STAPP_IITK

- **Field performance**
- **Degradation mechanisms**
- **Levelized cost of photovoltaic systems**

There are number of solar photovoltaic (SPV) technologies available in the market. Each technology has its own strength. Some are marketed as highly efficient one while others are sold as low cost options. The laboratory tested 1KWp solar modules never gives 1KWp power output in field conditions. The performance parameters and power ratings of solar cells, modules and inverter/converter as evaluated under controlled laboratory conditions are not sufficient. The interaction of modules with power conditioning unit and other components of the SPV system has major effect on the ultimate power output. The different technologies react differently with environment factors. Few degrade faster than others. A long term energy output assessment of different SPV technologies under similar weather conditions is desired. The long term reliability and warranty of different components can be checked in actual field conditions. Keeping the ultimate cost and long term power output into account, the Levelized Cost of Electricity (LCOE) makes an assessment of the technology and gives its real value to the customer.

Grid Connected SPV Power station @ IITK

Under the DST sponsored Indo-UK project "Stability & Performance of Photovoltaic (STAPP)", IIT Kanpur has taken up the task of carrying out the field performance testing of SPV systems. A 50 KWp solar power plant consisting of ten state of the art performance testing stations of five different PV technologies in two different configurations has been built at newly established **Solar Energy Research Enclave (SERE)**. The power station is unique and first of its kind in the country.

Various SPV technologies

The five PV technologies under test are:

- **Mono-crystalline silicon**
- **Multi-crystalline silicon**
- **Amorphous silicon thin film,**
- **Copper-Indium-Gallium-Selenide (CIGS) thin film**
- **High concentration high efficiency triple junction solar cells.**

They are rigged up in fixed angle and 2D tracker configuration at 5 KWp levels. The online monitoring system for comprehensive field performance evaluation of various SPV system parameters and ambient conditions has been designed. A 5KWp battery supported off-grid solar system meets the electricity needs of the SERE. The solar power station is feeding about 250 units electricity per day to IITK grid.

The laboratory measured efficiency of crystalline and multi-crystalline silicon solar cells are 14-16% and modules are 2% less efficient. Presently, in more than 80% of PV based solar systems, crystalline and multi-crystalline solar panels are used.

Multi-Crystalline Silicon modules on 2D Tracker installed at SERE

In thin films, we have amorphous silicon, cadmium telluride (CdTe) and copper-indium-gallium-selenide (CIGS) as major technologies. The low cost option like amorphous silicon solar cells are less efficient and hence occupy large areas for same power output.

Thin Film Amorphous Silicon and CIGS modules on 2D Tracker installed at SERE

Technically, thin film use less material and have better spectrum response, but one is not sure about its ultimate cost to the user.

High efficiency III-V semiconductor based concentrators are another important technology for solar electricity generation and are technologically challenging configuration.

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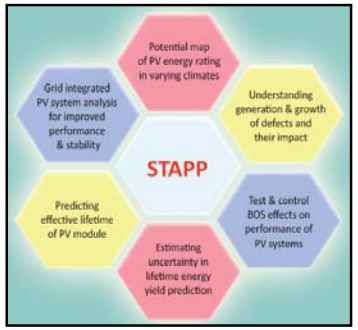
High Efficiency & high concentration small area solar cell modules on 2D Tracker installed at SERE

There are many other technologies like polymers, nano-particles/rods, quantum dots (QD) or their hybrids under developments and it will take few more years till these become commercially viable. As we are becoming familiar with various technologies, cells, modules, inverters/converters used in solar systems, lots of technological issues demand our attention for rendering better performance.

STAPP - Project Overview

STAPP delivers and upgrades the fundamental understanding required to reduce the levelised costs of energy from photovoltaic systems through a multidisciplinary collaboration of leading research teams in two countries, involving 23 investigators of 9 institutes/universities and more than 15 companies, for the benefit of both nations. Research Council UK and Department of Science & Technology, India provided funding of £ 4 Million, while considering the importance of the project.

Photovoltaic is a green technology with an undeniable potential for energy delivery. The key issue is the cost of the generated energy which is dominated by the long term performance of the PV system and its stability. The success of a PV system is defined in terms of the investment having an appropriate return. Understanding of the stability and performance enable the increase of life-time energy yield and thus reduces the levelised cost of energy. A lack of under- standing will result in high risk investments with relatively high probability of failure rates. Emphasis of projects is on the topics related to stability and long-term performance of PV module and systems.The environ-ments in the UK and India are very different, but both countries have about the same capacity installed at present. The UK is lower on indigenous production of PV modules. However, installations and the related costs are 70% of the value and are generated nationally. STAPP will help in increasing the profitability of systems and thus enhance national industries as well as reducing the cost of green energy obtained from PV.



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Grid Connected Solar Photovoltaic Power Station

Established at
Indian Institute of Technology Kanpur
Under

STABILITY & PERFORMANCE OF PHOTOVOLTAIC (STAPP)

UK-India Research Initiative in Solar Energy

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