

An Indian-Australian research partnership

Project Title: **Issues facing large scale deployment of solar energy in India**

Project Number **IMURA0710**

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Research Academy Themes:

Highlight which of the Academy's Theme(s) this project will address?

(Feel free to nominate more than one. For more information, see www.iitbmonash.org)

1. Advanced computational engineering, simulation and manufacture
2. Infrastructure Engineering
3. **Clean Energy**
4. Water
5. Nanotechnology
6. Biotechnology and Stem Cell Research

The research problem

Define the problem

This research program aims to analyse the various issues that would have to be addressed in generating at least 50% of India's electricity needs from solar energy by 2050. The program has three inter-related problem areas that need to be addressed to facilitate large scale solar adoption and grid integration:

- Technology solutions,
- Economic analysis, and,
- Modeling, simulation and optimisation of power and energy systems.

The precise problems tackled in the project will be broadly entail working on one or more of the above mentioned three areas.

Project aims

Define the aims of the project

The aims of the project are to::

- Understand the potential of solar energy to supply electricity needs of India by 2050. Identify barriers hindering India from taking leadership role in solar technology research, development and deployment on a massive scale given its highest solar insolation amongst G20 countries
- Develop a blueprint of actions that India can take to achieve a notional target of 50% of energy from solar by 2050.
- Propose decision support tools for shaping up solar policies and facilitate implementation via technology solutions.

Expected outcomes

Highlight the expected outcomes of the project

The outcome from this research program would be a suite of computational models that can be used by the energy industry and government policy analysts and policy makers, and a comprehensive report for both the Governments of India and Australia on whether a 50% solar by 2050 for India is achievable and what actions need to be taken to make it a reality

The scope of ideas expressed here is intentionally quite broad, and possibly beyond the scope of one PhD project. Consideration may need to be given to splitting it into a few inter-related projects each with predominant input from a single discipline.

How will the project address the Goals of the above Themes?

Describe how the project will address the goals of one or more of the 6 Themes listed above.

Energy and Systems modelling (Themes 1,2 and 3)

1. Estimate the maximum (theoretical) energy insolation from the sun in India under the current climatic conditions (in different States) and how much GWh can be generated using current conversion technologies and potential for increases in that conversion rate.
2. Forecast the total electricity generation over the same period from all other sources – coal, gas, nuclear, hydro, wind, bio mass, etc.
3. Forecast India's total electricity requirements to 2050 under different demand growth scenarios.
4. Model the interconnectedness of the national grid, current and future, and assess the impact of different amounts of solar power feeding into the grid in different States (in the case of grid connected PV) and possible distributed systems with solar power.

Technology: (Themes 3 and 5)

5. There are many issues: Improving conversion efficiency, comparison of PV and solar thermal, Grid connected or off-grid or both, Use of solar technology on both demand side and supply side.
6. Assess the actual and potential capacity of the Indian manufacturing and construction sectors to deploy large volume solar installations, and the Government industry policies required to realise the potential.
7. Innovation in solar technology deployment: what lessons, if any, can be learnt from the rapid penetration of cell phones in India?

Energy and Development economics: (Themes 2, 3 and 4)

8. Understand the views of key stakeholders in India: GOI, State Governments, Regulators, and Utilities in both private and public sector, NGOs, Media, Community organisations.
9. Understand the barriers that hinder large-scale take-off of solar power. Examples (some quoted by the ADB) are :

- a. Institutional capacity: (e.g. Ability of the rural institutions to participate in and handle solar energy. Political power structures at village levels).
 - b. Policy: (e.g.: Energy pricing in general, and for rural sector in particular; Reduction of network losses)
 - c. Financing – (e.g. Where will the investment money come from? Will there be sufficient return on such investment? What will the rural customers pay for electricity? Importance of Clean Development Mechanism as a means of attracting foreign investment)
 - d. National perspective:
 - How does one change the perspective of solar energy from “a high cost, fancy technology for the rich nations” to “the foundation for India’s environmentally sustainable growth of 7 - 10% per annum, during the next 4 decades”?
 - e. Availability of adequate land, reservation of land for food production, rural water purification potential.
10. Assess the level of carbon price (or CER prices) needed for local and overseas investment to flow to the solar energy sector.

Capabilities and Degrees Required

The applicants are expected to have a strong mathematical aptitude. Background in either electrical/electronic engineering or economics/management science is desired.