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Abstract

World's energy demand is growing faster because of population explosion and technological advancements. It is therefore important to go for reliable, cost effective and everlasting renewable energy source for energy demand arising in future. Solar energy, generally speaking, is clean renewable energy and non-polluting. Solar energy is the most abundant form of energy on Earth. It is available to every location on the planet and can easily meet all of the energy needs of mankind. It is a sustainable energy as it is obtained from source that are inexhaustible, cost-effective and efficient. Solar power is fastest-growing source of new energy all over the world because of the high demand for energy while major energy source, fossil fuel, is limited and other sources are expensive. It has become a tool to develop economic status of developing countries and to sustain the lives of many underprivileged people as it is now cost effective after a long aggressive researches done to expedite its development. The challenge of climate change has impelled many nations to set a Solar Energy Target (SET). Increasingly, governments around the world are turning to solar energy to end our dependence on fossil fuels.

Introduction:

Solar power is clean green electricity that is created from sunlight, or heat from the sun. While there are a number of factors that determine the electrical output of a solar power system, the number of solar cells and overall size of the solar panel array, are the major determinants in how much electricity can be generated from a solar system. The more solar cells and larger the solar panel array is, the more electricity can be generated. They type of solar cells will also impact the efficiency with which a solar panel generates energy. Hundreds of solar cells (also called photovoltaic cells) make up a solar photovoltaic (PV) array. Solar cells are the components of solar arrays that convert radiant light from the sun into electricity that is then used to power electrical devices and heat and cool homes and businesses. Solar cells contain materials with semiconducting properties in which their electrons become excited and turned into an electrical current when struck by sunlight. While there are dozens of variations of solar cells, the two most common types are those made of crystalline silicon (monocrystalline with efficiencies 20 % , polycrystalline with 13-16% efficiency), and those made with what is called thin film technology. Generally speaking, monocrystalline silicon is the most efficient material to use in solar cells. Polycrystalline silicon and thin film cells are also commonly used and are less expensive than monocrystalline.

Thin Film Solar Cells: Thin film solar cells have the potential to revolutionize how solar power is gathered across the globe. Lightweight, flexible and semi-transparent, they can be used in building photovoltaic, as a glazing material painted onto windows, or as rigid solar panels at photovoltaic power stations. new thin-film solar cells are made of posphorene, a lightweight, ultrathin, p-type semiconductor. Conventional thin film solar cells are made by depositing one or more layers of photovoltaic material onto a plastic, glass or metal substrate.

The major draw of thin film technologies is their cost. The thin film market continues to grow. One major drawback is that thin film technologies require a lot of space: Thin film technology using various photovoltaic substances such as posphorene, amorphous silicon, cadmium telluride, copper indium and gallium selenide. Each type of material is suitable for different types of solar applications. Semi-transparent thin film solar technologies can replace any plastic surface with a working solar cell such as printable solar cell.

Printable Solar Cells:

To find a cheap and reliable means of manufacturing a mass quantity of cells, Instead of the plastic banknotes, researchers have modified commercial printers to accept solar inks and effectively print thin flexible photovoltaic sheets. Since they're still using commercial printers, the manufacturing process is incredibly cost effective and scalable, and it is to expand upon the capabilities of its pilot scale production process. Solar inks are typically comprised of metal salts suspended in a polymer fullerene blend. The ink may consist of a photoactive layer made up of p-type polymer and an n-type fullerene, a hole transport ink, and can be combined with a cathode and an anode suspended on a substrate. Since the system can be applied in layered coatings, it is possible to use existing ink jet printer technologies to print working solar cells onto plastic substrates.

Future of Printable Solar Cells: Cheap and printable, these solar panels would be easy to deploy in third world countries offering energy independence and a clean alternative to a much wider span of people than current commercial solar technologies.

Advances in Solar Cell Technology

Light-Sensitive Nanoparticles: A new type of light-sensitive nanoparticle called colloidal quantum dots that many believe will offer a less expensive and more flexible material for solar cells. Gallium Arsenide: Researcher has discovered a new material - gallium arsenide - that could make solar PV systems nearly three times more efficient than existing products on the market. The solar cells are called "triple junction cells" and they're much more efficient, because they can be chemically altered in a manner that optimizes sunlight capture. The model uses a sensor-driven window blind that can track sun light along with "light-pipes" that guide the light into the system.

Advances in Energy Storage: Another major focus is to find new ways to store energy produced by solar PV systems. Currently, electricity is largely a "use it or lose it" type resource whereby once it's generated by a solar PV system (or any type of fuel source) the electricity goes onto the grid and must be used immediately or be lost. That is why scientists are exploring different ways to store this electricity so that it can be used on demand such as Molten Salt Storage Technology: Solar Panel with Built-In Battery

Advances in Solar Cell Manufacturing: Another area that has made solar PV technologies cost prohibitive compared to traditional fuel sources is the manufacturing process. Scientists are also focused on ways to improve the efficiency of how solar components are manufactured. The traditional conventional method is to use flat silicon solar panels you occasionally see on people's roofs. Sunlight can be subdivided into two parts for solar collection purpose. The first component is the direct beam, which carries roughly 90 percent of the energy in solar spectrum. The remaining 10% of the energy is found in diffuse light which increases in cloudy weather. Since most solar panels are flat, the angle at which sunlight hits the solar panel is very important. An 8° misalignment can correspond to as much as 8.3% loss in energy. A properly synchronised solar tracking system can add as much as 40% output power of a solar system in a day. To overcome this dependency many solar panels also employ tracking systems that face the panel directly towards the sun. Large scale solar farms will use similar tracking systems on their mirrors and optics to focus light onto superefficient multijunction photovoltaic cells. It may seem small, but tracking the sun is part of the reason it was able to achieve record breaking solar efficiency in outdoor conditions. Their solar prototype used one of the highest efficiency technologies available in the world of solar, concentrated photovoltaics(CPV). Concentrated photovoltaics (CPV) is a technology that uses a set of lenses and/or mirrors to concentrate sunlight onto a multijunction cell. The drawback of CPV systems is the inability to collect diffuse sunlight; a single cloud could be enough to halt energy production making them difficult to integrate into a grid. To partially overcome this deficiency, many CPV systems employ tracking systems that follow the movement of the sun over the course of a day. CPV systems can generate enough energy from peak solar activity during the morning and afternoon to surpass even conventional photovoltaics in

areas that receive a lot of sun. The large capital cost associated with installing CPV keeps them confined in a niche for large scale solar electricity generation projects.

Advantages of Solar Energy: Renewable Energy Source which is clean & pollution free, Reduces Electricity Bills, Diverse Applications, Low Maintenance Costs, and Technology Development. With reduced costs and improved technologies, the solar energy ensures the reduced electricity bills, increases countries' energy security through reliance on an indigenous, inexhaustible resources, enhanced sustainability, reduced pollution, lower the costs of mitigating global warming, and keeps fossil fuel prices lower than otherwise. It is environment friendly and any one can use it. The advantages are global. Hence the additional costs of the incentives for early deployment should be considered learning investments; they must be wisely spent and need to be widely shared.

Solar Energy Disadvantages: Initial cost to purchase solar systems, Weather Dependence, Expensive Energy Storage, Uses a Lot of Space, & Solar panels cannot create AC power on their own.

The two main types of solar power systems are grid connect and off grid (standalone/remote power) installations. A grid connect installation ensures you have the electricity you need, whenever you need it – automatically and regardless of conditions. An off grid solar power system is installed completely separated from mains power and utilises a deep cycle battery bank for storing electricity generated by solar panels. Off grid installations are most common in rural and outback areas across the world, where the main grid simply isn't available, or prohibitively expensive to connect to.

New Solar Applications

When most people think of solar PV systems they think of them atop roofs or mounted for industrial scale use. But researchers are exploring a number of unconventional solar applications that could promise to transform the industry such as Solar Roadways, Floating Solar, Space Based Solar.

Optimizing Solar PV Systems

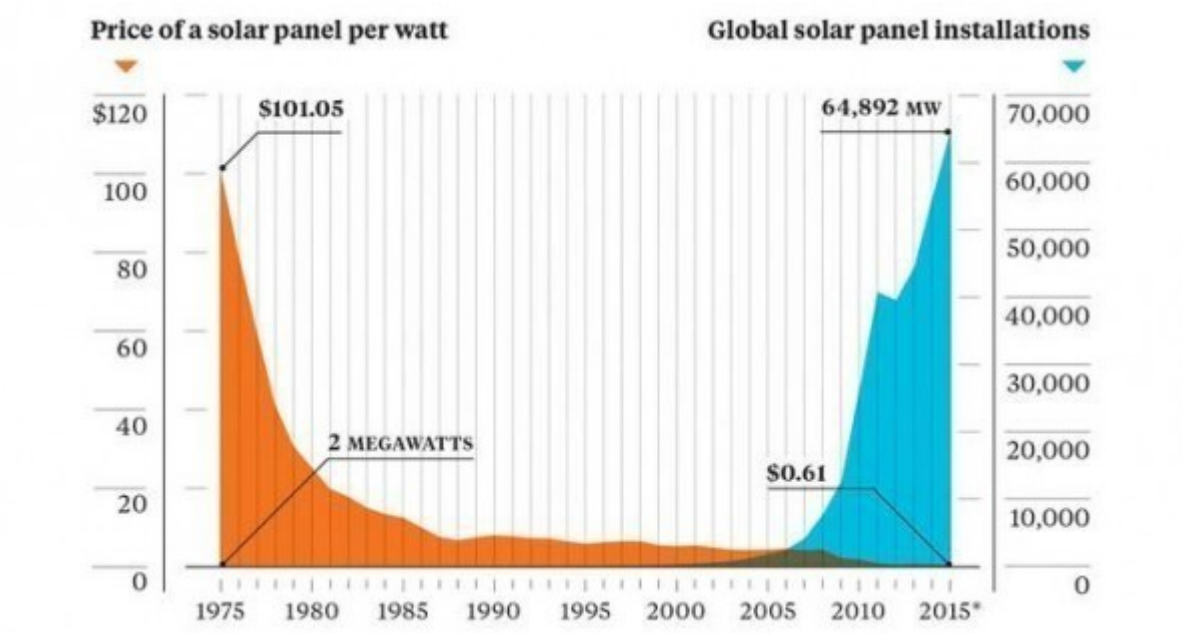

Figure 1

The cost of PV panels has dropped significantly in the last 40 years from approximately $120/watt to around $0.5/watt, or less as shown in figure 1. This reduced price, and resulting increase in sales, has boosted other areas of the solar industry, increasing demand in diverse application for off-grid systems.

At present, 1.4 billion people worldwide have no access to electricity, of which 500 million are in Asia. In future, we can build a clean energy supply system featured by solar power, with distributed and micro power networks, to make electricity accessible to everyone on earth by 2030.

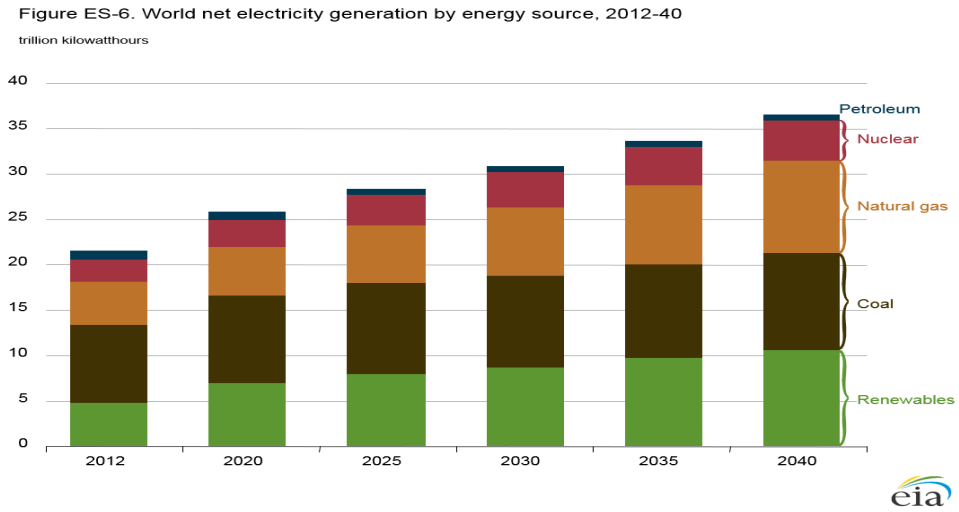

Fig 2 World net electricity generation by fuel type, *Credit: www.EIA.gov*

Future scope

Solar energy is becoming the centrepiece of worlds clean, renewable and distributed electricity generation and will play an important role in the smart home revolution. The technology and the panels are becoming smaller, more economical, and efficient better looking than ever. With implementation of new technology such as CPV with multi-junction cell, solar ink, solar print cell, Light-Sensitive Nanoparticles, to improve solar conversion efficiency 45 % and more in outdoor sunlight within the next few years is desired goal: Cost of Solar PV is set to decrease by 16% with doubling of capacity. It is said that renewables and fossil fuels will have an almost equal share of the energy mix by 2050. Solar photovoltaics (PV) will drive the ongoing expansion of renewable energy, whilst gas is on course to surpass oil in 2034 as the single biggest energy source as shown in figure 2.

The global energy transition will occur without a significant increase in overall annual energy expenditure. Renewables accounted for almost two-thirds of net new power capacity around the world in 2016, with almost 165 gigawatts (GW). Out of which, solar energy addition accounts 50 % driven by sharp cost reductions of solar photovoltaic and policy support.

Till 2016, solar power generation account only 1.3% of total share of global energy demand. Share has to reach 10% of total global power in next five year with 25 % growth rate. The world's energy will cost 3% less of global GDP compared to the current level of 5% within next five year.

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