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## SPACE-BASED SOLAR POWER

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According to the most optimistical forecasts, the oil and the natural gas will be completely exhausted by the middle years of our century<sup>[1]</sup>. And that's one of many reasons why many progressive countries today invest in projects in alternative kinds of energy. Examples are very simple to be found out. "Tokamak" in France(thermonuclear fusion)<sup>[2]</sup>, history about cold thermonuclear fusion of Martin Fleischman and Stanley Pons<sup>[3]</sup>, nuclear energy- just several examples of attempting of human to find some kind of energy that would have become replacement to traditional kinds of fossil fuel.

Space-based solar power- energy that might be gotten on the geostationary orbit with the help of satellites- receivers of solar light. The technologies of such kind of energy are supposed to be the technologies of alternative production of energy. But if we would use in right way mechanisms for getting and transformation energy, we might get energy comparable to energy from hydroelectric power stations. For example, today the most lighted places of the world would be able to produce about 35-36 percents of the energy that might be produced in space fields. That is the reason why the problem of getting solar energy is very actual in our modern world. Soon the

humans will have to find other types of energy. And space- based solar power will become an important part of future energy sources.

Purposes and tasks considered in the article- analysis of today's situation in the field of space- based power in the context of world power complex, learn about merits and demerits of this kind of energy for different consumers- on the surface of our planet and out of it. No fear that today the word "wireless" is supposed to be used towards describing high technologies. Without any doubts, if we were able to transport energy without cables, we might open an opportunity to get clean, natural and safe energy right from the space fields. Without mentioning that we could transport energy on the surface of our planet, saving millions tons of copper, aluminum, steel, that we use in producing of electrotechnical facilities. But yet it's still a big problem for us to send energy from one point to the second without using some other kinds of energy sources although we use radios to get radio waves without any cables. But the fact is that efficiency of this energy transport is insignificant.

And finally, we are coming to the two problems that might be solved with using of wireless energy transportation: abolition from very many facilities for energy transportation and abilities to get and transport energy from the places where it's impossible to have direct connections with the help of cables.

The problem of energy safe is especially acute today. As far as anyone can see, the main energy sources like oil, natural gas will be completely exhausted soon enough in accordance with today's massive using of it. Meanwhile, every day, every morning we are able to watch the most impressive, beautiful, incredible in its sizes thermonuclear reactor- the Sun. And it gives a lot of energy that might be used. And it's hard to escape the question- why not to get a solar power in near-planet fields, right above our heads? For example, to place the transformer of energy on the geostationary orbit(GSO). GSO is a circular orbit 35,786 kilometers (22,236 mi) above the Earth's equator and following the direction of the Earth's rotation.<sup>[4]</sup> Isaac Asimov, the science-fiction writer, published in 1941 a short story named "Reason" where he described the how space station transforms energy from the star and uses microwave beams to send it to the planets far away from the satellite-transformer. The large space station in the form of a globe is covered with photocells that convert solar power into electric current feeding huge generator of microwave beams that sends narrow beams to the receiving station on the Earth.

History of real development of SBSP(Space based solar power) began in 70s in the USA. Appearance of such project was connected with energy crisis. NASA and Boeing were set aside a budget in 20 million dollars for computation of profits of getting energy with help of Solar Power Satellite (SPS) and of its transportation to the Earth. Experts made a conclusion that such satellite could get power above 5000 MW, which after transportation to the surface of planet could be above 2000 MW. But the price of this project was 1 trillion of dollars. That was the reason why project was closed. During 70s-2000s there were different researches by the USA and Japan in this field. Eventually, today some companies try to bring in life concepts of space solar satellites.

Technologies in SBSP. Generally, systems of SBSP consist of:

1) Facilities for getting energy on geostationary orbit. Large Satellites that are able to gather solar energy with help of solar cell batteries. In common, these technologies of getting solar power are used today by many usual people in Europe in particular. The only problem is how to make satellite useful, what form it must have for high efficiency. The problem appears when we need create mechanism for transportation energy to the surface of planet. You are not able to connect satellite with the surface with help of cables. You need something what will be capable of transmitting energy without material medium.

2) Facilities for transportation energy with help of microwave beams, laser or wireless beams. Usual microwave may be supposed to be example of wireless energy. But on a space scale, satellite needs to transport energy to the Earth from GSO, above 35 786 kilometers. The technical problem that engineers have to decide is how to save energy that is wasted on the way to surface. Power beaming by microwaves has the difficulty that, for most space applications, the required aperture sizes are very large due to diffraction limiting antenna directionality. For example, the 1978 NASA Study of solar power satellites required a 1-km diameter transmitting antenna and a 10 km diameter rectifying antenna for a microwave beam at 2.45 GHz. Such large sizes may be decreased by using shorter wavelengths, but short wavelengths can have difficulties with absorption in atmosphere of beam. Because of the "thinned array curse," it is impossible to make a narrower beam by combining the beams of several smaller satellites.

For applications on the surface of planet, a large-area 10 km diameter rectifying antenna allows large total power levels to be used while operating at the low power density that cannot harm human by electromagnetic emanation.[6]

3) Facilities for receiving energy on the surface of planet. For example, rectifying antennas- special type of antennas for converting microwave beams into direct current electricity. The simplest element of rectifying antenna consist of a dipole antenna with an RF diode connected across the dipole elements. The diode rectifies the AC current induced in the antenna by the microwaves, to produce DC power, which powers a load connected across the diode. Schottky diodes are usually used because they have the lowest voltage drop and highest speed and therefore have the lowest power losses due to conduction and switching. Large rectennas consist of an array of many such dipole elements.

Advantages and disadvantages of using SBSP

It's not a secret that exploitation of different alternative sources of energy intends existence of some problems in creating technologies, in realizing in real life. The same thing is about SBSP. Correlation between different factors when people want to create new technologies defines profits of using some alternative sources of energy. So, what SBSP can offer to human as a source of solar energy?

- No emissions of gases that increase greenhouse effects

- No water pollution sources that have critical importance for health of humans and animals
- SBSP does not produce dangerous waste unlike nuclear stations
- SBSP technologies are supposed to be used 24 hours a day, 7 days a week and without depending upon weather
- SBSP does not require mining operations for getting energy sources unlike coal, gas and nuclear fuels

What disadvantages SBSP suppose to have? First of all, high technologies used in creating satellites, facilities for transmitting and for receiving energy will cost very much. Development of solar power depends on financing of this research field.

Examples of using space based solar power

Are there any examples of using SBSP? Does anyone try to bring to life ideas of Peter Glaizer? Unfortunately, nowadays we are able just to watch how some companies make researches in space solar energy field.

- Solaren Corporation, firm created by group of engineers, is going to deliver energy from space with help of several large satellites with system of mirrors. Energy that satellite is going to get on the orbit will be sent to the Earth by wireless beams which will be received by rectennas covering several square kilometers of ground. Power of such source of energy is planned to be above 1.200 mln- 4 mln kW of energy[7].

- JAXA(The Japan Aerospace Exploration Agency) is ready for conducting experiments in transmitting energy wireless way. Experts suppose JAXA will launch solar satellites in 2030's years, when technical problems will be solved.

Conclusion

Today's level of development of SBSP is pretty low towards usual sources of energy. In case we want to live in clean and green world in the near future, we have to pay our attention to alternative sources of energy like space based solar power because it is able to give people a lot of clean and safety energy from the biggest in our Solar System energy source- the Sun

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