



Workshop: Climate Technology Innovation Centres
New Delhi, 20th October, 2009



IIT Kanpur

A sample of some of the on-going work on

Clean Technology

from

Indian Institute of Technology Kanpur

Backdrop:

The Centre for Environmental Science & Engineering building rated 5 star TERI-GRIHA Green Building certification.
<http://www.iitk.ac.in/cese/>

Solar Energy Research Enclave

- The Solar Energy Research Enclave has been approved by the Board of Governors at IIT Kanpur and land has been allotted to it. A seed fund of Rs.100 lakhs has been provided by the institute
- An interdisciplinary team of faculty and researchers are building a 1MW plant in two phases, with 500 kW being built in the first phase
- It will also include a test bed to research on solar panels, storage systems and power extraction and management design
- The enclave will be a centre of research and training for technologies related to solar energy harvesting and usage

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Department of Materials and Metallurgical Engineering
& Prof. Raj Ganesh Pala rpala@iitk.ac.in
Department of Chemical Engineering

Key requirement:

- ❑ Budget for the enclave is Rs.50 crores with a significant fraction to be used for the power plant.



Land belonging to IIT Kanpur between the Lower Ganga Canal and the Shivli Road has been allotted for the research enclave



A 1.2 kWp solar concentrator PV system Installed by Moser Baer on IIT campus.



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Harvesting Wind Energy

- Low Cost Savonius Wind Turbine
- Power Control & Storm Security Device

Main contact:

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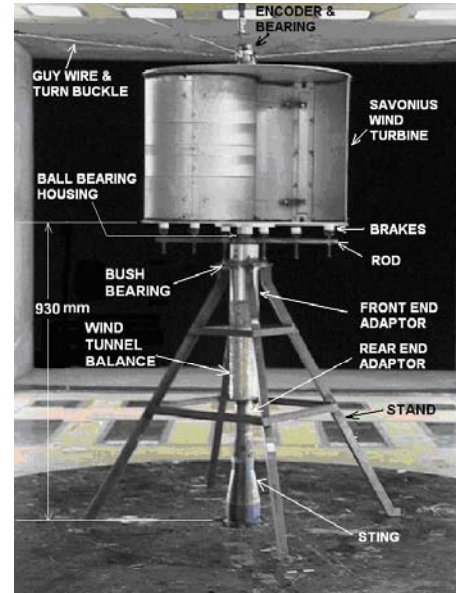
Key requirement:

Savonius Wind Turbine

- The newly developed needs to be field – tested. Hence an R & D lab in a coastal windy area is needed.
- Involvement of private capital

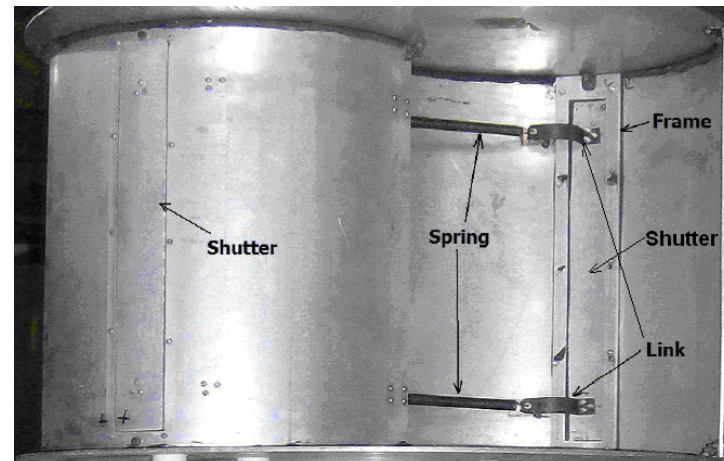
Permanent Magnet Alternator (PMA)

- Need Skilled Manpower to develop and implement the technology indigenously the PMA for power generation from wind



Experimental Set-up in
3m x 2.25m Test Section
of Wind Tunnel;
Turbine Diameter = 700 mm
and height = 500mm

Power Control Device with
Shutters Closed



Organic Solar Cells

- Solar cells with active layers from organic material have great potential to lower material and processing cost of solar panels
- Currently in our labs, the organic solar cells power conversion efficiency is ~3% power

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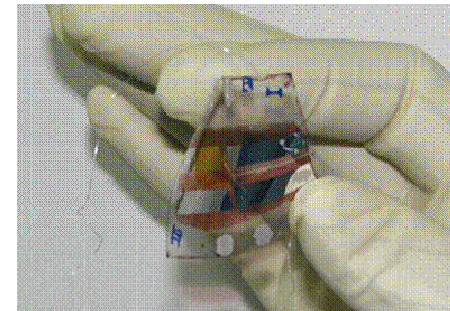
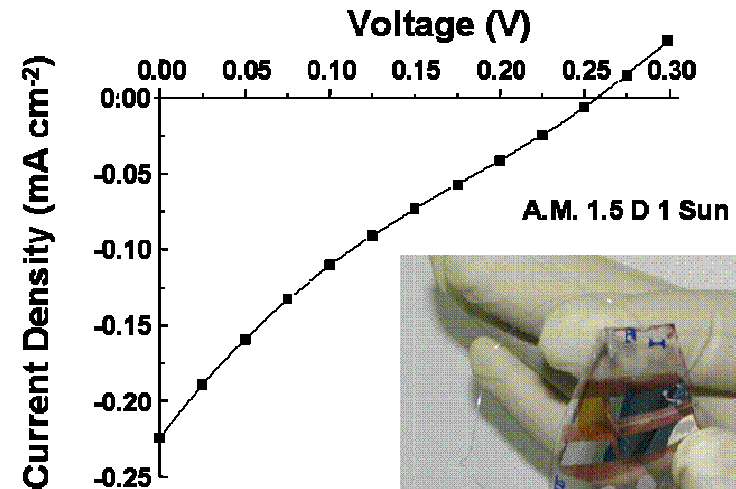
Department of Electrical Engineering

Key requirement:

- Industrial tie-ups to build commercial modules
- Funds for further research and development



Module built with organic solar cells



Organic solar cells on flexible substrates and its J-V characteristics



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Fuel Cells and Fuel Generation

- Solid oxide fuel cells for large scale - long term energy conversion
- Efficient liquid fuel generation/delivery for fuel cells; generation from renewable sources
- CO₂ sequestration and conversion

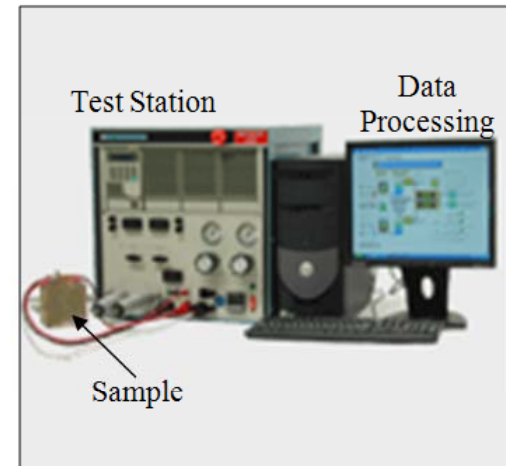
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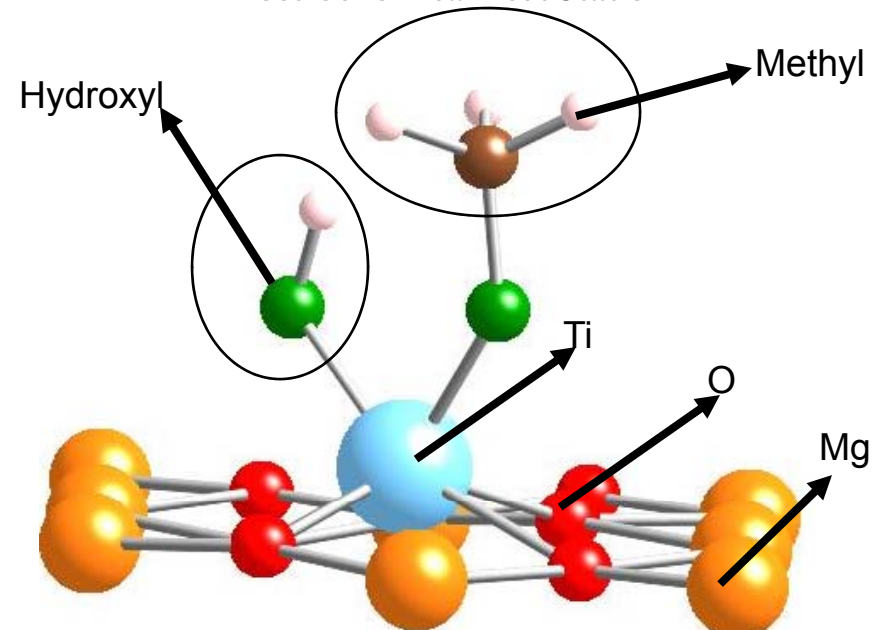
Department of Chemical Engineering

Key requirement:

- ❑ Energy storage is critical for solar energy implementation in Indian context
- ❑ In the above mentioned areas, technical bottleneck are more critical. To an extent government policy (like C caps) will also help.



Electrochemical Test Station



CH₄ activation catalytic site



Modular Power Extraction & Smart Delivery Mechanisms

- Design & Installation of delivery mechanisms for an island village (load ~ 30 kW, solar & wind powered), to be completed by 2012, Govt. funded

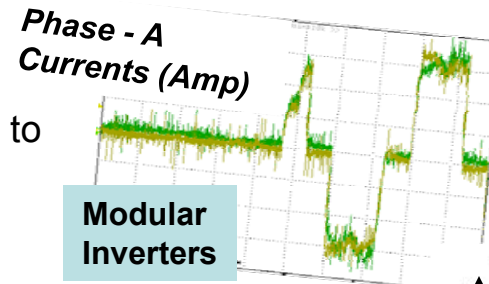
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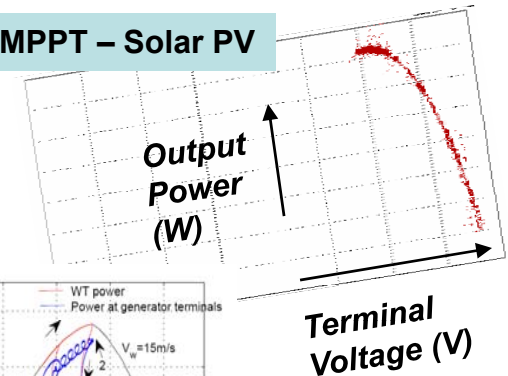
Department of Electrical Engineering

Key requirement:

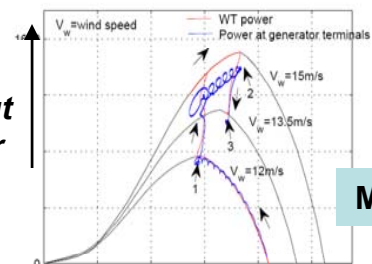
- Industry for mass manufacture
- Good marketing with after-sales
- Government policy: Emphasis should be on billed energy instead of installed capacity.



MPPT – Solar PV



Output Power (W)



MPPT – Wind



Site – section of PV panels



Organic White Light Emitting Diode

- White Light Emitting Diode for energy efficient lighting, significantly lower usage of energy for lighting

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Department of Materials and Metallurgical Engineering

& Prof. Monica Katiyar mk@iitk.ac.in

Department of Materials and Metallurgical Engineering

Key requirement:

- More development work to improve efficacy
- Entrepreneurs to pick up idea for manufacture

A white OLED
fabricated in our labs
Device dimension is
3 mm x 3mm



ISO 6 clean rooms; This clean room is 220 m²



Cluster tools for device fabrication. This tool is also used to fabricate 1.5 inch passive matrix colour displays



Railway Sleepers w/ Recycled Plastic

- Composite Sleepers are new types of environment friendly sleepers to hold together railway tracks, made of waste plastics. These sleepers not only are a good substitute for wooden sleepers, but also recycle the non biodegradable plastic waste.
- While there are manufactures in developed countries, currently, there are no manufacturers of composite sleepers in India.
- The work aimed at IIT Kanpur is to explore the project feasibility in terms of making material choice, simpler synthetic route, and technology development for mass production after having satisfied with the mechano-chemical properties of the developed sleeper composites.



Railway sleepers with similar material from a company outside India has been tested in Eastern Railways (left); sleepers with recycled plastic from supplier staked up (right).

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Department of Chemistry

Key requirement:

- ☐ **SCALE UP PROCESS:** Need a collaboration with CIPET Chennai for scale up operations after successive mechanical testing of the Dog bone samples.



30 Kg batch process employing an Injection moulding machine at the Falcon industry-Kanpur(left) ; finished product for making dog-bone samples (right)



Low Emission, Energy Efficient Combustion System

- Design and development of Low Emission Burner (already tested)
- Incinerator (2010)
- Bio-fuel Burner (ongoing)
- Biogas burner (already tested)
- Smart Trapped vortex combustor (2010)
- Coal Fired Combustor (ongoing)

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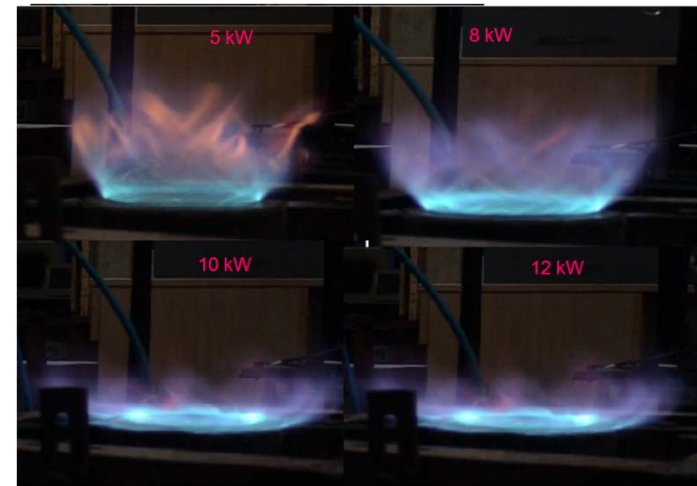
Department of Aerospace Engineering

Key requirement:

- Entrepreneur to pick up the idea
- Capital to start production



Combustion Lab



Photographs of flame in low emission burners



Bio-fuels for Transportation

- Development of Bi-Functional Solid Catalyst for Transesterification of Jatropha Oil and effect of Jatropha oil Biodiesel on the lubricating oil performance and life in a medium duty compression ignition transportation engine, (Co-PI: Prof. Anil Kumar, IITK), Shell India Pvt. Ltd., Four Years starting August 2007.
- Fundamental Investigations on Laser Ignition of Combustible Gas-Air Mixtures in a Constant Volume Combustion Chamber for Engine Applications, DST, Two Years starting February 2009.
- **Main contact:**

Prof. Avinash K. Agarwal akag@iitk.ac.in
Department of Mechanical Engineering

Key requirement:

- Capital to be invested in state-of-the art equipment and building infrastructure.
- Skilled manpower especially in Kanpur region.



The Engine Research Lab,
Biodiesel Pilot Plant
(25 Litre/ batch)



Biodiesel produced at Engine Research Laboratory at IIT Kanpur was road tested with this Mahindra and Mahindra vehicle



Analysis of Policies and Barriers, and Design of Implementation Framework for Clean & Efficient Technologies

Some completed studies are:

- “Stakeholder Perspective and Indicators for Climate Policy Action in the Indian Power Sector” (2009), with Dept. of Economics, University of Cambridge, Climate Strategies, UK)
- “South-North cooperation on implementation of domestic policies” (2008-09), with: Dept. of Economics, University of Cambridge, and Climate Strategies, UK)
- “Analysing barriers and policy measures to wider adoption of clean and energy efficient technologies in the power Sector.” (2003-04); funded by Swedish International Development Agency (SIDA) and coordinated by Asian Institute of Technology (AIT), Thailand.

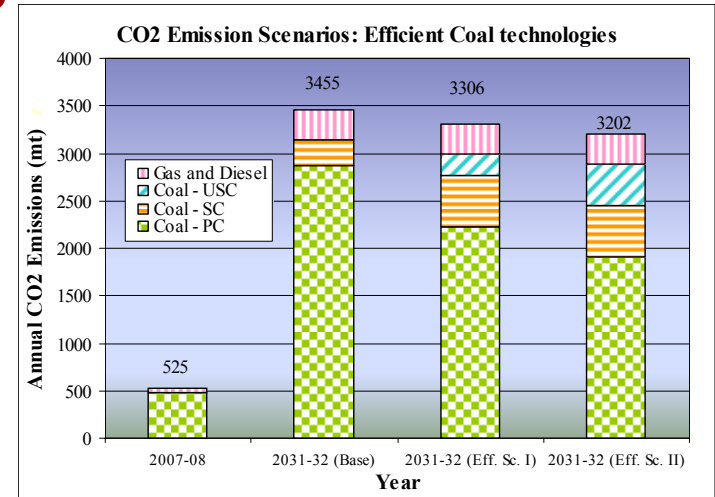
Main contact:

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Department of Industrial and Management Engineering

Key requirement:

- ❑ Design an implementation framework for a large scale rollout of efficient technologies (initial work presented for pump sets here).



| Responsibility | Policy Formulation | Policy Description | Programme Design | Implementation | Monitoring | Financing |
|--------------------|--------------------|--------------------|------------------|----------------|--------------|--------------|
| Min. of Power | Orange arrow | Yellow arrow | Orange arrow | Orange arrow | Yellow arrow | Yellow arrow |
| Min. of Finance | | | | | | Yellow arrow |
| CEA | | Yellow arrow | | | | |
| State Govts. | Orange arrow | | Orange arrow | | | |
| R-APDRP | | | | | Yellow arrow | Yellow arrow |
| CERC | | | | | | |
| SERCs | | Yellow arrow | Orange arrow | | Yellow arrow | |
| Gencos | | | | | | |
| Discoms | | Yellow arrow | Orange arrow | Orange arrow | Yellow arrow | Yellow arrow |
| Equipment Mfg. | | | | Orange arrow | | |
| BEE / BIS | | Yellow arrow | | Orange arrow | | |
| Rural Elec. Corpn. | | Yellow arrow | Orange arrow | Orange arrow | Yellow arrow | |
| NGOs/ Consumers | | | Orange arrow | Orange arrow | | |
| Intl. Cooperation | | | | | | |
| CDM financing | | | | | | |

Table: Strategy for Implementing a Policy for Efficient Agricultural Pump Sets



Summary

- IIT Kanpur has a rich diversity of talent from different disciplines related to clean technologies
- Important efforts on different aspects of clean technology are underway – some of which are shown in the poster
- Please contact Dean, Research and Development of IIT Kanpur for any further details

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