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ADVANCEMENT OF KNOWLEDGE AND USE OF SOLAR ENERGY

BY

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Abstract. At the height of the Industrial Revolution, during times when the supply of fossil fuels (*i.e.* oil and coal) were seemingly endless, there were a few people who were concerned about the future of the nation once these non-renewable sources have finally been exhausted. Solar energy is one of the emerging renewable energy technologies still not competitive, but exhibiting both technical and economic potential to be so inside 10…15 years. There is basically no necessary "technology jumps" as prerequisites, but such a development will demand a favourable political climate.

Key words: solar energy; renewable energy; solar house; sustainability.

1. Introduction

Solar energy is the most important and reliable resource of all renewable energy sources currently exploited, could even say that is an inexhaustible source of energy.

The history of using solar energy is like a hero's poem: heroes are coming, they win the fight, they fall and other heroes took their place. Maybe this is the most tragic chapter in the history of science, scoring the largest

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amounts of abortion and losses. Throughout the history of civilization have been few energy crises, when almost every time the solution was solar one. Then always found cheaper sources of energy and solar energy has become "uneconomic" and lost interest in it. Next crisis raised other heroes who restart the fight based on the results of their forebears, continuing the development of solutions for the improvement of solar energy use throughout its history and describing a continuous growth curve.

Development of renewable energy as a clean energy resource is significant and one of the main objectives of the current global energy policies in the context of sustainable development, aimed at reducing energy consumption, increase energy supply security, environmental protection and development of viable energy technologies. One of the main goals of using renewable energies is to decrease emissions of greenhouse gases.

2. History of Solar Energy Utilization

2.1. Solar Architecture in Ancient Greece

According to Socrates, the ideal home should be cool in summer and warm in winter. But Socrates' ideal was not easy to accomplish 2,500 years ago in ancient Greece. The Greeks had no artificial means of cooling their homes during the scorching summers; nor were their heating systems, mostly portable charcoal-burning braziers, adequate to keep them warm in winter.

Modern excavations of many Classical Greek cities show that solar architecture flourished throughout the area. Individual homes were oriented toward the southern horizon, and entire cities were planned to allow their citizens equal access to the winter sun. A solar-oriented home allowed its inhabitants to depend less on charcoal - conserving fuel and saving money.

In Greek cities were built first community housing complex samples (today we call them *districts*), which have been designed into the architecture of energy awareness. Olynthos was a city on the northern Greek mainland, where winter temperatures often dropped below freezing. The city has built a neighborhood for 2,500 people on a platter. The streets were oriented North-South and East-West, all the houses they could use as much solar radiation, and housing units built closely side by side (in the quarter shall type) were all oriented to the South, largely with planimetric arrangement described above.

Priéné was a small town that was built on the coast of Minor Asia, South of Pergamon. In the city they built a neighborhood similar to that of Olynthos. Natural conditions were more suitable here, because the housing was limited to the North by a high rocky wall, which protect against cold winter winds.

2.2. Solar Architecture in Roman Empire

Romans, alike Greeks, widely used wood for heating purposes, but due to a more advanced architectural techniques (in a lot of wealthy homes there was central heating or under floor heating), they cleared forests at a rate even greater than Greeks. When forests virtually disappeared from the Appenin peninsula, was necessary the import of wood from Germany, the Caucasus, and other distant places. The solution to the problem occurred was marked by usage of solar energy in architecture, which has seen major growth in the 1st century BC.

The Romans not only took over the Greek solar architecture, but they developed it further. Because the empire was very large size, for different climatic areas were developed different architectural solutions. For example houses built in North Africa were partially oriented toward North and for colder climates in Europe they formed buildings after Greek example. Basic principles on the various regions were collected by Vitruvius in his famous treaty of architecture.

It was a very important step towards the Greeks, because Romans knew glass, and used mica to isolate windows. In this way it was used the greenhouse effect, to retain heat in buildings.

Fig. 1 – Public bath built on foundations of adjoining Roman, Bath, England.

Public baths (thermae, Fig. 1) have been in Rome the most popular community meeting places, which were built pretty much the 1st century BC in the capital, but also in other parts of the empire. They were centers of social life, bath and sport, in which could find a place thousands of people in certain cases. Large glass walls were used in these baths often to ensure a greater capacity to retain heat in the building.

2.3. Middle Ages and Renaissance

Results of Greek and Roman solar architecture were almost entirely forgotten in the Middle Ages and Renaissance. Solar energy has run largely on fantasy. Such a fantastic idea was to use mirrors and lenses for military outbreaks. Military engineers dreamed of mirrors and lenses, which can turn enemy fleet or destroy enemy cities. These fantasies were delivered from Archimedes legend, which in 212 BC would be on Roman ships, attacking Syracuse city, with outbreaks mirrors.

Fire box mirrors were already used in ancient times, primarily for cult purposes. The mirrors were also used to light the fire on the altars of sacrifice. Obviously, mentioned strategically expectations were unrealistic, but also took care of similar projects and scientists such as Roger Bacon and Leonardo da Vinci. Bacon proposed during 1200's, as Christian army, which went to the Holy Land, to light with fire box mirrors the Saracen (arab) attacking fleets. The idea was rejected by the church, because they saw it as impermissible using ray's sunlight due to the will of God, and Bacon was thrown in jail.

From the 1600's were built increasing size mirrors, spherical and parabolic; are not rare mirrors of 2…3 m diameter. They served first demonstration purposes. The problem was that the formation of an accurate mirror surface in one piece was difficult, because they were very heavy, and if the mirrors were made of thin plates, they were risking breakage and injuries. An important step in the late XVIIIth century was the innovation of Peter Hoesen, a master of Dresden, which formed a huge spherical mirror from segments. Angle mirror could change, and that was mounted on wheels, has become a mobile demonstration tool. Hoesen has held many successful demonstrations of his mirror, which was suitable for firing.

2.4. Solar Energy in Architecture

Forgotten energy conscious architecture of ancient era was reminded several times throughout the XIXth and XXth centuries, but these were only occasional cases, especially with demonstration or experimental purposes.

In England, famous for its dark neighborhoods, unhealthy, in 1860 near Liverpool, was built Port Sunlight, an exemplary neighborhood of solar energy conscious design. Similar neighborhoods have been designed in 1910 and in France and Germany. He became famous neighborhood "Siemensstadt" (built in 1929) near Berlin, Zeilenbau district, designed for a smaller community, and Neubühl in Switzerland, near Zürich.

In America, at the beginning of the century were built the first skyscrapers. Shading effects of tall buildings have raised these architectural

issues, ethical and legal. This problem was first held in Boston by architect William Atkinson. He managed to obtain from the Prefecture of Boston in 1904 an order to regulate building height. Atkinson continued theoretical and experimental activity on the orientation of buildings, using solar radiation and shading effects. He wrote design guides, he built demonstration apparatus and experimental greenhouses. In 1912 he published his book, "The Orientation of Buildings in Terms of Solar Energy Use", but it hasn't resonance, Atkinson's work has gone into oblivion and its results were used only after several decades.

European efforts and results were incentive on New World also. In the 1930's a new wave of solar energy use has start in the United States when new machines were built. The best-known builders were George Keck and Arthur Brown. Near Chicago was built and named Solar Park neighborhood, where designers have tried to orient buildings for maximum use of solar energy. The "Solar buildings" success determined some entrepreneurs to specialize in this field. At that time was built variants that were made entirely of prefabricated elements, and could be mounted in place, in a very short time.

Fig. 2 – Solar houses – Massachusetts Institute of Technology.

The largest solar energy program began in 1938 and breaks a few years, but it last until 1962. The main reason that gave rise to this program was

sustained by the fact that United States consumes a huge amount of heating energy, with power consumption greater than the industry. If this amount would have ensured at least partly from solar energy, this could have a huge economic entry.

During the program were built four different houses (Fig. 2) where their heating and hot water supply wanted to be solved with solar energy. Each experimental house has worked for several years, and in this time continuous measurements were made, in order to accumulate a rich experience. Program leader was Hoyt Hottel, professor of Chemical Engineering Department of the Massachusetts Institute of Technology (MIT).

Telkes Mária, an hungarian origin physicist which handles initially experiments in the metals industry, has worked from 1945 in solar energy use at MIT, then with the working group of solar homes, but independent from them.

She considered difficult solutions on heat storage tanks of large volumes of water with gravel. She knew, also, that the melting of crystalline materials stores a large amount of heat which is released at hardening (heat of phase change). Mária Telkes long sought after a cheap crystalline material with low melting point and high melting heat. In the latter considered that for its purpose the best is Glauber salt (sodium-sulphatedecahydrate – $Na_2SO_4 \cdot 10H_2O$), which has a melting temperature of 32°C.

Fig. 3 – Telkes Mária house – Dover, Boston.

Home heating (Fig. 3), as Telkes Mária thought, was provided entirely by solar radiation. Therefore the top of the southern facade was covered with upright collectors and the hot air here was conducted in salt storage boxes behind them. Glauber salt was melting because of the absorbed heat, then in the evening, when temperatures drop solidifies releasing latent heat and warming the house.

Through the top actual results can be mentioned the autonomous house (with energy self-sufficiency) in Freiburg, Germany (Fig. 4). It contains in addition to the passive elements (transparent insulation, windows filled with inert gas, special insulation for wall to the North and foundation) and active elements: 14 m^2 collector, solar panels on an area of 30 m^2, which put into place a water separation system. Some electric energy is stored in 48 batteries, while the other is used for separating water, the gained hydrogen being used for culinary purposes.

Fig. 4 – Autonomous house – Freiburg.

3. Conclusions

As oil prices spike, people are looking for alternative energy sources to save money. Solar energy can be defined rather simply as the conversion of sunlight into usable energy. Currently, solar energy is used to provide electric energy to homes, businesses, schools, universities and space vehicles used by NASA. As traditional energy prices rise, solar energy use is growing at a rate of 25% a year.

There are many more advantages than disadvantages of solar energy. The main disadvantages are the initial cost of the equipment used to harness the suns energy, the large area for the system to be efficient, pollution which affects efficiency of installations and the fact that solar energy is useful only when the sun is shining. There are many solar energy advantages; after the initial investment has been recovered, the energy from the sun is practically free. Solar energy is environmentally friendly, has a low maintenance and provides independence.

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PROGRESUL CUNOAŞTERII ŞI FOLOSIRII ENERGIEI SOLARE

(Rezumat)

În perioada revoluției industriale, atunci când exploatarea combustibililor fosili (petrol, cărbune etc.) părea aparent fără sfârşit, au existat câțiva oameni care au fost preocupați de viitorul omenirii, odată ce aceste surse de energie non-regenerabilă s-ar fi epuizat. Astfel, energia solară a devenit una dintre tehnologiile emergente de energie regenerabilă care, chiar dacă nu era competitivă, prezenta un potențial tehnic şi economic imens. Nu este necesar practic niciun „salt tehnologic" ca premisă a dezvoltării sale, dar acest lucru va necesita în viitor un climat politic favorabil.