PROPOSAL OF 100 KW PHOTOVOLTAIC POWER PLANTS AT THE AIRPORT KOŠICE

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Thesis describes general possibilities of using photovoltaic in practice and also to identify and describe the possibility of using solar energy at the international airport in Košice. We can not imagine airport operation without continual energy (particularly electricity) supplies these days. Thesis answers questions of alternative energy sources, particularly photovoltaic (solar) energy use. Also the possibility of construction of photovoltaic power plants in the Košice airport, specifying the placement options photovoltaic power plant. It also describes the advantages and disadvantages of photovoltaic plant construction and use of energy from the Sun.

K e y w o r d s: photovoltaic, solar energy, power plant

1 PHOTOVOLTAIC

Photovoltaic is a method of generating electrical power by converting solar radiation into direct current electricity. Photovoltaic power generation employs solar panels composed of a number of solar cells containing a photovoltaic material. It using semiconductor that exhibit the photoelectric effect.

The photoelectric effect is the observation that many metals emit electrons when light shines upon them. Electrons could be emitted from the surface of a metal into the vacuum under irradiation of lights, where photon energy is large then the work function of the metal. Such external photoelectric effect is the basis of classic photoelectric diodes. Electrons emitted in this manner may be called photoelectrons.

The photoelectric effect was firs observed by Heinrich Hertz in 1887 during experiments with a spark-gap generator. In these experiments a spark is generated between two small metal spheres in the transmitter to induce a similar spark to jump between different metal spheres in the receiver. Later studies by J. J. Thomson showed that increases sensitivity was the result of light pushing on electrons. Later experiments by others, most notably Robert Millikan, found that light with frequencies below a certain cutoff value, called the threshold frequency, would not eject photoelectrons from the metal surface no matter how bright the source. These results were completely unexpected. Given that it is possible to move electrons with light and given that the energy in a beam of light is related to its intensity, classical physics would predict that a more intense beam of light would eject electrons with greater energy than a less intense beam no matter what the frequency. This was not the case, however.

2 PROPOSAL OF 100 KW PHOTOVOLTAIC POWER PLANTS AT THE AIRPORT KOŠICE

When planning the construction of photovoltaic power plant to first find out what the construction of this type of equipment is necessary. Technologically it is not complicated process for the actual construction. The whole construction can be met in a few weeks or months.

The first possibility is the placement of photovoltaic to a solid construction. With this type of construction are solar panels installed under the indicated inclination shot on the South, South-East or South-West side.

3 Details of photovoltaic system

A photovoltaic system typically includes:

- Solar / photovoltaic panel or array of solar modules,
- MPPT solar controller or inverters,
- inverter / solar inverter,
- batteries,
- many other elements of photovoltaic system.

3.1 Photovoltaic panels

A solar panel is a set of solar photovoltaic modules electrically connected and mounted on a supporting structure. A photovoltaic module is a packed, connected assembly of solar cells. The solar panel can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications.

3.2 Inverter

A power inverter or inverter is an electronic device or circuitry that changes direct current (DC) to alternating current (AC). The input voltage, output frequency, and overall power handling, are dependent on the design of the specific device or circuitry.

A power inverter can be entirely electronic or may be a combination of mechanical effects and electronic circuitry.

Static inverters do not use moving parts in the conversion process.

3.3 Batteries

An electric battery is a device consisting of one or more electrochemical cells that convert stored chemical energy into electrical energy.

Each cells contains of a positive terminal (or cathode) and a negative terminal (or anode). Electrolytes allow ions to move between the electrodes and terminals, which allows current out of the battery to perform work.
The sealed valve regulated lead-acid battery (VRLA battery) is popular in the automotive industry as a replacement for the lead–acid wet cell. The VRLA battery uses an immobilized sulfuric acid electrolyte, reducing the chance of leakage and extending shelf life. VRLA batteries immobilize the electrolyte. The two types are:

- Gel batteries (or "gel cell") use a semi-solid electrolyte,
- Absorbed Glass Mat (AGM) batteries absorb the electrolyte in the special fiberglass matting.

3.4 Airport Košice

International airport in Košice has a very large potential for exploitation of energy from sunlight, whereas lies at an altitude of 230 m (755 ft) and, according to Slovak hydro-meteorological institute is the average length of sunshine from 2,000 to 2,200 hours a year (up astronomically possible sunshine duration for a region of the Danube lowlands is 4,447 hours per year), which can be considered a strategic position in the use of this alternative energy source.

Us to achieve the desired output of 100 kW is therefore necessary to count with about 900 to 1,000 square meters area of solar panels installed at the airport Košice.

To this must be added the area spacing between the panels to each other done shadow thereby unnecessarily degrading the performance of photovoltaic power.
At the airport Košice I was primarily focused on the unused grassy area is located between technical buildings at the old aviation fuel storage.

I chose from there shaped as a rectangle with an area of over 4000 m2.

It is a sufficiently large grassy area that could meet the requirements for installing PV 100 kW.

3.5 Advantages and disadvantages of Photovoltaic panels

Photovoltaic (PV) panels can cover our basic energy (electricity) needs at a domestic level (solar power for home), commercially (solar power for commercial applications*)* or at the community level – providing electricity for small communities, or at a larger scale through utility scale power applications. Solar Photovoltaic (PV) panels are green power technology systems that exploit into renewable solar energy facilitating towards a sustainable energy mix. In this review we note some important advantages of photovoltaic systems**:**

ADVANTAGES:

- Photovoltaic (PV) systems provide green, renewable power by exploiting solar energy. We can use photovoltaic (PV) panels as an alternative energy source in place of electricity generated from conventional fossil fuels.
- Photovoltaic (PV) panels constitute a reliable, industrially matured, green technology for the exploitation of solar energy. Photovoltaic (PV) companies give valuable warranties for PV panels in terms of both PV panel life span (years of PV life) and PV panels' efficiency levels across time. PV panels can last up to 25 years or more, some with a maximum efficiency loss of 18% only, even after 20 years of operation.
- Unlike wind turbines, Photovoltaic (PV) panels operate autonomous without any noise generation as they do not incorporate any moving mechanical parts.
- With respect to operating costs and maintenance costs, Photovoltaic (PV) panels, unlike other renewable energy technologies, require minimum operating or maintenance costs.
- Photovoltaic (PV) panels can be ideal for distributed power generation as they are highly suitable for remote applications, such as in a remote farmhouse.
- One of the most important advantages of Photovoltaic (PV) systems is actually inherited by all solar energy systems in general; solar energy peak power generation usually coincides with peak energy demand (e.g. in hot summer days).
- Photovoltaic (PV) panels have become very popular in the past years particularly in both home energy applications (domestic level) and small-scale power generation applications
- Following their popularity and being a proven technology, photovoltaic (PV) panels are amongst the first solar energy solutions promoted by financial institutions (banks) through green-power financial incentives and green-projects. Financial institutions are now offering green-loans mortgaging leveraged debt on the cash flows that Photovoltaic PV systems will generate.

DISADVANTAGES:

- Perhaps the biggest disadvantage of Photovoltaic (PV) panels is their limited efficiency levels; compared to other renewable energy sources – such as solar thermal – PV systems have a relatively low efficiency level ranging between 12-20%. Although there is continuous technological development in PV materials for improving existing systems' performances or creating new products, PV systems are still limited

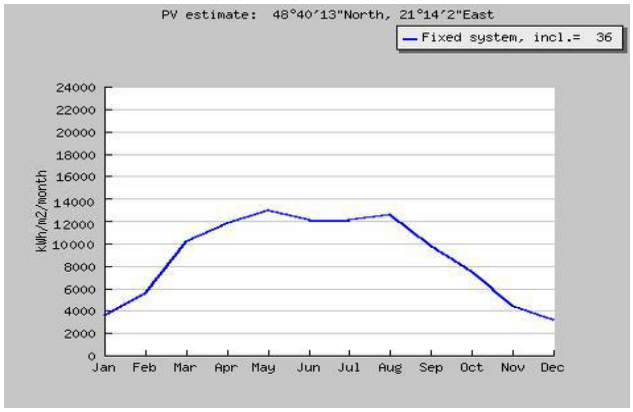
by the capabilities of the materials used in PV cells.

- Another disadvantage of Photovoltaic PV panels is that they produce direct electric current which must be converted to alternating current (AC) before it can be used for consumption (either to be transferred to the power grid, or directly for own consumption). To convert DC to AC, PV panel systems use inverters, expensive electronic equipment and with certain technological limitations, adding to the overall system's cost especially at larger power sizes.
- Although supply of solar energy is, usually, concurrent with peak energy demand (e.g. for cooling in hot summer days), one of Solar Photovoltaic (PV) panels' main disadvantage is that it delivers only in direct sunlight and it cannot store excess amounts of produced energy for later use.
- It should be noted that low voltage output or fluctuation in PV electric current may lead to increased waste of electricity since it cannot be transmitted onto the network (intermittent output).

3.6 Using photovoltaic panels from crystalline silicon

When using photovoltaic panels from crystalline silicon panels and the location of the static structure with an inclination of 36 ° and orientation rotated by 1° west are obtained from the ideal system outputs:

- rated power 100kW photovoltaic power,
- estimated losses due to temperature and low irradiance: 7.7%,
- estimated losses due to reflection: 2.9%,
- Other losses (cables, inverter...): 14.0%,
- Combined PV system losses: 22.9%.



Fixed system: inclination=36°, orientation=-1°				
Month	E_d	E_m	H_d	H_m
Jan	113.00	3510	1.33	41.1
Feb	198.00	5540	2.37	66.3
Mar	328.00	10200	4.07	126
Apr	395.00	11800	5.14	154
May	417.00	12900	5.57	173
Jun	403.00	12100	5.46	164
Jul	390.00	12100	5.33	165
Aug	406.00	12600	5.50	170
Sep	325.00	9750	4.26	128
Oct	242.00	7510	3.06	94.7
Nov	148.00	4440	1.79	53.8
Dec	102.00	3150	1.19	37.0
Yearly average	**289**	**8800**	**3.76**	**114**
Total for year		**106000**		**1370**

3.7 Using amorphous CIS photovoltaic panels

When using photovoltaic panels from CIS technology and the location of the static structure with an inclination of 36 ° and orientation rotated by 1° west are obtained from the ideal system outputs:

- rated power 100kW photovoltaic power,
- estimated losses due to temperature and low irradiance: 6.5%,
- estimated losses due to reflection: 2.9%,
- Other losses (cables, inverter...): 14.0%,
- Combined PV system losses: 21.9%.

Fixed system: inclination=36°, orientation=-1°				
Month	E_d	E_m	H_d	H_m
Jan	112.00	3490	1.33	41.1
Feb	198.00	5540	2.37	66.3
Mar	330.00	10200	4.07	126
Apr	401.00	12000	5.14	154
May	425.00	13200	5.57	173
Jun	411.00	12300	5.46	164
Jul	398.00	12300	5.33	165
Aug	415.00	12900	5.50	170
Sep	330.00	9900	4.26	128
Oct	244.00	7570	3.06	94.7
Nov	148.00	4440	1.79	53.8
Dec	101.00	3120	1.19	37.0
Yearly average	**293**	**8920**	**3.76**	**114**
Total for year		**107000**		**1370**

Electricity generation using amorphous photovoltaic panels will allow us to get a year up to 1000 kWh of energy than conventional silicon panels with the same settings panel.

3.7 Using amorphous CIS photovoltaic panels

When using photovoltaic panels from CIS technology and the location of the static structure with an inclination of 36 ° and orientation rotated by 1° west are obtained from the ideal system outputs:

- rated power 100kW photovoltaic power,
- estimated losses due to temperature and low irradiance: -0.3%,
- estimated losses due to reflection: 2.9%,
- Other losses (cables, inverter...): 14.0%,
- Combined PV system losses: 21.9%.

Fixed system: inclination=36°, orientation=-1°				
Month	E_d	E_m	H_d	H_m
Jan	117.00	3630	1.33	41.1
Feb	207.00	5780	2.37	66.3
Mar	347.00	10800	4.07	126
Apr	428.00	12800	5.14	154
May	459.00	14200	5.57	173
Jun	449.00	13500	5.46	164
Jul	436.00	13500	5.33	165
Aug	452.00	14000	5.50	170
Sep	357.00	10700	4.26	128
Oct	263.00	8140	3.06	94.7
Nov	157.00	4720	1.79	53.8
Dec	105.00	3270	1.19	37.0
Yearly average	**315**	**9590**	**3.76**	**114**
Total for year		**115000**		**1370**

These panels are more expensive than conventional silicon panels. Profit from them, however, to by about 7% more energy than silicon panels, and about 6% more energy than CIS panels. Allow the production of 115,000 kWh of electricity in the same conditions.

For the year, the system is capable of producing about 9,000 kWh of electricity more

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