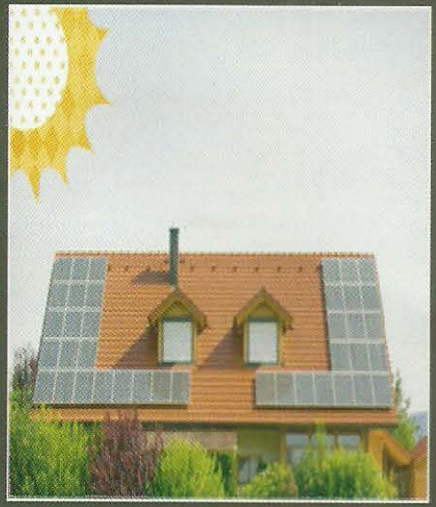
Photovoltaics – the Ultimate Energy Solution!

by Jose Rajan (National University of Singapore)



Alternate energy sources are actively sought in light of rising energy demand and depleting oil resources. Overdependence on fossil fuels leaves us vulnerable to air pollutants, viz. CO, NOx, and SOx, and related health risks and global warming due to the increased greenhouse gas concentration. These issues raise severe concerns on the sustenance of life on the earth. For example a rise of ~1°C in global temperature would melt a significant portion of the polar ice thereby removing large area from lower lying lands by the seas and oceans; migration of the living organism poleward thereby causing population imbalance; appearance of new micro organisms and diseases; etc. Therefore, a step forward in the pursuit of alternative energy sources is the harness of energy from carbon-free sources such as wind, geothermal, hydroelectricity, tidal, and solar energy.

Our primary source of clean abundant energy is the sun – plants and winds are energized by the sun. More solar energy strikes the Earth in one hour (4.3×10^{20} J) than all energy human consumes in one year (4.1×10^{20} J)! Solar energy is conventionally used by human for drying and heating. Attempts to convert solar energy into electrical energy, the science and technology of which is called photovoltaics, gained momentum in the second half of the twentieth century due to the advent of photovoltaic effect in silicon. Solar cell is the device that does this energy conversion. Due to enormity of electrical appliances used routinely in daily life, availability of high power solar cells

Solar cells are built using materials that absorb the solar light – called semiconductors. Monolithic silicon based solar cells are most efficient if a single semiconductor is used, which are also called single junction solar cells. Efficiency of solar cells can be increased by suitably combining semiconductors that absorb solar radiation of wavelength (colors), which are called multilayer solar cells.

After intensive research and development, single junction solar cells can now convert 25% of the solar power striking on it into electrical power, which for multilayer solar cells is ~32%. If intensity of the striking radiation is increased by means of 'solar concentrators', single junction and multilayer structures convert solar power with efficiencies 29 and 42%, respectively. Present targets in solar cells are to reduce the cost of fabrication and/or installation such that the investment for installing them, the so called "payback time", could be effectively reduced. Present payback time for solar cells built using single crystalline silicon is one to three years which could work for 25 years. Scientists and engineers are now intensively investigating new methodologies for fabricating solar cells using commonly available materials such as TiO_2 and simple fabrication technologies.

References

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