ELECTRICITY FROM THE SUN – PHOTOVOLTAIC ELECTRICITY

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ABSTRACT

This paper deals with the form of renewable energy - solar energy through photovoltaic cells and modules. Materials presently used for photovoltaic include monocrystalline silicon, polycrystalline silicon, microcrystalline silicon, cadmium telluride, and copper indium selenide/sulfide. Due to the growing demand for renewable energy sources, the manufacture of solar cells and photovoltaic arrays has advanced dramatically in recent years

1. INTRODUCTION

Driven by advances in technology and increases in manufacturing scale and sophistication, the cost of photovoltaics has declined steadily since the first solar cells were manufactured. Net metering and financial incentives, such as preferential feed-in tariffs for solar-generated electricity; have supported solar PV installations in many countries. The installed power of solar power plants and small cogeneration plants is less, but continuously growing. The Solar America Initiative (SAI) provides the means of developing PV Technologies and advance PV manufacturing. Programs of interest to cell and module manufacturing include the Technology Pathway Partnership, TPP, geared towards larger and more mature entities, the PV Incubator program for small businesses, as well as the Future Generation and University programs geared at longer-term technology developments or in support of university driven R&D aspects, respectively. Currently, First Solar has announced capacity expansion greater than 1000 MWp annual capacity by the end of 2009, but those new factories are built (already under construction) in Malaysia.

2. OVERVIEW OF AVAILABLE PHOTOVOLTAIC TECHNOLOGIES

2.1. Photovoltaic

Energy from the sun can be used in three main ways:

- passive heat,
- solar thermal,
- photovoltaic energy PV.

Passive heat is heat that we receive from the sun naturally. This can be taken into account in the design of buildings so that less additional heating is required.
Solar thermal we use the heat of sun to provide hot water for homes or swimming pools (also heating systems).Photovoltaic energy PV uses energy from the sun to create electricity to run appliances and lighting. A photovoltaic system requires only daylight - not direct sunlight - to generate electricity.In 1839 was entered into human history photovoltaic when as the first French physicist A. E. Becqerel described photovoltaic effect. Photovoltaic is a marriage of two words: 'photo', from Greek roots, meaning light, and 'voltaic', from 'volt', which is the unit used to measure electric potential at a given point.In 1905 A. Einstain presented study the photoelectric effect, for which he received Nobel Prize of Physics in the 1921. However, photovoltaic effect began to be used to direct energy conversion of sunlight into electricity until 1954.

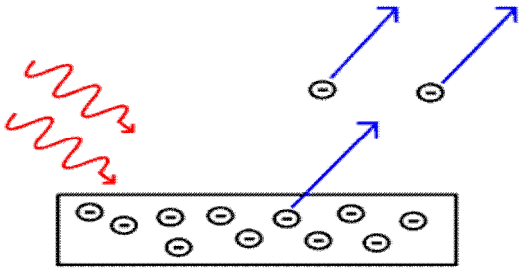

Figure 1 - Photoelectric effect -A diagram illustrating the emission of electrons from a metal plate, requiring energy gained from an incoming photon to be more than the work function of the material.

Photovoltaic systems use cells to convert solar radiation into electricity. The cell consists of one or two layers of a semi-conducting material. When light shines on the cell it creates an electric field across the layers, causing electricity to flow. The greater the intensity of the light, the greater the flow of electricity is.Electricity is produced in this way silently, without any moving parts and no side products.
Photovoltaic system operates automatically, without operator and major maintenance requirements.

The basic units of PV solar systems are solar cells, which will build the basic building blocks - photovoltaic modules, thus more connected of PV solar cells.

2.2. Types of PV Systems

Autonomous (Island) systems - use especially on the spot where is not access to the electricity grid (cottages, electrical equipment along the roads and so on). This system needs a battery where the produced energy is stored.
Systems unconnected to the network (separate systems) - to use contain mostly the battery of energy storage when the sun does not shine and control mechanism that protects against excessive charge and discharge the battery or voltage converter also.
Systems connected to the network - used mainly in countries with fully developed electricity grid. They are directly linked to the local electricity network, enabling them to supply electricity generated by the network, or if necessary take it. These systems include voltage converter.

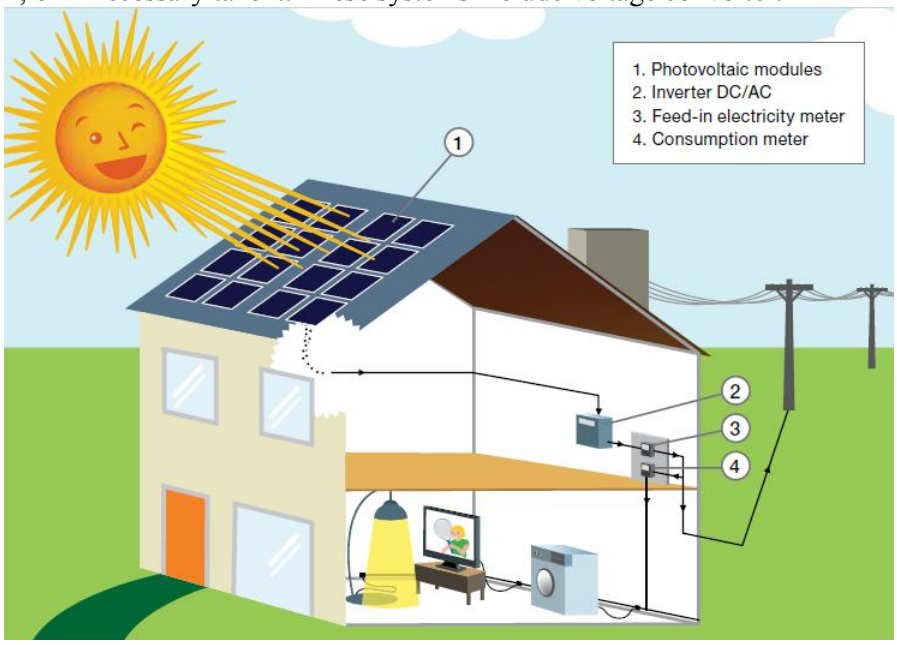

Figure 2 - Systems connected to the network [1]

In these plants is needed to contract in our with the distribution companies (ZSE, SSE, VSE), which enables the delivery of power to the system of preferential tariff. In Slovakia is not valid "green

bonus" as are in the Czech Republic and therefore is financially better to sell and subsequently buy the energy from Distribution Company.
Hybrid systems – are combination solar with other energy sources such as biomass, wind turbines, diesel generators. They can be connected to a network or individual.
The priority for the installation of small PV systems (mounted on private homes, public buildings, shops, etc.). In addition to functionality, aesthetic value and reasonable price. Development is directed to incorporated materials to the roofs of buildings and structures, where they also perform the function of the architectural element.
PV cells are generally made either from crystalline silicon, sliced from ingots or castings, from grown ribbons or thin film, deposited in thin layers on a low-cost backing.
The performance of a solar cell is measured in terms of its efficiency at turning sunlight into electricity. A typical commercial solar cell has an efficiency of 15% - about one-sixth of the sunlight striking the cell is an important goal of the PV industry.

2.3. Technology PV Modules

At present, the production of PV modules based on four core technologies:

1. **traditional crystalline silicon.** Its advantage is higher efficiency systems (more than 20%), the problem is still incrising price of raw material, or lack thereof. The scope for reducing prices of these modules in the future is limited, given the price of silicon and said production technology (module assembly of individual cells).

Japan’s Mitsubishi Electric Corporation says it has produced the world’s most efficient multi-crystalline silicon photovoltaic (PV) cell. It claims to have reached a conversion efficiency rate for a 150 mm square cell of 18.9%.
The 0.3% improvement on its previous record efficiency for what it describes as a ‘practical-sized’ cell largely comes on the back of a 26% improvement in efficiency in utilizing infrared rays. This has been achieved through the introduction of a newly developed rear-surface reflection structure.
Mitsubishi adds that this new cell also adopts the same low-reflective honeycomb textured surface structure which it previously developed and which features very small concave depressions on the surface.
Mitsubishi Electric says it will begin introducing this multi-crystal silicon PV cell technology into mass-produced PV modules from April 2010. The company also aims to increase output of PV systems by combining the technology with its own inverters [2]

2. **thin films - amorphous silicon** (effectiveness of more than 10%). The technology is already used in 80tych years in calculators and digital watches.
3. **thin layers of cadmium - tellurium (CdTe)** - very suitable for mass production. Efficiency is about 15 to 16.5%. Toxic effects of CdTe articles are not shown, despite the presence of cadmium, which is self-toxic. Cadmium in the manufacture of articles produced as a side product of zinc mining.
4. **thin layer of copper-indium-gallium-selenium (CIGS).** Indium is obtained for PV sector as secondary product extraction and processing of other metals over the world. Stocks and available are perspective for the PV sector in economic, geographical and political point of view. Similarly, gallium is obtained in processing bauxite.

The latest discoveries in the PV sector are organic PV systems (OPV), using the ability of some polymers behave in the presence of other substances as a semiconductor. Their clear priority should be low cost, the major obstacle is still very low efficiency (around 5%).

3. CONCLUSIONS

The photovoltaic sector is particularly promising in terms of job and local wealth creation. The sector invests heavily in research and technological innovation and generates employment, which to a very high degree means skilled, high quality jobs. Moreover, the PV sector and the renewable energies in general have a decentralized structure, which leads to employment in the less industrialised areas.

Photovoltaic is emerging as a major power source due to its numerous environmental and economic benefits and proven reliability. Photovoltaic fuel is free until the world is end. Solar power uses only the power of the sun as its fuel It produces no noise, harmful, emissions or polluting gases. Systems can be aesthetically integrated in buildings. European building legislations have been and are being reviewed to make renewable energies as a required energy source in public and residential buildings. PV systems are very safe and highly it reliable requires low maintenance and can be recycled. Photovoltaic brings electricity to remote rural areas.

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