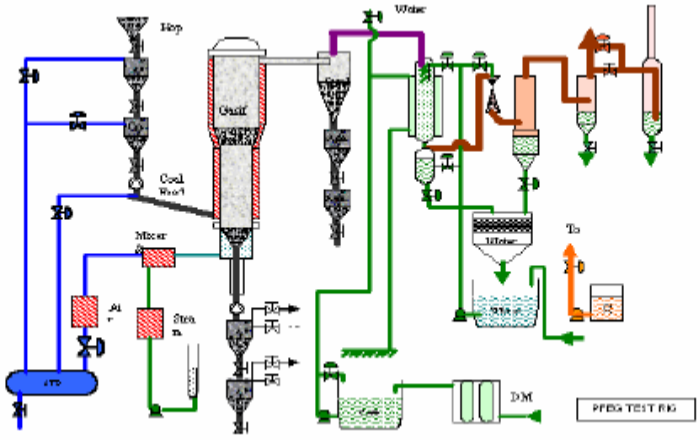
(UCG)

Underground coal seam acts as a chemical reactor!



- Indian coal- low sulphur, high ash
- BHEL, IITM-IGCC 6 MW in 1980's
- Limited experience in advanced coal technology
- NTPC BHEL R & D effort proposed
- Underground coal gasification
- Carbon sequestration and storage

CFBC GIPCL, Surat (2x125 MW)



PFBG PILOT PLANT at CIMFR

R & D Status

	Industry	R&D status	Needs
Energy Efficiency	Commercial	Industry-low Academic-low	Information sharing Benchmarking Next processes
Clean Coal	Conventional Coal manufacturing plants	Gaps/subcritical teams High ash, low sulphur coal	Pilot plants catalyse research teams
Wind	Commercial High growth	C-WET / Limited R&D in industry – need to strengthen	Low range turbines, low cost inverters
Solar Thermal	Commercial for cooking low temperature industrial heating	Small companies Innovations	Need for consortium long terms approaches, prototypes
Solar PV	Commercial	Industry-low R&D Reasonable academic capability	Cost reduction Tracking field performance

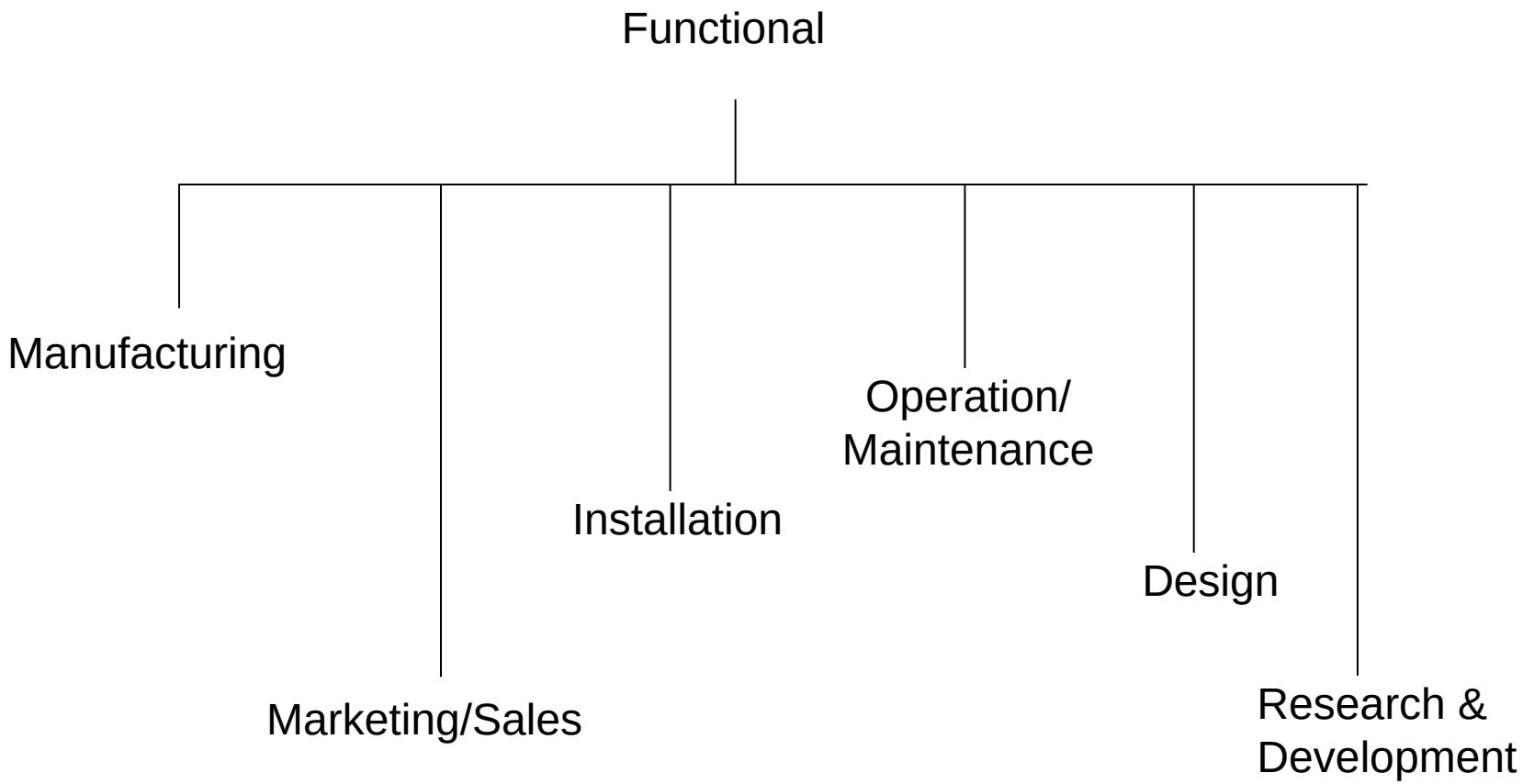
R & D Status - Contd..

	Industry	R&D status	Needs
Small Hydro	Low growth rates	No major industry thrust AHEC, Roorkee	Commercial Exploitation
Biomass	Small industry	Atmospheric gasification Thermal application Significant-R & D capability-academic 'empirical'	Need for mainstream
Fuel Cells Hydrogen	Low industry interest	Several academic / groups, no product focus	Cost reduction required
Storage	Low industry interest	CECRI Academic Institutes	Need for concerted efforts

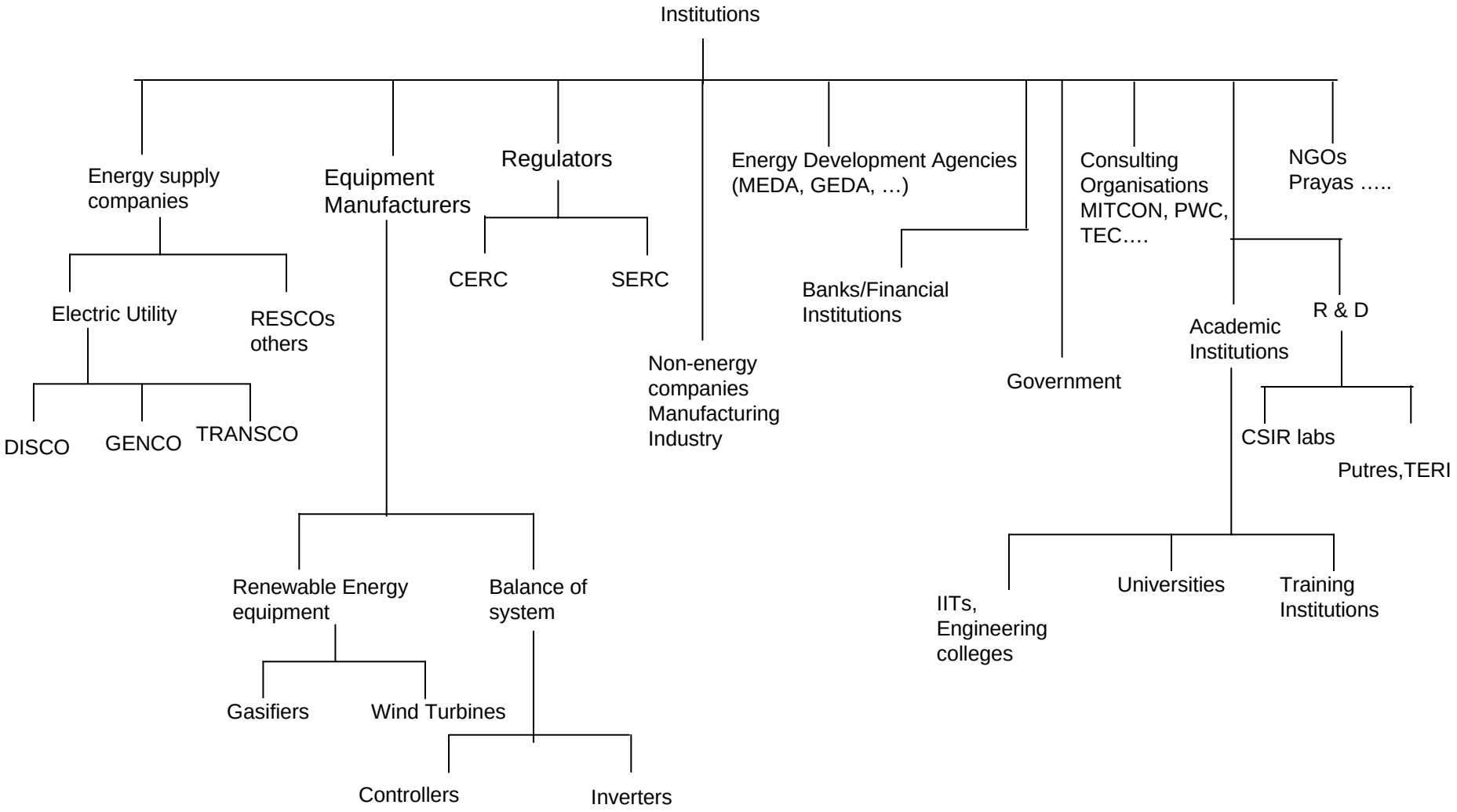
Making it happen

- People – Attracting best people from traditional domains
- Research “ Grand challenge”
- Directed research – “ Mission”
- Reality check – benchmarking performance and achievements
- Competence building – education and research

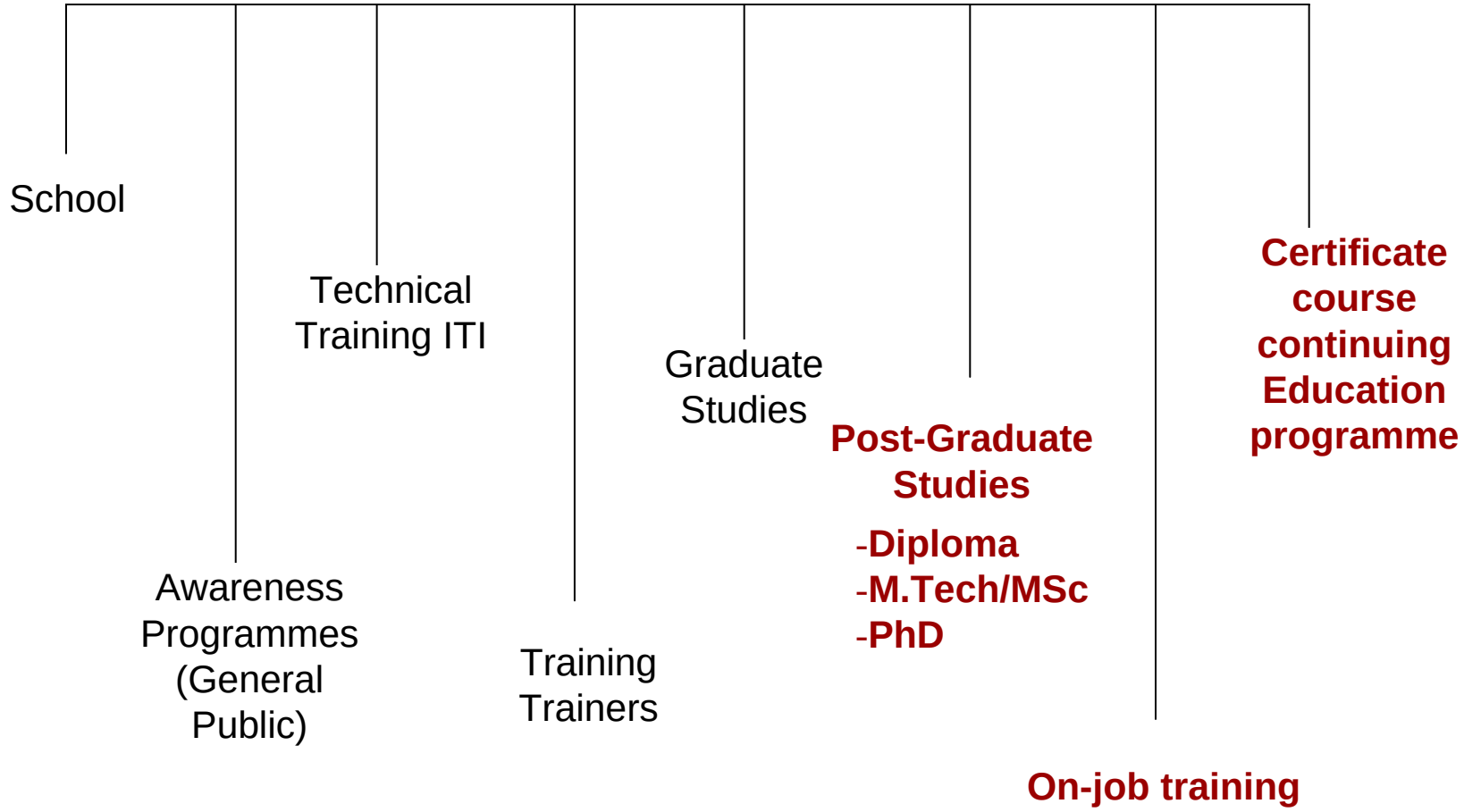
Functional Areas -Renewables



Renewable Energy Institutions



Classification of Training Levels



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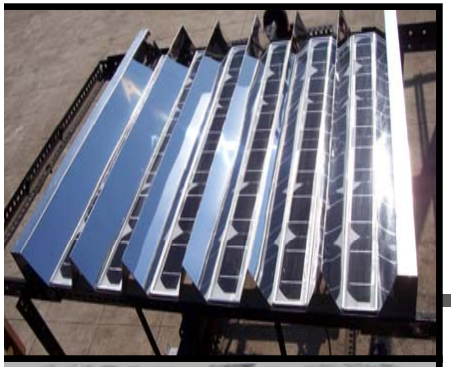
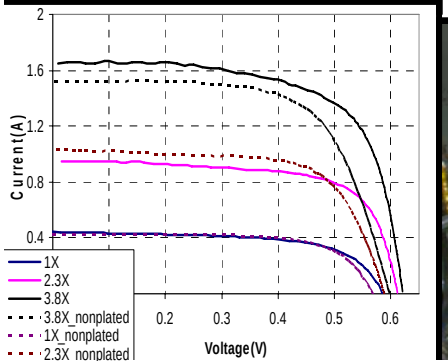
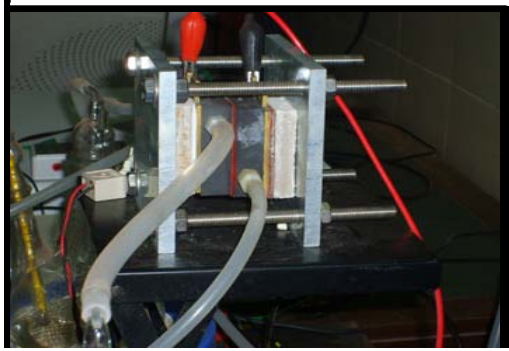
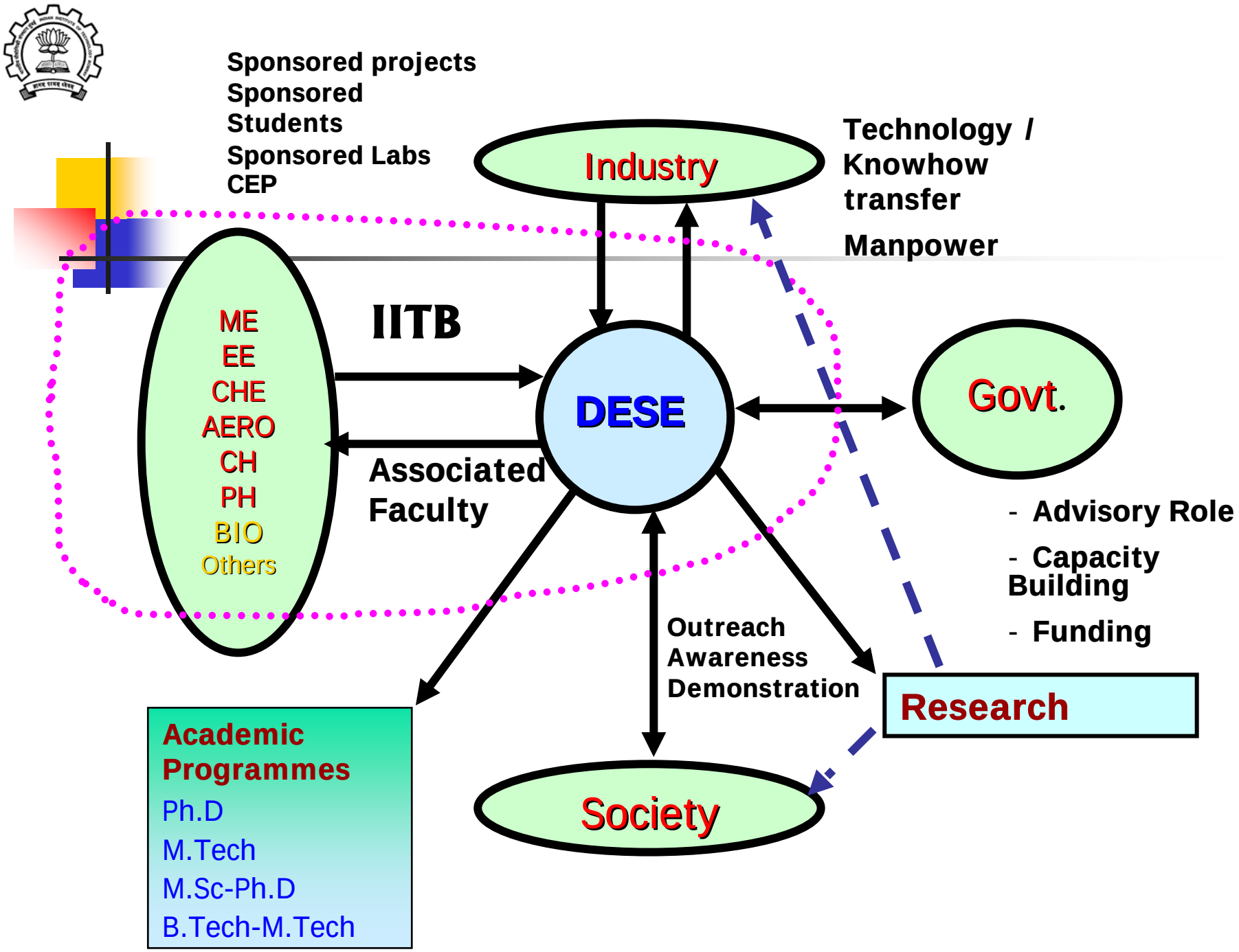


Vision

To develop sustainable energy systems and solutions for the future






Sponsored projects
Sponsored Students
Sponsored Labs
CEP
Industry
Technology / Knowhow transfer
Manpower
IITB
ME
EE
CHE
AERO
CH
PH
BIO
Others
DESE
Govt.
Associated Faculty
- Advisory Role
- Capacity Building
- Funding
Outreach
Awareness
Demonstration
Research
Society
Academic Programmes
Ph.D
M.Tech
M.Sc-Ph.D
B.Tech-M.Tech

Academic Programmes

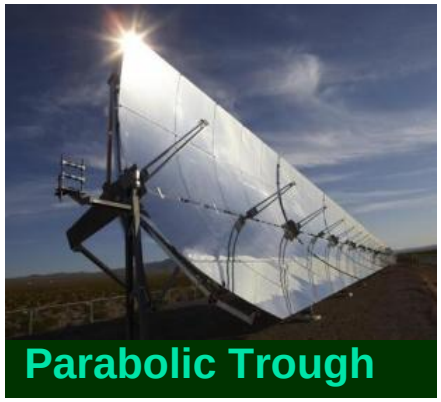
- M.Tech in Energy Systems Engineering(25- 30)
- PhD (3-5)
- Dual Degree -MSc- PhD (started from 2007) Batch of 12
- Dual Degree- B.Tech in Energy Engineering

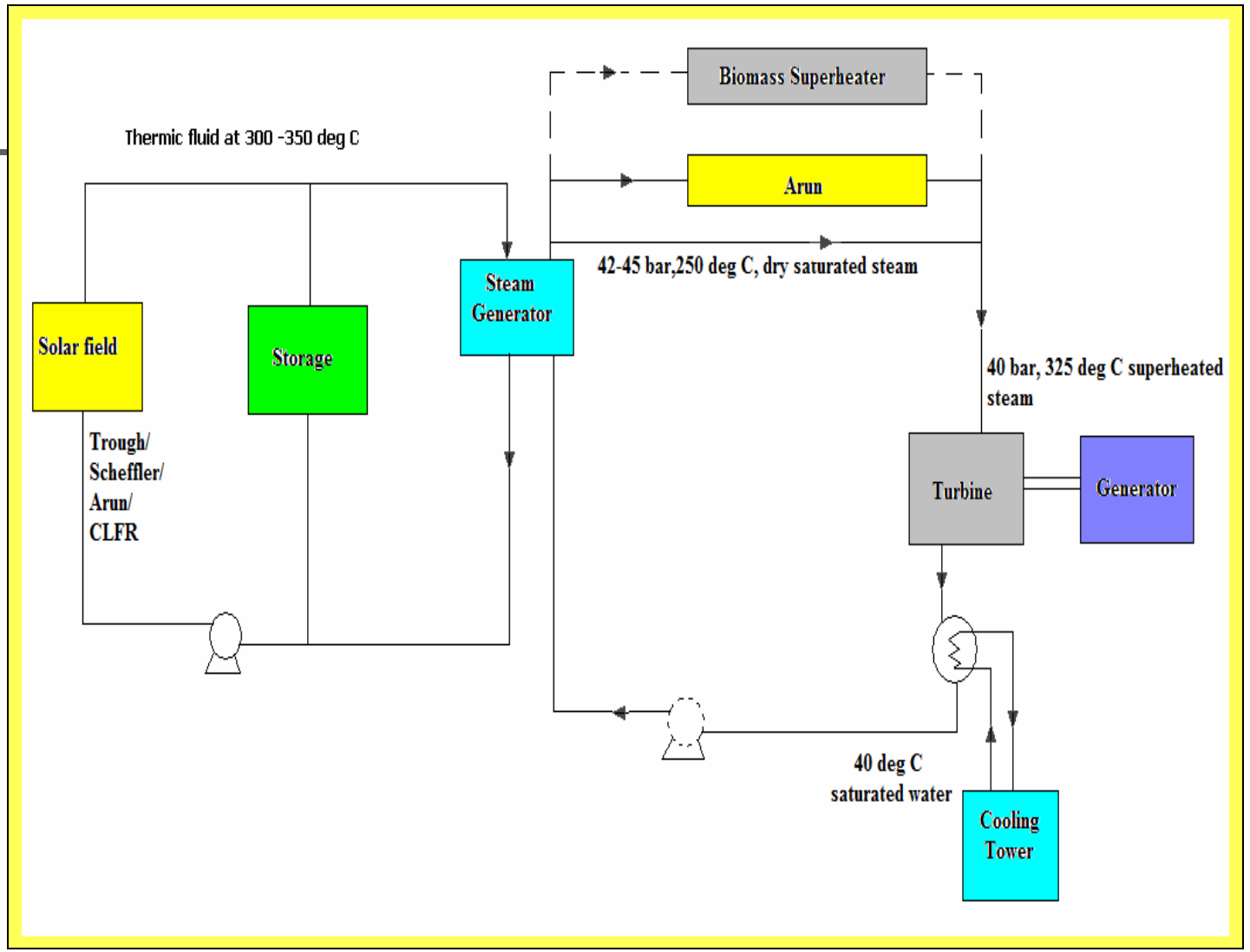
  M.Tech in Energy Systems Engineering (started from 2008) Batch of 22 (Five year programme)
- Minor in Energy Engineering for B.Tech students

Industry Collaboration Modes

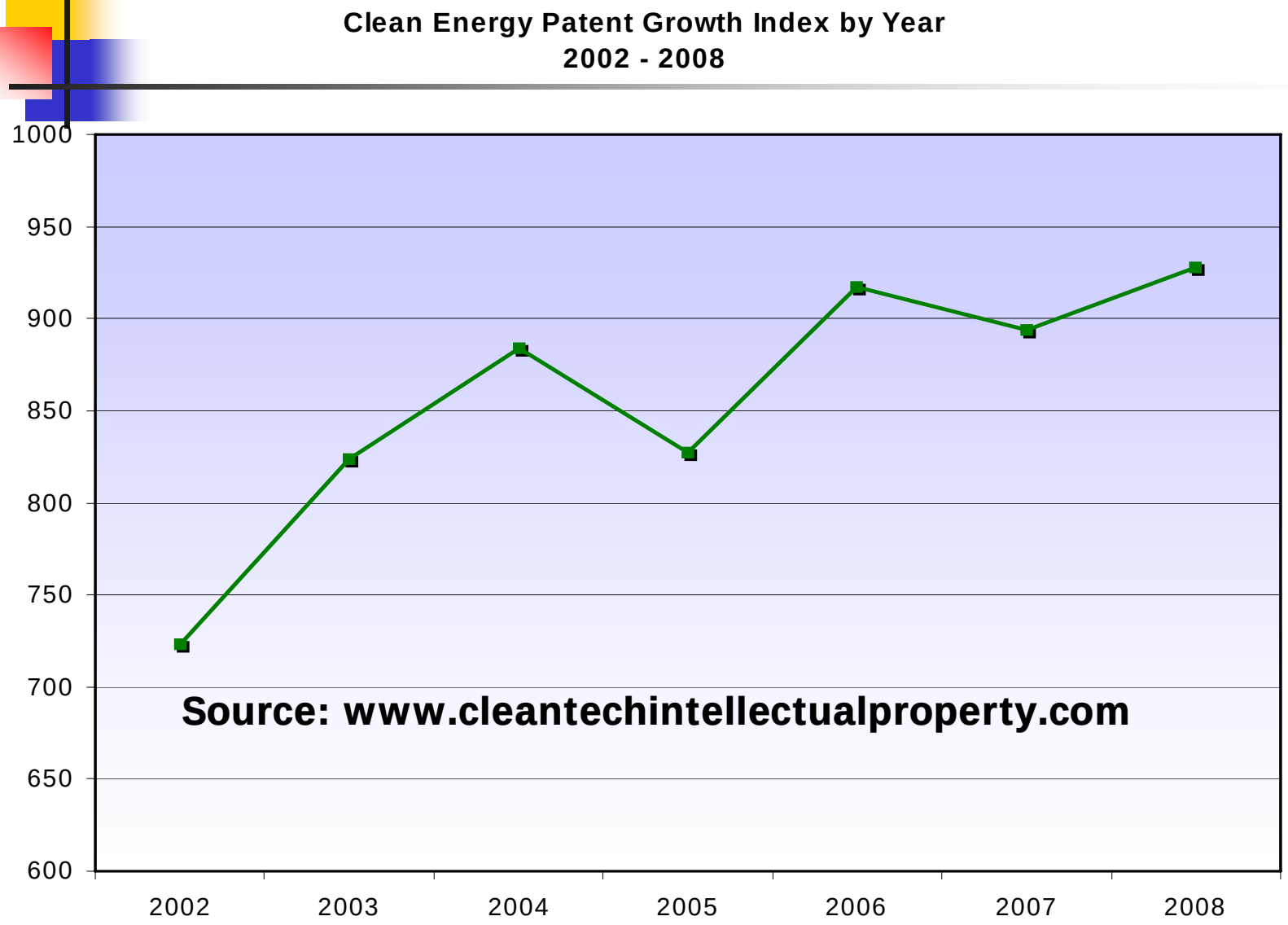
- Sponsored research projects
- Consultancy projects
- Student sponsorships / fellowships
- Sponsored research laboratories (Cummins,Forbes Marshall, ONGC)
- Chair Professorships (Forbes Marshall)
- Continuing Education Programmes

Solar Thermal Power Project





Clean Energy Patents USPTO



Strategies

- Research Road maps – evolved through transparent, open processes
- Network of industry-academics-government
- Incubation – for sustainable energy –"CII-IIM MNRE–Research"
- Encourage Consortia
- Facilitate – lab scale- prototype-commercialisation
- National Sustainable Energy PhD Fellowships

  100/ year (Rs 25,000 p.m + Research fund)
- Intellectual Property – protection and Licensing
- No quick fixes – long term focus, mid term correction, independent assessment

References

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- Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World,UNEP/ILO/IOE/ITUC, September 2008.
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Thank you