Solar Energy Research Enclave (SERE)

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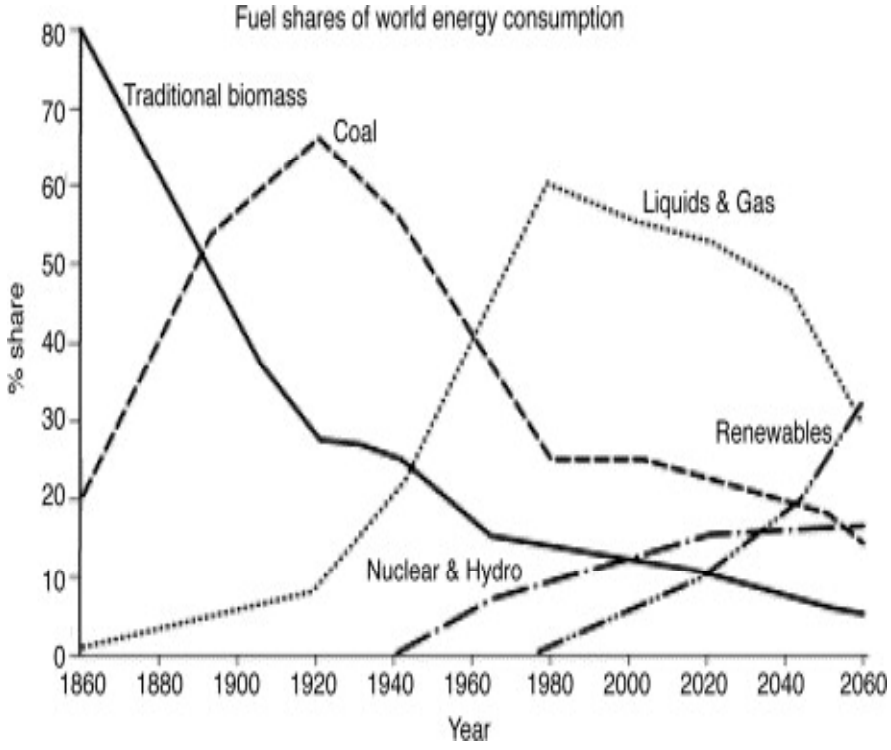
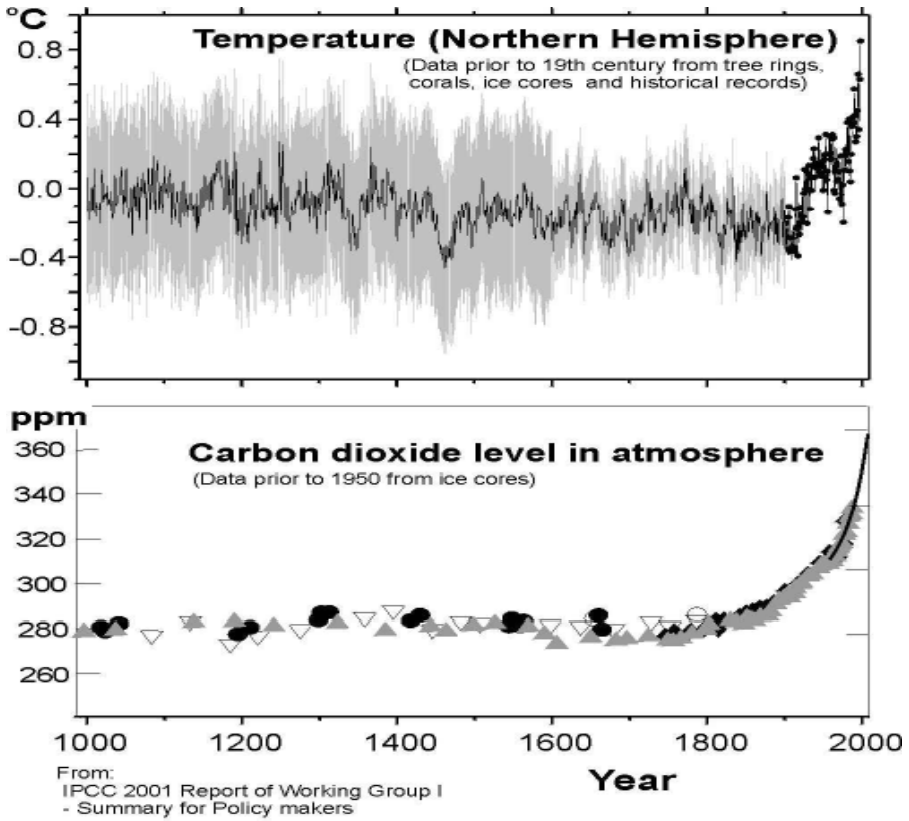
Outline

- Introduction
- SWOT Analysis of photovoltaic (PV) technology
- Objectives of SERE
- Technology demonstrator
- Research goals
- Summary

Energy & Environment Trends



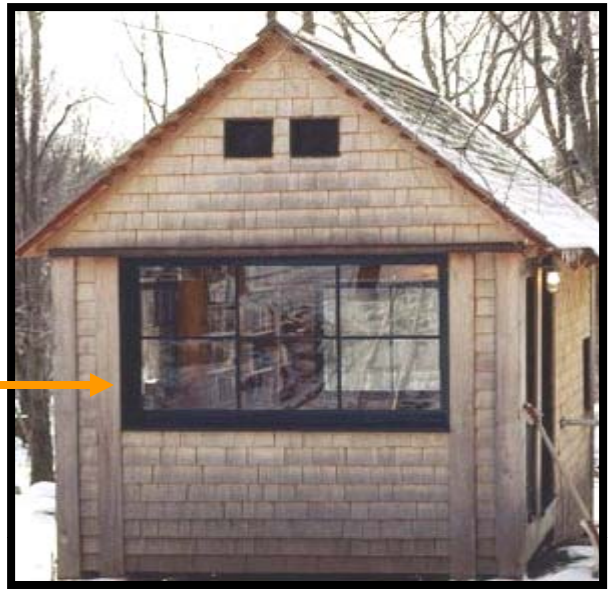


- At the site of generation, there is no carbon emissions for solar energy
- Solar energy received by earth 160,000 TW; 16 TW is enough for world's consumption (2006)
- Tropical country like India, available for most of the year

Grid connected Solar-PV

Off-grid Solar-PV
(islanded)

DAY



Other
renewable
Energy

NIGHT

STORAGE

Photovoltaic Module Production

WORLD

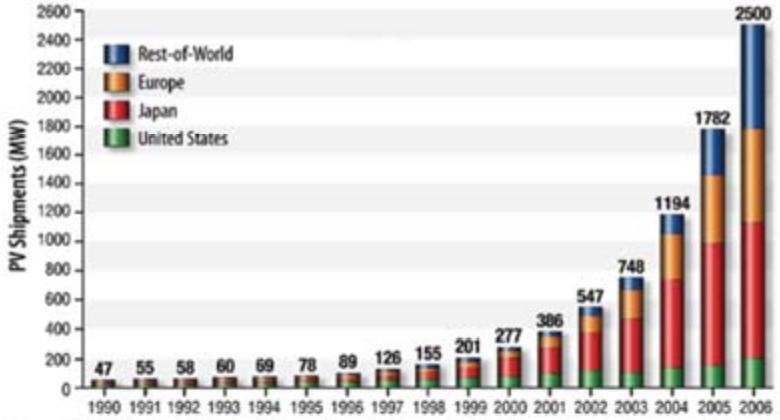
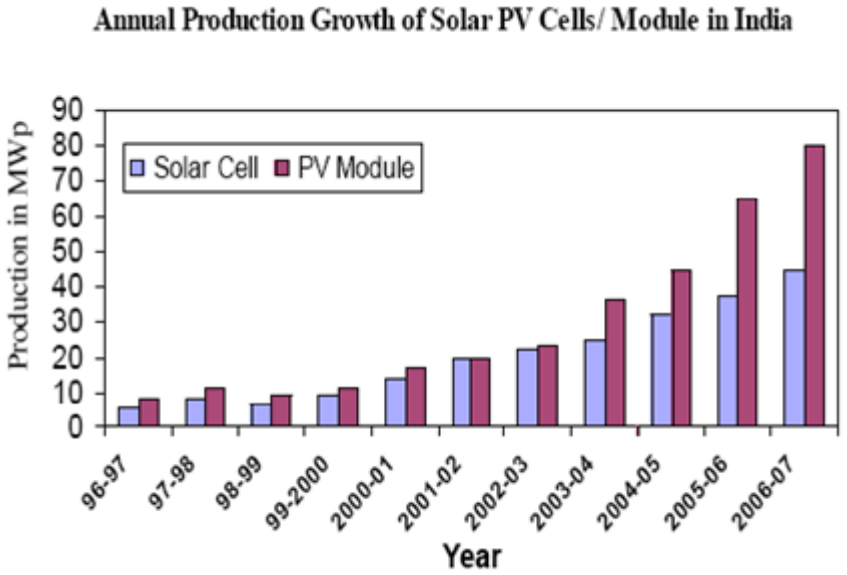


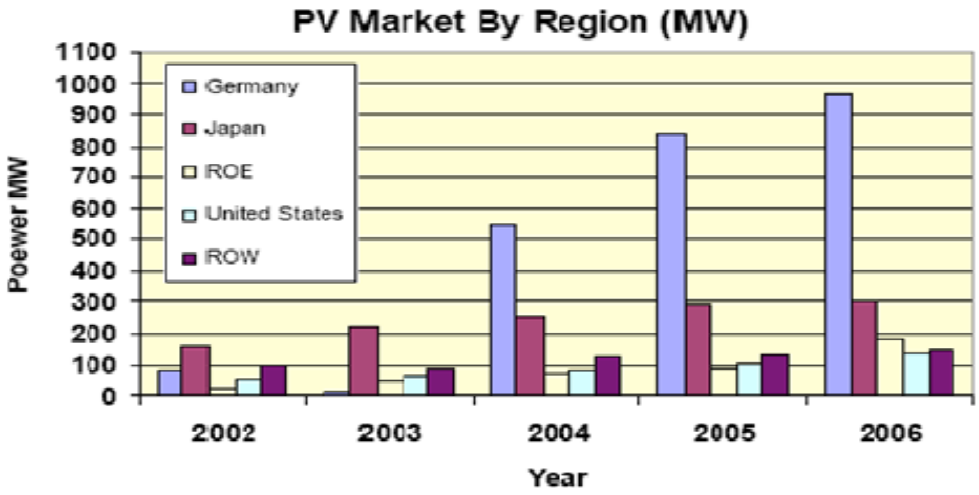
Figure 1. World photovoltaic module production (in megawatts), total consumer, and commercial per country (from *PV News*, Paul Maycock, Editor; February 2004). Most of this production is from crystalline or multicrystalline Si solar cells at present.

INDIA



PV Installations

WORLD



- World PV production
- Indian PV Export

INDIA

	Capacity	Location
1	200KWp	Punjab
2	100KWp	Lonavala
3	100KWp	Lucknow
4	100KWp	Bangalore
5	100KWp	Lakshadeep
6	100KWp	Hyderabad

- **2.12 MW only (2008)**

Solar-PV : A SWOT analysis

Strength

- Plenty of sun shine
- Carbon credits
- Government subsidies and incentives
- Domestic Manufacturing base for PV modules

Weakness

- Needs greater support through a national policy
- Poor program and project design
- Lack of technical support for remote locations

Opportunity

- Increasing energy requirement of the country
- Energy dependence on imports
- Impetus to domestic research
- Lead via a large scale project
- Development of human resources

Threats

- Long term return of investments
- Change in long term government policy
- Poor implementation
- Technological challenges (Storage)
- Lack of cooperation from local distribution utility

Strengths of the core group

- **Partha Sarathi Sensarma (EE)**
  - Renewable energy related power electronics

- **Raj Ganesh Pala (ChE)**
  - Fuel flexible fuel cells
  - Generation of renewable Fuels

- **Monica Katiyar (MME)**
  - Thin film solar cell
  - Solar cell fabrication

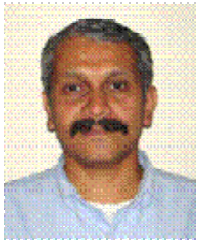
- **Malay K. Das (ME)**
  - Fuel cell transport phenomena
  - Reacting flow

- **Raghubir S. Anand (EE)**
  - Silicon and Organic Solar Cell Design, Simulation, Device Processing and Characterization

- **Anoop Singh (IME)**
  - Renewable Energy Policy and programme implementation
  - Energy Economics
  - Project Financing

- **Santanu K. Mishra (EE)**
  - Multiphase DC-DC Modelling & Control
  - International Rectifier Corp.

- **S. Sundar Kumar Iyer (EE)**
  - Organic Solar Cells
  - Solar cell fabrication



Objectives of SERE

- **500 KWp solar power station/*modular* research test-grid**
- **Supplement electricity to IITK during day**

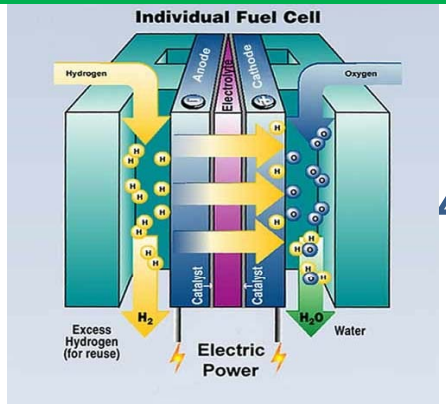
- **Modules to be used for research products**
- **Long term research & development in solar power generation, storage and distribution**
- **Practical input for graduate and undergraduate programs**

- **Training and human resource development in the area of renewable energy**

Power Electronics

Solar Power Sub-station
Technology Demonstrator

Fuel Cells/Secondary Batteries



High Efficiency and low cost
Solar Cells

Land required for solar energy capture

- Capacity of photovoltaic panels = 500kWp
- Land requirement = 10-12 acres (40000 - 48000 m^2)
- Facilities to be hosted = Solar Panels, System integration instrumentation, Energy storage devices
- Scope for future expansion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Engaging faculty and students in long-term solar energy research and development

Proposed Research Programs in four areas:

Power Electronics	**Policy/Implementation /Design**	**Fuel Cells**	**Photovoltaics**
Santanu K. Mishra (EE)	Anoop Singh (IME)	Raj Ganesh Pala (ChE)	Raghubir S. Anand (EE)
Partha Sarathi Sensarma (EE)		Malay K. Das (ME)	Monica Katiyar (MME)
Shyama P. Das (EE)		Sameer Khandekar (ME)	Y. N. Mohapatra (Phy)
		Kantesh Balani (MME)	S. Sundar Kumar Iyer (EE)
		Krishanu Biswas (MME)	Kallol Mandal (MME)
		Deepak Kunzru (ChE)	
		Goutam Deo (ChE)	
		Nitin Kaistha (ChE)	

Fuel cells

- Flexible device to generate electricity from chemical fuels

- Renewable fuels desirable
  - H_2 from water using solar energy
  - Ethanol from biomass

- Efficient large-scale stationary power generation

Power Electronics

- Interfacing with various energy (solar/fuel cell, etc.) and energy storage sources (batteries)
  - Efficiency of power conversion (DC-AC)
  - Dynamic improvement

- Grid synchronization

PV Modules

- Increase power conversion efficiency of solar cell
- Reduce cost of materials
- New materials and technologies – Organic Solar Cells

Energy Policy Program

- Provide Inputs for policy for enhancing project implementation
- Establish baseline for economic viability
- Identify specific policy actions at the distribution utility's level
- CDM financing

Tentative Budget & Time line

- **Ist phase (1-3 yrs):**

Component	Cost (Crores)
PV- panels (Assuming a mix of technologies to be used and average cost Rs.200/KW_p)	10
Fuel Cells/Batteries	3
Power Electronics	2
Operational cost, maintenance and security	1
Research initiation for low-cost Si material, high efficiency PV, fuel cells and power electronics	2
Total	18

- Possibility of subsidies and incentives from MNRE/KESCO

- **IInd phase (4-6 yrs):**

- Sustained funding of 4-5 crore per year will be needed for research projects to lower cost of solar energy

Summary

- A detailed project report will be submitted by the team
- Seed money required: Rs. 10 Lakhs
- To be used for
    - Visit to existing plants
    - Meeting with MNRE and KESCO
    - Meet manufacturers
    - Project assistance


Thank you

Extras

Why 500kWp?

- 100s of kW
  - A small rural economy can be supported, small industries, irrigation and domestic loads
  - From IIT's perspective:
    - 400 rooms in Hall 7 and Hall 8
    - Each room has a authorized load of 300 W, (40W tube light, 60W > Fan and 200 W for computer)
    - So total load is 120kW per hostel if all lights, fans and computer are on simultaneously.

Significance of Technology Demonstrator

- Test platforms for large scale solar energy utilization technologies
- Increased awareness of green technologies amongst the public
- Overall cost of the energy technology decreases with large scale utilization
- Encourage the entrepreneurs to invest in solar energy technologies.
- To make available a design and project template for replication elsewhere