Online Journal of Space Communication

Volume 9
Issue 16 *Solar Power Satellites (Winter 2010)*

Article 21

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Recommended Citation
Globus, Al () "Space Solar Power Via Prizes," *Online Journal of Space Communication*: Vol. 9 : Iss. 16 , Article 21.
Available at: https://ohioopen.library.ohio.edu/spacejournal/vol9/iss16/21

Space Solar Power Via Prizes

Al Globus

Abstract

A system of prizes is proposed to spur development of Space Solar Power (SSP) by the private sector. The prize is sized ($21 billion) to match the recently announced Japanese initiative to build a one gigawatt (1GW) power satellite. The prize is divided into 21 separate $1B prizes and only one of these will be awarded per satellite installation. This approach will spur development of at least 21 power satellites, or the prize money will be returned to the sponsor. Historically, prizes have been used to spur needed developments in the public interest costing several times more than the purse, so one might reasonably expect a $21 billion investment on the part of the U.S. federal government to elicit private commitments of perhaps $50-100 billion jump-starting a new energy industry.

Introduction

SSP will be very hard to develop. The engineering problems are staggering and the economic challenges even more difficult. While there is no market risk (the total energy market is measured in trillions of dollars), to be successful SSP must deliver energy at a price comparable to the alternatives - a few cents per kw-hr. A kw-hr is one kilowatt - one thousand watts - provided for one hour. This is enough energy to light ten 100 watt light bulbs for one hour.

Some have argued such a goal is impossible, as space is a difficult place to work and can never compete with earth bound alternatives (Fetter 2004). Others have argued that supplying the enormous global market for energy can give SSP the economies of scale necessary to drive prices down to competitive levels (Globus 2009) and that the problems Fetter cites are really just R&D challenges that can be met.

While a mature SSP economy supplying terawatts of power to earth may be economically competitive, how do we get there from here? The Japanese have one answer: a $21 billion program over 30 years to design and build a one gigawatt solar power satellite (Shigeru Sato, 2009). This seems roughly the necessary level of funding and time horizon for SSP development although a much more modest effort may be sufficient. In any case, if successful and unanswered, this project would put Japan in position to control the energy supplies of the future. Should no one else step up to SSP development and the project fails, then we (and the rest of the world) will not garner the benefits of large quantities of very clean, very reliable electricity that SSP promises.

Let us suppose that America decides that SSP is sufficiently promising to match the Japanese effort. We could, of course, undertake such a project using NASA in cooperation with America's aerospace industry, utility companies and interested others. However, this project also could spend the entire $21 billion and fail to meet its goal. Even if successful, in this scenario only a single satellite would be built with no mechanism to insure that power would be produced economically.

Fortunately, there is another way that might work better: prizes. The prize system I will describe will deliver at least one working powersat for each billion dollars spent. Should no one build a working powersat, then no public money will be spent. This plan is far less risky than a traditional $21 billion aerospace program and could deliver much greater benefits. Here's how it might work:

Solar Power Prizes

Congress places $21 billion dollars in escrow (either all at once or over time; say $1 billion a year for 21 years). The prize designates that there will be 21 levels, each valued at one billion dollars. The first level pays for $5/kw-hr delivered to the ground, the second level pays out $4/kw-hr delivered, and so on according to this table:

Level	$/kw-hr	Total mw/h purchased	Sat Size (MW)	Days to earn prize
1	$5.00	200,000	100	83
2	$4.00	250,000	100	104
3	$3.00	333,333	100	139
4	$2.00	500,000	100	208
5	$1.00	1,000,000	100	417
6	$.90	1,111,111	100	463
7	$.80	1,250,000	100	521
8	$.70	1,428,571	100	595
9	$.60	1,666,667	100	694
10	$.50	2,000,000	100	833
11	$.40	2,500,000	1000	104
12	$.30	3,333,333	1000	139
13	$.20	5,000,000	1000	208

14	$.10	10,000,000	1000	417
15	$.09	11,111,111	1000	463
16	$.08	12,500,000	1000	521
17	$.07	14,285,714	1000	595
18	$.06	16,666,667	1000	694
19	$.05	20,000,000	1000	833
20	$.04	25,000,000	1000	1042
21	$.03	33,333,333	1000	1389

The first column represents the level, which is also equal to the number of billions available. The second column is the amount paid for each kw-hr produced at that level. The third column indicates the number of kw-hrs that will be purchased if the whole level is claimed. The fourth and fifth column are linked. The fifth column is the minimum number of days necessary to earn all of the prize money with a satellite that can deliver the amount of energy indicated in the fourth column. This metric gives an idea of the time it will take to collect the whole $1 billion at each level. Note that the final level, three cents per kw-hr, is the price of the cheapest electricity produced in the U.S.

The decreasing price in end-user cost of electricity forces suppliers to develop better and better technology to continue receiving prize money. Of course, these levels and the total cost is somewhat arbitrary; other levels and totals might work just as well or better. A much cheaper program might indeed be just as effective. For example, a $10 billion program could be considered by simply eliminating levels 6, 8, 10, 12, and15-21. A smaller program of this type would create a minimum of 10 satellites, not 21. Ten satellites may be sufficient to get the industry off the ground.

Proposed rules for the contest could be as follows:

1. The prize money is allocated on a first-come first-served basis for power delivered to a local grid on the ground;
2. Any one power producing satellite may only receive money set aside at a designated level. This means that at least 21 satellites must be operational to win the entire pot, more if multiple satellites compete for the same level's funding.
3. No one company may receive funds for more than one satellite in two adjacent levels. Thus, if the first XYZ Corp satellite earns $5/kw-hr money from the first level's funds, the second XYZ Corp satellite may earn no more than $3/kw-hr from third level funds. This means at least two, and probably many more, companies could receive prize money.

Once a satellite has won all the prize money possible at a given level, the owners are free to sell power to whomever they please.

Interest earned by the money in escrow can be used to administer the program and fund pre-competitive research on SSP-related technologies at universities and laboratories.

Any funds not claimed within 30 years of the start of the program will be returned to the treasury. Thus, the nation either gets working SSP systems that deliver power to earth, or it gets its money back. A prize of this magnitude will very likely generate a large number of competitors. Most will fail, but that does not matter. When one or more have succeeded, the world will be on the way to tapping a clean, safe supply of electrical power that will last for billions of years.

The Challenge

The primary risk is that the prize is too small to stimulate SSP development, i.e., that $1billion at $5/kw-hr is insufficient to fund the first satellite, even when matched by private sector investment. However, it is encouraging to note that PG&E, a major power company in California, announced in 2009 a deal to purchase 200 megawatts of electricity for a 15-year period from Solaren Corp., an 8-year-old company based in Manhattan Beach, California (California, 2009). This level of power production is expected to be available beginning in 2016. While the exact price PG&E agreed to pay is unknown, it is certainly far less than $0.50/kw-hr, suggesting that $5kw-hr for the initial prize will be attractive to potential providers. In the above scenario, as successful contestants are free to sell power on the open market once they've received all the prize money to which they are entitled, they could simply sell subsequent power to PG&E or other utilities at the same price Solaren Corp. is receiving.

A $21 billion public investment, structured as prizes, would in all likelihood provide an incentive sufficient to jump-start our SSP industry. Having 21 satellites in operation should be more than sufficient to set the U.S. on a course to lead the world in energy production. Supplying our own energy from space could have four great consequences: 1) an inexhaustible supply of electrical power 2) much less dependence on imported fossil fuels, 3) a huge reduction in green-house gas and other atmospheric emissions and 4) increased investment in access to space transport and infrastructure enabling a wide variety of unreachable space capabilities, including settlement.

REFERENCES

1. Steve Fetter, "Space Solar Power: An Idea Whose Time Will Never Come?" 2009, http://www.publicpolicy.umd.edu/Fetter/2004-P&S-SSP.pdf.
2. Al Globus, "In Defense of Space Solar Power," 2009, http://space.alglobus.net/papers/FetterResponse.html.

3. Shigeru Sato and Yuji Okada, "Mitsubishi, IHO to join $21Billion space solar project," September 1, 2009, http://www.bloomberg.com/apps/news.
4. California Public Utilities Commission, "PUC takes another step towards state's renewable energy goal with approval of PG&E contract," December 3, 2009, http://docs.cpuc.ca.gov/PUBLISHED/NEWS_RELEASE/110678.htm.