How to build a Space Solar Power System

(Including a copy of the Sunsat Act)

Updated December 19, 2007

Abstract — Many energy "solutions" have been proposed - windmills, bio-fuels like ethanol, ground based solar, "clean" coal and even nuclear power. These merely nibble at the vast and growing energy & environmental problems we face. Space Solar Power offers the ultimate truly clean baseload energy to our planet. Technically, there is no question SSP can be built; the question is how to build it economically – as a private company would. (An engineer has been defined as someone who can build for a dime what any fool can build for a dollar.) Learning how to build SSP cost-effectively is why we should build a demonstrator satellite immediately. The established energy and aerospace corporations are incapable of pursuing the high risk development necessary to build such a Space Solar Power System. Government agencies, like NASA or DOE, are not the right tool to build SSP. It must be a commercial power generation company.

The best means to pursue the immense promise which SSP holds is the formation of a congressionally chartered public/private corporation – a co-operation between government and private enterprise. This is a well-understood path, used often in the past when America faced seemingly insurmountable problems. In 1862 the Transcontinental Railroad Act, which spanned North America with rail and telegraph, was enacted by Congress. The extremely successful COMmunications SATellite (Comsat) Act chartered in 1962, was also such a public/private corporation. Just as COMSAT opened space for communication satellites, so a Sun Satellite (SunSat) Corporation Act can open space to power satellites. While Comsat was chartered to build commercial communications, SunSat would be chartered to build commercial power satellites to collect and transmit energy to electric power grids for contracting wholesale (utility) customers on earth. Forty some years after Comsat's charter, the space communications industry has revenue in excess of $100 Billion, which we now enjoy. Congress should, therefore, charter Sunsat Corp., with the single purpose of building and develop SSP. Like competing, and inadequate, terrestrial energy solutions, Sunsat Corp. would be given developmental subsidies, such as discounted space transportation access. A Lunar Development Authority and many opportunities would also be helpful, as conceivably commercial products from the Moon could be sold to Sunsat Corp. Sunsat Corp. should have no financial entanglements with lunar development, or other ventures outside their business of providing clean baseload energy to her customers. Let's take the brakes off space development!!

Review of the problem

We have just reviewed a “laundry list” of known and rapidly approaching energy and environmental stresses have made clean baseload energy alternatives vitally important. Virtually nothing is being done on the scale and time frame that must be addressed, according to the DOE’s own Hirsch report.

A careful study of escalating global CO_2 levels, the impact on our food chain, from plankton to fish and from plants to the animals we depend on as conflict between food and fuel grows is increasingly disturbing.[1] SSP[2] is the right solution to these thorny problems. The new 2007 U.S. Energy bill mandates "a sixfold increase in ethanol use to 36 billion gallons a year by 2022", although global food stocks are at historic lows and food prices are soaring to historic levels[3] (article below).

Corn used for ethanol production in the US passed the amount of corn used for export in 2007. World wheat stores declined 11 percent this year, to the lowest level since 1980, while prices of wheat and oilseeds are at record highs. U.S. wheat futures broke $10 a bushel for the first time December 17, the agricultural equivalent of $100 a barrel oil. The US has been the leading provider (exporter) of corn to the world. The total cost of foodstuffs imported by the neediest countries rose 25 percent, to $107 million, in the last year. And Congress has guaranteed that the world is going to be getting much hungrier.

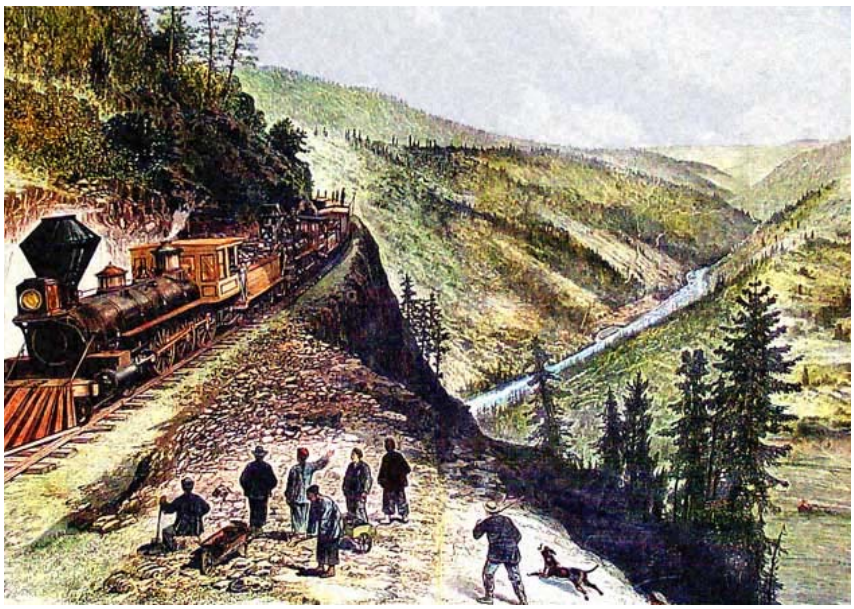
So how do we provide such wonderful energy?

Introduction to the solution

There is no question SSP can be built; the question is how to build it economically – as a private company would. An engineer has been defined as someone who can build for a dime what any fool can build for a dollar. That is the task we face. When America has faced such seemingly insurmountable problems as SSP before, often a public/private corporation has been chartered – a co-operation between government and individuals.

In1862 the Transcontinental Railroad[4] act, which spanned North America with rail, was enacted by Congress after years of debate. The Union Pacific Railroad Company was chartered "to aid in the construction of a railroad and telegraph line from the Missouri River to the Pacific Ocean". Let's take a look at a page from that era showing the grants and subsidies specifically created for those railroads during that colorful history:

> *The President of the United States received sealed bids on two points: First, within how short a time will the contractors complete the railroad? Second, at what rate per annum will the contractors carry the mails and Government freights for a period of twenty years from the date of the completion of the road?*
>
> *The government organized and executed surveys from the Mississippi River westward to the Pacific Ocean, to ascertain the most practicable route. The chief engineer, in his 1869 report to the president said: "In 1863 and 1864 surveys were inaugurated, but in 1866 the country was systematically occupied, and day and night, summer and winter, the explorations were pushed forward through dangers and hardships that very few at this date appreciate. As every mile had to be run within the range of the musket, there was not a moment's security.*



The Excursion Train Rounding Cape Horn At The Head Of The Great American Canon, With A View Of The South Fork Of The American River, Where Gold Was First Discovered In 1848. … Figure 1

- *Frank Leslie's Illustrated Newspaper*, April 27, 1878

"Right of way was granted through public lands to the extent of 200 feet in width on each side of the track, and a grant of land in the amount of ten alternate section[1]s per mile on each side of the road within the limits of 20 miles on each side of the road, not previously sold or reserved, at the time ...

"Upon the completion of each 20 consecutive miles of railroad,… title to the granted sections were to be issued.

"It also provided for at subsidy in bonds of $16,000 per mile between the Missouri River and the base of the Rocky Mountains; $48,000 per mile for the distance of 150 miles through the mountain range;

"These bonds were payable thirty years after date, bearing 6 per cent interest, and were in the nature of a loan of credit by the United States, and were made a second-mortgage lien on the railroad, telegraph and all appurtenances, subordinate to bonds which the companies could issue.

"In making the surveys numbers of our men, some of the ablest and most promising, were killed, and during the construction our stock (horses and cattle) were run off by the hundreds - I might add by the thousands. The lack of confidence in the project,

1 1 Section = 640 acres = 1 mile long, by 1 mile wide ; 1 Acre = 0.4047 hectare

even in the localities to be the most benefited, was so great that laborers demanded their pay in advance before they would perform a day's work.

So the process to create such a congressionally chartered corporation, the SunSat Act,[5] is well understood. This was the same legislative tool used to create Comsat in 1962, one hundred years after the Transcontinental Railroad. The horse thieves, bushwhackers, vast distances and Rocky Mountains our Sunsat corporation must budget to overcome may be a little different, but they introduce the same challenges. An SSP system is no less a challenge than Comsat or the Transcontinental Railroad were in their day and would also seem to dictate a public/private corporation to reduce those risks via compensating appropriate rewards.

Michael Schwaal, an energy economist with Arlington, VA-based Energy Ventures, pointed out that "there is not much enthusiasm in the U.S. government for space based solar power", going on to point that NASA is not the best agency to take up the cause.[6] The energy investment community and the SSPW would agree – NASA, DOE and JAXA are not chartered for commercial manufacturing or operation. The proper path to build SSP, is a congressionally chartered corporation; we call it SunSat Corporation.

The struggle for redirecting space transportation funding priorities toward the private sector is central to the larger struggle of building SSP. SSP is the crucially important piece necessary to solving our crushing energy and environmental problems. It would be a massive benefit to all, beginning with and especially for aerospace and energy businesses. There will be surely be job retraining required, but we all expect to retrain at least every five or ten years. As we change jobs and titles and programs this learning is part of the joy of life – like learning to ride a bicycle or trying Mexican cuisine.

The purpose in this paper is to explore SunSat Corp's forest as we look at the trees ahead of us. We want to <u>understand</u> the new and complex business process which we must cultivate and drive. The chapters we are writing on the keys to SSP – Space Transportation, WPT, Photovoltaics (PV), etc., must be simple to understand. As teachers, we know it requires deep understanding to be able to explain a complex subject in simple terms. Let's look at

some of the key points of the draft legislation chartering SunSat corporation and initiating SSP construction.

Draft

SunSat Corporation charter[2]

Draft

Sec. 1 Subchapter I - General Provisions

(a) Policy

The Congress declares that it is the policy of the United States to establish, in conjunction and in cooperation with other countries, as expeditiously as practicable a commercial space solar power satellite system, as part of environmentally enhanced and improved global electric power generation and networks, which will be responsive to public needs and national objectives, which will serve the growing electric power needs of the United States and other countries, and which will contribute to world peace, understanding, harmony and increased sustainable electric power generation and economic development.

(b) Availability of electric power services

These expanded electric power services are to be made available as promptly as possible and are to be extended to provide electric power services to additional power grids at the earliest practicable date. In effectuating this program, care and attention will be directed toward providing such services to both economically less developed countries and areas and those more highly developed; toward efficient, prudent and economical use of the

[2]Thanks to **www.permanent.com/archimedes/LawLibrary.html** for COMSAT Act link

electromagnetic frequency spectrum, and toward the reflection of the benefits of this new technology in quality, reliability, and charges for such services.

(c) Private enterprise; access; competition

To facilitate the widest possible participation by private enterprise, United States participation in the global system shall be in the form of a private corporation, subject to appropriate governmental regulation. It is the intent of Congress that all authorized electric power companies shall have nondiscriminatory access to the system; that maximum competition be maintained in the provision of equipment and services utilized by the system; that the private corporation created under this chapter be so organized and operated as to maintain and strengthen competition in the provision of baseload or throttled electric power services to national, international, public and private power grids; and that the activities of the corporation created under this chapter and of the persons or companies participating in the ownership of the corporation shall be consistent with the Federal antitrust and other trade laws.

(d) Domestic use; additional systems

It is not the intent of Congress by this chapter to preclude the use of power satellite systems for domestic or international energy companies or electric power companies where consistent with the provisions of this chapter nor to preclude the creation of additional or competing power satellite systems, if required to meet unique needs or if otherwise required in the national interest.

(e) Low-cost commercial reusable space transportation systems

It is the intent of Congress by this chapter to provide further directed support to the establishment of this power satellite corporation such that low cost commercial reusable space transportation systems are made available in concert with the need for high volumes of freight which are essential to and characteristic of the advent of full scale construction of power satellite systems. This support may take the form of launch subsidies, transportation systems developmental assistance, tax relief, insurance, and developmental bond relief, separately or in combination.

(f) Demonstration Power Satellites

It is the intent of Congress by this chapter to direct and support the design, development, construction and operation of a demonstration power satellite as rapidly as possible. The overall management of this work will be assumed by the power satellite corporation to be formed by this Act. This support may take the form of launch subsidies, transportation systems developmental assistance, tax relief, insurance, and developmental bond relief, separately or in combination. The principle purpose of this first power satellite is to improve the understanding and practice of engineering and technology essential to building efficient and reliable power satellites and related systems, including rectennas (receiving antennas). Ownership and operation of two such completed demonstration power satellites shall be with the power satellite corporation, although the rectenna shall be owned by the client electric power company receiving the power satellite feed. The debt incurred by the power satellite corporation for the development, design, and construction of two demonstration power satellites shall be ten percentum of the total construction cost of the power satellites.

This debenture shall be repaid to the Congress over thirty years at a rate of 3% interest. A developmental launch cost subsidy shall be provided for ten years in the amount of one half of that portion of launch costs including insurance which exceeds $200./lb to Low Earth Orbit (LEO).

(g) Business Focus

The power satellite corporation shall not be engaged in the development, construction, or marketing of space transportation systems or photovoltaic (PV) conversion cells or systems, except as directly required in support of corporations engaged in those businesses providing for the power satellite corporation's needs. Space transportation and PV systems shall be purchased on the open market.

(h) Reporting

The power satellite corporation shall provide full reports on its work to Congress as well as advisories concerning related topics of interest to Congress at six month intervals. The cost of preparing these reports shall be considered part of the developmental design and construction costs of the demonstration power satellites.

Sec. 2. Definitions

As used in this chapter, and unless the context otherwise requires -

(1) the term “power satellite system" refers to a system of satellites in Geo-Synchronous Orbit(GSO) or other useful orbit, whose purpose is to collect energy from the Sun and convert it to a wireless power transfer medium for the purpose of safely transferring that energy to rectennas on earth, together with such associated equipment and facilities for tracking, guidance, control, and command functions as are not part of the generalized launching, tracking, control, and command facilities for all space purposes;

(2) the term "rectenna" refers to an array of interconnected receiving antennas located on the earth's surface, operationally connected with one or more terrestrial electric power transmission and distribution systems, with necessary associated operational equipment.

(3) the term “power satellite" means an earth satellite which is intentionally used for the purpose of collecting energy from the Sun and converting it to a wireless power transfer medium for the purpose of safely transferring that energy to a rectenna on earth;

(4) the term "associated equipment and facilities" refers to facilities other than satellite terminal stations and power satellites, to be constructed and operated for the primary purpose of a power satellite system, whether for administration and management, for research and development, or for direct support of space operations;

(5) the term “research and development” refers to the conception, design, and first creation of experimental or prototype operational devices for the operation of a power satellite system, including the assembly of separate components into a working whole, as distinguished from the term “production”, which relates to the construction of such devices to fixed specifications compatible with repetitive duplication for operational applications; and

(6) the term “wireless power transfer" means any transmission, emission or reception of electromagnetic energy by radio, optical, or other electromagnetic systems for the purpose of providing electrical energy to an electric power company.

(7) the term "electric power company" refers to any corporation governed by the Federal Energy Regulatory Commission under the Energy Act of 1964, as amended, or comparable Acts in other countries who are engaged in the reception, transmission, marketing and/or distribution of electrical power to its customers;

(8) the term "corporation" means the corporation authorized by subchapter III of this chapter.

(9) the term "Administration" means the National Aeronautics and Space Administration; and

…..(10) the term “energy company” includes any corporations engaged in the development, production, marketing, or sale of coal, oil, gas, or nuclear materials from natural resources; or electric power generation from these sources.

Subchapter II - Federal Coordination, Planning, and Regulation

Sec. 721. Implementation of policy

In order to achieve the objectives and to carry out the purposes of this chapter -

(a) Executive functions; execution of national program; review; agency coordination; supervision of foreign relationships; foreign participation; use for general governmental purposes; separate systems; compatibility with domestic and foreign facilities the President shall -

(1) aid in the planning and development and foster the execution of a national program for the establishment and operation of global and lunar commercial power satellite systems;

(2) provide for continuous review of all phases of the development and operation of such systems, including the activities of a power satellite corporation authorized under subchapter III of this chapter;

(3) coordinate the activities of governmental agencies with responsibilities in the field of electric power generation and transmission, so as to insure that there is full and effective compliance at all times with the policies set forth in this chapter;

(4) exercise such supervision over relationships of the corporation with foreign governments or entities or with international bodies as may be appropriate to assure that such relationships shall be consistent with the national interest and foreign policy of the United States;

(5) insure that timely arrangements are made under which there can be foreign participation in the establishment and use of power satellite systems;

(6) create a Power Satellite Commission to provide necessary governmental coordination, as required in the national interest; It shall meet quarterly or as often as required; it shall be composed of these members to be named by:

(a) the power satellite corporation

(b) Federal Energy Regulatory Commission

(c) Federal Communications Commission

(d) Department of State

(e) Department of Commerce

(f) Department of Energy

(g) The Congress

(h) Space Transportation Association

(i) The Chairman of the Power Satellite Commission shall be named by the power satellite corporation.

(7) so exercise his authority as to help attain coordinated and efficient use of the electromagnetic spectrum and the technical compatibility of the system with existing electric power companies both in the United States and abroad.

(b) Administration functions; technical advice to Commission; cooperation in research and development and technical consultation with corporation; assistance and launching,

associated services and other services to corporation on reimbursable basis the National Aeronautics and Space Administration shall -

(1) advise the Commission on technical characteristics of the power satellite system;

(2) cooperate with the corporation in research and development to the extent deemed appropriate by the Commission in the public interest;

(3) assist the corporation in the conduct of its research and development program by furnishing to the corporation, when requested, on a reimbursable basis, such services as the Administration deems necessary for the most expeditious and economical development of the power satellite system;

(4) consult with the corporation regarding technical characteristics of the power satellite system;

(5) furnish to the corporation, on request and on a reimbursable basis, associated services required for the establishment, operation, and maintenance of the power satellite system approved by the Commission;

(c) Commission functions; competitive bidding; consultation with Small Business Administration; discrimination; just and reasonable charges, classifications, practices, regulations and other terms and conditions; allocation of facilities; establishment of power to particular foreign point; technical compatibility of system and stations; accounting; rates; technical approval; construction and operation authorizations; financing of corporation; additions; rules and regulations of the Federal Energy Regulatory Commission, in its administration of the provisions of the Public Utility Regulatory Policy Act of 1978, as

amended (http://www.ferc.fed.us/intro/acts/purpa.htm), and as supplemented by this chapter, shall -

(1) insure effective competition, including the use of competitive bidding where appropriate, in the procurement by the corporation and associated entitites of apparatus, equipment, and services required for the establishment and operation of the power satellite system and satellite terminal stations; and the Commission shall consult with the Small Business Administration and solicit its recommendations on measures and procedures which will insure that small business concerns are given an equitable opportunity to share in the procurement program of the corporation for property and services, including but not limited to research, development, construction, maintenance, and repair.

(2) insure that all present and future authorized electric power transmission, distribution and generation corporations shall have nondiscriminatory use of, and equitable access to, the power satellite system and rectenna stations under just and reasonable charges, classifications, practices, regulations, and other terms and conditions and regulate the manner in which available facilities of the system and stations are allocated among such users thereof;

(3) in any case where a member of the Commission, Secretary of Defense, or other authorized agency or government entity after obtaining the advice of the Administration as to technical feasibility, has advised that communication of power to a particular foreign point by means of the power satellite system and rectennas should be established in the national interest, institute forthwith appropriate proceedings as necessary;

(4) insure that facilities of the power satellite system and rectennas are technically compatible and interconnected operationally with each other and with existing power transmission facilities;

(5) prescribe such accounting regulations and systems and engage in such ratemaking procedures as will insure that any economies made possible by a power satellite system are appropriately reflected in rates for public electric power services;

(6) approve technical characteristics of the operational power satellite system to be employed by the corporation and of the associated rectenns; and

(7) grant appropriate authorizations and guidelines for the construction and operation of each satellite rectenna station, either to the corporation or to one or more authorized construction corporations as will best serve the public interest, convenience, and necessity. In determining the public interest, convenience, and necessity the Commission shall authorize the construction and operation of such rectennas by client electric power companies or their agents, without preference;

(8) authorize the corporation to issue any shares of capital stock, except the initial issue of capital stock referred to in section 734(a) of this title, or to borrow any moneys, or to assume any obligation in respect of the securities of any other person, upon a finding that such issuance, borrowing, or assumption is compatible with the public interest, convenience, and necessity and is necessary or appropriate for or consistent with carrying out the purposes and objectives of this chapter by the corporation;

(9) insure that no substantial additions are made by the corporation or other contracting agents with respect to facilities of the power satellite system or rectennas unless such additions are required by the public interest, convenience, and necessity;

(10) require, in accordance with the Public Utility Regulatory Policy Act of 1978, as amended , that additions be made by the corporation or agents with respect to facilities of the power satellite system or rectennas where such additions would serve the public interest, convenience, and necessity; and

(11) make rules and regulations to carry out the provisions of this chapter.

Subchapter III - Power Satellite Corporation

Sec. 731. Creation of corporation

There is authorized to be created a power satellite corporation for profit which will not be an agency or establishment of the United States Government.

Sec. 732. Applicable laws

The corporation shall be subject to the provisions of this chapter and, to the extent consistent with this chapter, to the District of Columbia Business Corporation Act (D.C. Code, Sec. 29-301 et seq.). The right to repeal, alter, or amend this chapter at any time is expressly reserved.

Sec. 733. Directors and officers

(a) Board of directors; qualifications; chairman; appointment by President; term; election by stockholders; percentage of stock ownership determining right to elect; cumulative voting; amendment of articles of incorporation; bylaws for national emergencies

The corporation shall have a board of directors consisting of fifteen individuals who are citizens of the United States, of whom one shall be elected annually by the board to serve as chairman. Three members of the board shall be appointed by the President of the United States, by and with the advice and consent of the Senate, effective the date on which the other members are elected, and serve for terms of one, two, and three years, respectively, or until their successors have been appointed and qualified, and any member so appointed to fill a vacancy shall be appointed only for the unexpired term of the director whom he succeeds. The remaining twelve members of the board shall be elected annually by the stockholders. Six of such members shall be elected by those stockholders who are not aerospace, electric power, or energy companies, and the remaining six such members shall be elected by the stockholders who are aerospace, electric power, or energy companies, except that if the number of shares of the voting capital stock of the corporation issued and outstanding and owned either directly or indirectly by aerospace, electric power, or energy companies, as of the record date for the annual meeting of stockholders is less than 45 per centum of the total number of shares of the voting capital stock of the corporation issued and outstanding, the number of members to be elected at such meeting by each group of stockholders shall be determined in accordance with the following table:

When the number of shares of the voting capital stock of the power satellite corporation issued and outstanding and owned either directly or indirectly by aerospace, electric power company, or energy company is less than -	But not less than	The number of members which stockholders who are aerospace, electric power company, or energy company are entitled to elect shall be:	And the number of members which other stockholders are entitled to elect shall be
20 per centum	14 per centum	2	10
14 per centum	8 per centum	1	11
8 per centum		0	12

No stockholder who is an aerospace, electric power, or energy companies, and no trustee for such a stockholder shall vote, either directly or indirectly, through the votes of subsidiaries or affiliated companies, nominees, or any persons subject to his direction or control, for more than three candidates for membership on the board, except that in the event the number of shares of the voting capital stock of the corporation issued and outstanding and owned either directly or indirectly by aerospace, electric power, or energy companies, as of the record date for the annual meeting is less than 8 per centum of the total number of shares of the voting capital stock of the corporation issued and outstanding, any stockholder who is a aerospace, electric power, or energy company shall be entitled to vote at such meeting for candidates for membership on the board in the same manner as all other

stockholders. Subject to the foregoing limitations, the articles of incorporation of the corporation shall provide for cumulative voting under section 27(d) of the District of Columbia Business Corporation Act (D.C. Code, sec. 29-27(d)). The articles of incorporation of the corporation may be amended, altered, changed, or repealed by a vote of not less than 66 2/3 per centum of the outstanding shares of the voting capital stock of the corporation owned by stockholders who are aerospace, electric power, or energy company and by stockholders who are not aerospace, electric power, or energy company, voting together, if such vote complies with all other requirements of this chapter and of the articles of incorporation of the corporation with respect to the amendment, alteration, change, or repeal of such articles. The corporation may adopt such bylaws as shall, notwithstanding the provisions of section 36 of the District of Columbia Business Corporation Act (D.C. Code, section 29-336(d)), provide for the continued ability of the board to transact business under such circumstances of national emergency as the President of the United States, or the officer designated by him, may determine, after February 18, 2010, would not permit a prompt meeting of a majority of the board to transact business.

(b) President of corporation; designation and appointment of other officers; compensation; United States citizenship of officers; dual salary prohibition

The corporation shall have a president, and such other officers as may be named and appointed by the board, at rates of compensation fixed by the board, and serving at the pleasure of the board. No individual other than a citizen of the United States may be an officer of the corporation. No officer of the corporation shall receive any salary from any source other than the corporation during the period of his employment by the corporation.

Sec. 734. Financing of corporation

(a) Capital stock; amount of issue; no par value shares; voting rights; dividends; price and public distribution of initial offering; shareholder eligibility

The corporation is authorized to issue and have outstanding, in such amounts as it shall determine, shares of capital stock, without par value, which shall carry voting rights and be eligible for dividends. The shares of such stock initially offered shall be sold in a manner to encourage the widest distribution to the American public. Subject to the provisions of subsections (b) and (d) of this section, shares of stock offered under this subsection may be issued to and held by any person.

(b) "Authorized carrier" defined; shareholder eligibility; voting rights limitation of authorized carriers and other stockholders

(1) For the purposes of this section the term "authorized carrier" shall mean an aerospace, electric power company, or energy company which is specifically authorized or which is a member of a class of carriers authorized by the Commission to own shares of stock in the corporation upon a finding that such ownership will be consistent with the public interest, convenience, and necessity.

(2) Only those aerospace, electric power, or energy companies which are authorized carriers shall own shares of stock in the corporation at any time, and no other aerospace, electric power, or energy companies shall own shares either directly or indirectly through

subsidiaries or affiliated companies, nominees, or any persons subject to its direction or control. At no time after the initial issue is completed shall the aggregate of the shares of voting stock of the corporation owned by authorized carriers directly or indirectly through subsidiaries or affiliated companies, nominees, or any persons subject to their direction or control exceed 25 per centum of such shares issued and outstanding.

(3) At no time shall any stockholder who is not an authorized carrier, or any syndicate or affiliated group of such stockholders, own more than 10 per centum of the shares of voting stock of the corporation issued and outstanding.

(c) Nonvoting security issues and certificates of indebtedness; rate base

The corporation is authorized to issue, in addition to the stock authorized by subsection (a) of this section, nonvoting securities, bonds, debentures, and other certificates of indebtedness as it may determine. Such nonvoting securities, bonds, debentures, or other certificates of indebtedness of the corporation shall be eligible for inclusion in the rate base of the corporation to the extent allowed by the Commission. The voting stock of the corporation shall not be eligible for inclusion in the rate base of the carrier.

(d) Alien share ownership limitation

Not more than an aggregate of 15 per centum of the shares of stock of the corporation authorized by subsection (a) of this section which are held by holders other than authorized carriers may be held by persons of the classes described in subsection (a) and paragraphs (1) through (4) of subsection (b) of section 310 of this title.

(e) Inspection and copying rights

The requirement of section 45(b) of the District of Columbia Business Corporation Act (D.C. Code, sec. 29-345(b)) as to the percentage of stock which a stockholder must hold in order to have the rights of inspection and copying set forth in that subsection shall not be applicable in the case of holders of the stock of the corporation, and they may exercise such rights without regard to the percentage of stock they hold.

(f) Transfer and distribution of shares among authorized carriers

Upon application to the Commission by any authorized carrier and after notice and hearing, the Commission may compel any other authorized carrier which owns shares of stock in the corporation to transfer to the applicant, for a fair and reasonable consideration, a number of such shares as the Commission determines will advance the public interest and the purposes of this chapter. In its determination with respect to ownership of shares of stock in the corporation, the Commission, whenever consistent with the public interest, shall promote the widest possible distribution of stock among the authorized carriers.

Sec. 735. Powers of corporation

(a) Authorized powers

In order to achieve the objectives and to carry out the purposes of this chapter, the corporation is authorized to -

(1) plan, initiate, construct, own, manage, and operate itself or in conjunction with foreign governments or business entities a commercial power satellite system;

(2) furnish, for hire, channels of communication to United States electric power companies and to other authorized electric power companies and entities, foreign and domestic; and

(3) own and operate satellite terminal stations when licensed by the Commission under section 721(c)(7) of this title.

(b) Specific corporate activities

Included in the activities authorized to the corporation for accomplishment of the purposes indicated in subsection (a) of this section, are, among others not specifically named -

(1) to conduct or contract for research and development related to its mission;

(2) to acquire the physical facilities, equipment and devices necessary to its operations, including power satellites and associated equipment and facilities, whether by construction, purchase, or gift;

(3) to purchase satellite launching and related services from commercial providers;

(4) to contract with authorized users, foreign or domestic, including the United States Government, for the services of the power satellite system; and

(5) to develop plans for the technical specifications of all elements of the power satellite system.

(c) Specifically excluded corporate activities

The power satellite corporation shall not engage in the manufacture, marketing, or sales of space launch vehicles, photovoltaic conversion devices, wiring or cables, or any major electrical or mechanical systems and/or components not related to and/or part of the power satellites. The power satellite corporation is to contract for these services and components as necessary.

(d) Usual powers of stock corporation

To carry out the foregoing purposes, the corporation shall have the usual powers conferred upon a stock corporation by the District of Columbia Business Corporation Act (D.C. Code, Sec. 29-301 et seq.).

Sec. 736. Foreign business negotiations of corporation; notice to Commission

Whenever the corporation shall enter into business negotiations with respect to facilities, operations, or services authorized by this chapter with any international or foreign entity, it shall notify the members of the Power Satellite Commission of the negotiations, and they shall advise the corporation of relevant foreign policy and regulatory considerations. Throughout such negotiations the corporation shall keep the Power Satellite Commission informed with respect to such considerations. The corporation may request Power Satellite Commission members to assist in the negotiations, and they shall render such assistance as may be appropriate.

Sec. 737. Sanctions

(a) Petition of Attorney General for equitable relief; venue

If the corporation created pursuant to this chapter shall engage in or adhere to any action, practices, or policies inconsistent with the policy and purposes declared in section 701 of this title, or if the corporation or any other person shall violate any provision of this chapter, or shall obstruct or interfere with any activities authorized by this chapter, or shall refuse, fail, or neglect to discharge his duties and responsibilities under this chapter, or shall threaten any such violation, obstruction, interference, refusal, failure, or neglect, the district court of the United States for any district in which such corporation or other person resides or may be found shall have jurisdiction, except as otherwise prohibited by law, upon petition of the Attorney General of the United States, to grant such equitable relief as may be necessary or appropriate to prevent or terminate such conduct or threat.

(b) Punishment, liability or sanction under other provisions

Nothing contained in this section shall be construed as relieving any person of any punishment, liability, or sanction which may be imposed otherwise than under this chapter.

(c) Duty of compliance with provisions of chapter and rules and regulations

It shall be the duty of the corporation and all aerospace, electric power companies, or energy companies to comply, insofar as applicable, with all provisions of this chapter and all rules and regulations promulgated thereunder.

Sec. 738. Reports to Congress

The corporation shall transmit to the President and the Congress, annually and at such other times as it deems desirable, a comprehensive and detailed report of its operations, activities, and accomplishments under this chapter.

Subchapter V - International Solar Power Rectenna Owners Organization

Sec. 751. Congressional declaration of policy and purpose

(a) Development and operation of rectennas and their associated electrical grid interconnection machinery, regulatory and environmental needs to serve power satellite downlink needs of the United States and member foreign countries

The Congress hereby declares that it is the policy of the United States to provide for the participation of the United States in the International Solar Power spAce ReCtenna Owners Organization (hereinafter in this subchapter referred to as "SPARCO") in order to develop and operate power satellite rectennas. SPARCO shall promote power frequency allocations

consistent with sound environmental regard for both the successful transmission of clean solar power and the environment through which this transmission takes place

(b) Corporate participation; private entity status; non-Government agency

It is the purpose of this subchapter to provide that the participation of the United States in SPARCO shall be through the power satellite corporation established pursuant to subchapter III of this chapter, which constitutes a private entity operating for profit, and which is not an agency or establishment of the Federal Government. Additional participation by aerospace, electric power, or energy companies is encouraged.

Sec. 752. Corporation's status as designated operating entity

(a) Statement of purpose; signature authorization

(1) the power satellite corporation established pursuant to subchapter III of this chapter is hereby designated as the initial organizing entity of the United States for participation in SPARCO , for the purpose of facilitating and encouraging improved understanding of power satellite downlink construction, operational, environmental and regulatory issues and services.

(2) The corporation may participate in and is hereby authorized to sign the operating agreement or other pertinent instruments of SPARCO as the initial designated operating entity of the United States.

(b) Powers of corporation

The corporation -

(1) shall advise, consult and facilitate as required in the design, construction and operation of satellite earth rectennas downlink stations and associated electrical power grid interconnections to local, national or other electric power grids public or private with the owners and operators of those electric power grids;

(2) shall interconnect such stations with the supplying power satellite to provide system integrity and assure continuous power flow, except as may be required for biannual or other maintenance, and as authorized by the Commission;

(3) shall provide for the common operational and system security of such rectennas and the power satellite transmitting to their rectenna partner, and with power relay equipment servicing other electric power grids, as requested, unless SPARCO or the Commission finds that such interconnection will not serve the interests of the electric power grid;

(c) Financial obligation

The corporation shall be responsible for fulfilling any financial obligation placed upon the corporation as a signatory to the operating agreement or other pertinent instruments, and any other financial obligation which may be placed upon the corporation as the result of a convention or other instrument establishing SPARCO. The corporation shall be the United States' organizing representative in the managing body of SPARCO.

(d) Ownership or/and operation of power satellite and rectennas for training of personnel pursuant to authorization of responsible executive department or Commission:

(1) Any person, including the Federal Government or any agency thereof, may be authorized, in accordance with paragraph (2) or paragraph (3), to be the sole owner or

operator, or both, of any power satellite or rectenna if such satellite or rectennas is used for the exclusive purposes of training personnel in the use of equipment associated with the operation and maintenance of such satellite or rectennas, or in carrying out experimentation relating to various power satellite services.

(2) If the person referred to in paragraph (1) is the Federal Government or any agency thereof, such power satellite or rectenna shall have been authorized to operate by the executive department charged with such responsibility.

(3) In any other case, such power satellite or rectenna shall have been authorized by the Commission.

(e) Additional noncorporation ownership of power satellite or rectenna for enhancement of power satellite services in the public interest

The Commission may authorize ownership of power satellites or rectennas by persons other than the corporation at any time the Commission determines that such additional ownership will enhance the provision of electric power services in the public interest.

(f) Operational arrangements for interconnection of power satellite or rectenna and facilities with other electric power grids, power systems or components for extension of electric power services:

The Commission shall determine the operational arrangements under which the corporation shall interconnect its satellite earth terminal station facilities and services with United States electric power companies, other than any electric power companies, system, or other entity in which the corporation has any ownership interest, and private electric power systems

when authorized pursuant to subsection (b)(3) of this section for the purpose of extending electric power services within the United States and in other areas.

SPARCO shall work with international developmental agencies to identify nations, states, power corporations and/or regions that are developmentally close to being capable of supporting an electric power grid of sufficient size to accept a share of rectenna downlinked SSP power. SPARCO shall work with these agencies to share in fostering subsidization of completion of these new downlinkable grid segments. In no case will the power satellite corporation take any share in title of the rectenna.

Sec. 753. Implementation of policy

(a) Administrative functions; agency coordination; use for general governmental purposes; separate systems; spectrum and orbital space use; compatibility with domestic and foreign facilities; interests and needs of ultimate users; Federal views on utilization and user needs The Secretary of Commerce shall -

(1) coordinate the activities of Federal agencies with responsibilities as an electric power company (other than the Commission), so as to ensure that there is full and effective compliance with the provisions of this subchapter;

(2) take all necessary steps to ensure the availability and appropriate utilization of the power satellite services provided by SPARCO for general governmental purposes, except in

any case in which a separate electric power company is required to meet unique governmental needs or is otherwise required in the national interest;

(3) exercise his authority in a manner which seeks to obtain coordinated and efficient use of the electromagnetic spectrum and orbital space, and to ensure the technical compatibility of the space segment with existing earthbound power transmission facilities in the United States and in foreign countries; and

(4) take all necessary steps to determine the interests and needs of the ultimate users of the electric power company foreign and domestic and to communicate the views of the Federal Government on utilization and user needs to SPARCO.

(b) Executive functions; supervision and instructions for foreign relationships and activities

The President shall exercise such supervision over, and issue such instructions to, the corporation in connection with its relationships and activities with foreign governments, international entities, and SPARCO as may be necessary to ensure that such relationships and activities are consistent with the national interest and foreign policy of the United States.

(c) Commission functions; institution of proceedings; recommendations for issuance of executive instructions; public space segment channel, construction, operation and other authorizations; review; rules

The Commission shall -

(1) institute such proceedings as may be necessary to carry out the provisions of section 752 of this title;

(2) make recommendations to the President for the purpose of assisting him in his issuance of instructions to the corporation;

(3) grant such authorizations as may be necessary under title II and title III of the Communications Act of 1934 (47 U.S.C. 201 et seq., 301 et seq.) and the Public Utility Regulatory Act of 1978 as amended to enable the corporation -(A) to provide to the public, in accordance with section 752(c)(2) of this title, space segment orbital locations from their owner; and title II and title III of the Communications Act of 1934 to carry out to the provisions of this subchapter;

(5) establish procedures to provide for the continuing review of the power satellite activities of the corporation as the United States signatory to the operating agreement or other pertinent instruments; and

(6) prescribe such rules as may be necessary to carry out the provisions of this subchapter.

(d) Commission regulatory instructions; conflicting and prevailing instructions of President

The Commission is authorized to issue instructions to the corporation with respect to regulatory matters within the jurisdiction of the Commission. In the event an instruction of the Commission conflicts with an instruction of the President pursuant to subsection (b) of this section, the instructions issued by the President shall prevail.

Appendix. Background on the Sunsat business planning process

While the SunSat Act is derived from the Comsat Act of 1962, there are many important differences to remember. In 1962, space was an entirely new field for communications. Space transportation and photovoltaics (PV) were in their infancy. Today these technologies are very mature. Then there was *no private* space transportation, PV or other space infrastructure provider.

Wireless Power Transfer (WPT), another key technology, was demonstrated in 1975 by Bill Brown of Raytheon. Today, telerobotics is poised and ready to build these huge, ultralight structures. Orbital work is simply too dangerous for astronauts, and astronauts are simply too expensive – astronauts are approximately one thousand times more expensive for the same work in orbit.

In 1962, either you built government launchers or you didn't go. Much technology simply did not exist. Virtually everything that Comsat needed to do business in space, we take for granted as available to Sunsat today – we just need to bring the costs down. The employees of Comsat had to invent it as they went along. We now have commercial off-the-shelf space systems.

The persons and/or corporate groups who choose to compete to form SunSat Corporation would assemble business plans in consultation with their component manufacturers and service providers and submit these in response to a Request For Proposal from the government. In both cases, potential bidders are required to submit in advance their implementation plans for the project so that their technical qualification can be examined and approved for the bidding process.

To begin *our* SSP business plan or proposal we would examine every aspect of SSP design, construction, marketing, operations, etc., and meet with possible providers for all component technologies. Among the key technologies that have been identified include

1. Space transportation
2. Thin-film PV fabric solar array designed for likely high voltage operation even in solar storm conditions.
3. WPT – transmitting antenna & rectenna
4. Telerobotic assembly and nearly autonomous operation
5. Advanced SunSat flight control operations and satellite geometries
6. Superconducting cables – Second Generation cabling is now available.
7. Terrestrial environmentally-positive rectenna construction, marketing, development and regulatory procedures (SPARCO interfaces)
8. Asteroid defense and cis-lunar (off earth) mining and manufacturing

Key Technologies. Figure 2.

Bridging the gap in Space Transportation

As the graph below shows, space transportation can be cheaper with expanded volume – but only a Sunsat Corp can provide the huge increase in demand necessary to finance that lower cost space transportation, The red dots defining this new curve are Elon Musk, SpaceX, $1300/lb and Roger Angel's $20/lb (Sandia electromagnetic launch).[7]

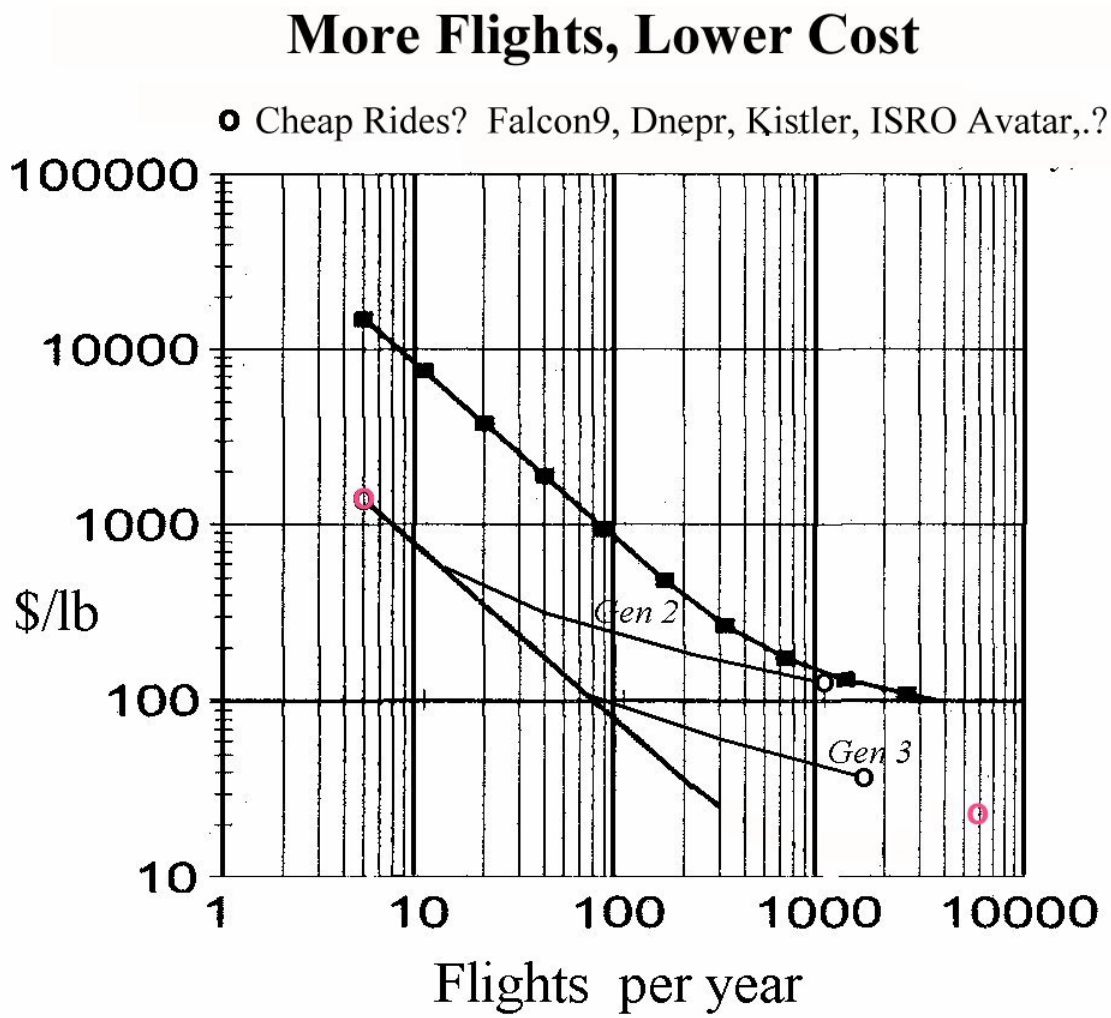
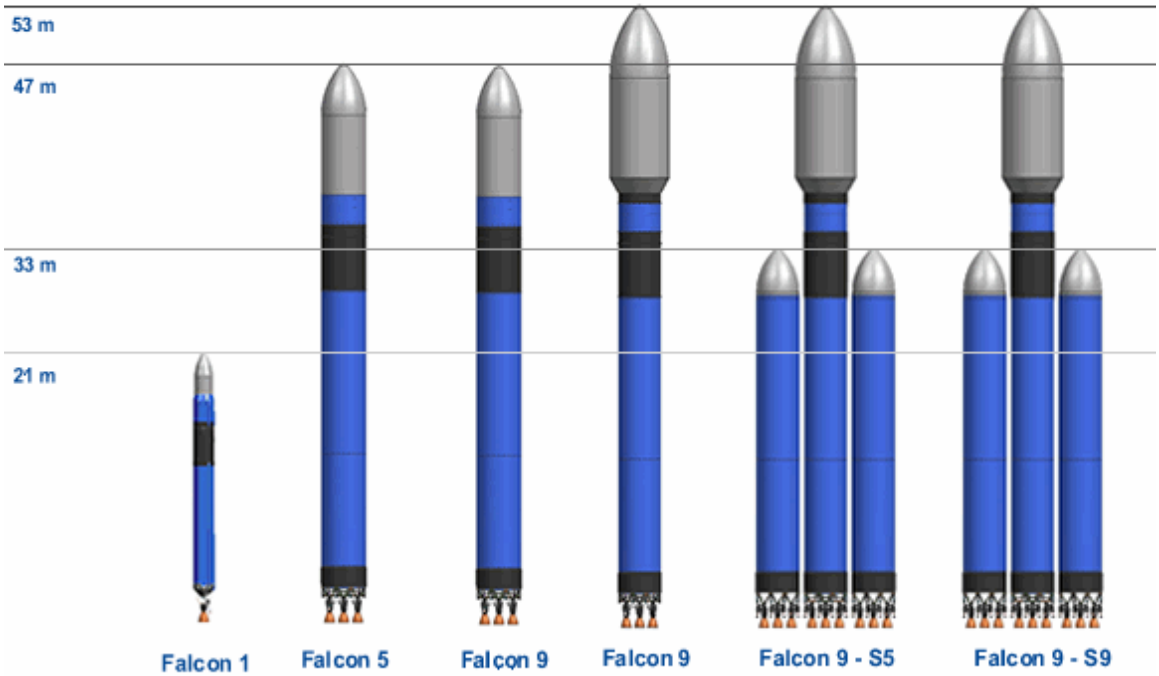


Figure 3. Increases in Flights per year lower the per flight costs substantially.



	Falcon 1	Falcon 5	Falcon 9	Falcon 9	Falcon 9 - S5	Falcon 9 - S9
LEO	570 kg	4,100 kg	9,300 kg	8,700 kg	16,500 kg	24,750 kg
GTO	--	1,050 kg	3,400 kg	3,100 kg	6,400 kg	9,650 kg
Fairing diameter	1.5 m	3.6 m	3.6 m	5.2 m	5.2 m	5.2 m
Price in millions *	$6.7	$18	$27	$35	$51	$78

* Prices are all inclusive of launch range, third party insurance and standard payload integration costs.

Falcon versions Figure 4

Of course, the lower cost curves actually represent several generations of launch vehicles – not a single launch system. Falcon or a similar vehicle could provide the cost structure for the generation of launch vehicles represented by the upper curve (Gen 2). At the new price performance curves, (Gen 2) being quoted by Mr. Musk and Kosmotras, in an admittedly thin market, we project the price would fall almost to $100/lbm[3] at 1,000 flights per year – once the requisite flight volume and appropriate spacecraft are realized. However, Gen 3 and Gen 4 flight curves would be defined by improved, lower cost launch vehicles that would be flying before Falcon, or a similar vehicle could reach these cost levels. *These require higher flight volumes.*

Without the vast launch market expansion which SSP demands, however, it may be many years before the costs for space transportation can be pushed low enough to enable SSP. They are interdependent. Without favorable launch costs, SSP is not possible.

[3] Lbm is pounds of *mass*. Pounds is usually a measure of weight.

In order to establish Sunsat Corp and spur the development of the necessary market volume, there will need to be an initial subsidy of launch costs through Sunsat Corp or similar participants. The high cost of placing thousands of tons per satellite in GSO is a central reason preventing SBSP's business case from being within reach of private development efforts.

To push down the cost of flight to orbit to enable an SBSP business case approximately one thousand flights per year are needed. There is no vehicle fleet currently foreseen able to do this. FAA's 2007 COMSTAC forecast projects a declining commercial launch rate during the next ten years.

Since SBSP would require ~ thirty times higher flight to orbit volume than is currently foreseen, a yet to be created corporation must consult & fund the construction of this fleet to enable an SBSP business case. Only SBSP can justify the market to build that fleet.

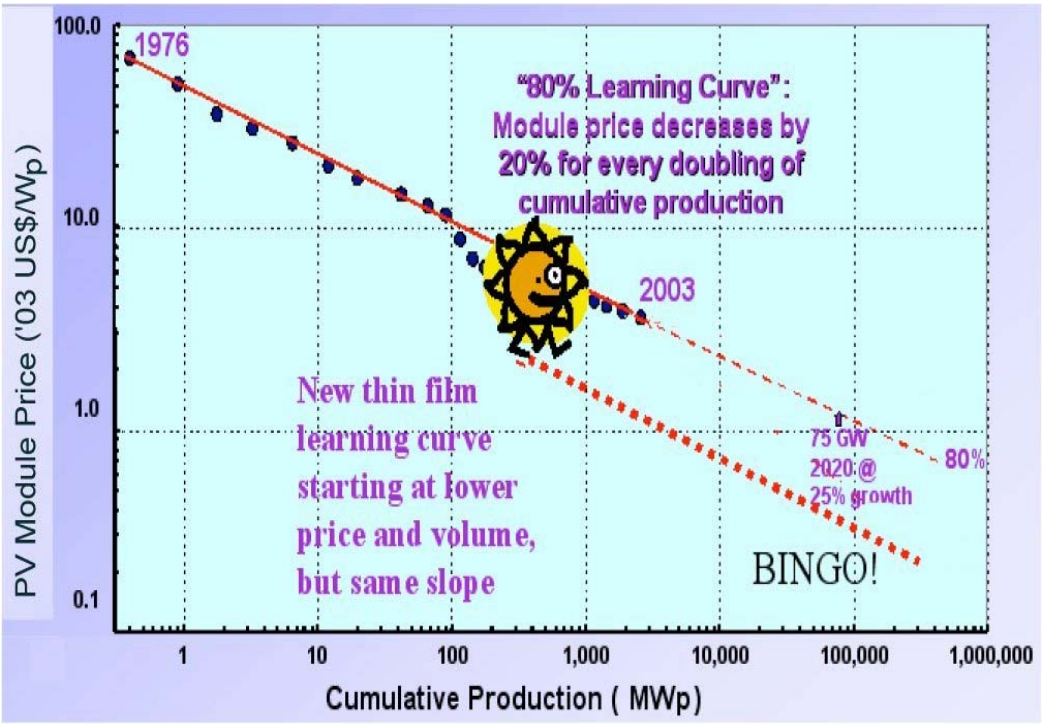
> *We recommend legislation to provide an 85% launch subsidy to **new** private or public/ private businesses, such as SunSat Corp, which are contracting for space transportation and 30 % launch subsidy to established businesses contracting for space transportation. These funds would go to those businesses buying launch services, as vouchers, not directly to space transportation companies. Other reasonable requirements in this legislation might be that the launch must be to LEO or higher. Orbital transfer vehicles, to boost payloads from LEO to GSO, for example, should also qualify.*

Since our Sunsat Corp. SSP launch market is aiming for 42,000 flights per year, nominally, prices would quickly fall below current levels once subsidies established such a market volume. *Many* other enterprises would be enabled. The lowest launch rate curve we seem to be discussing could be a fully reusable mag-lev rail launch, JPA's Ascender, such as a two stage to orbit. All this is moot unless launch rates move off single digits per year for at least one RLV provider, hence a subsidy for moving a lot of freight into orbit, which is a fundamental part of the proposed SunSat Corp legislation.

The space transportation industry is undergoing a metamorphosis toward commercial launch with many in the US advocating that NASA should leave LEO and other launch segments to commercial providers, even replacing the CEV with commercial providers such as Mr. Robert Bigelow's America's Prize promises to do. Establishing a dialog with potential providers and establishing a presence as a major customer is the beginning.

Bridging the gap in PV Production

Significant work must also be done to develop the SSP PV marketplace. SSP will also require massive quantities of PV thin-film fabric solar arrays, in addition to high volume cargo transport to GSO. This thin-film fabric must be very low cost. This declining PV cost, which we have been witnessing for many years with greater cumulative production is called a learning curve. Between 1968 and 1998, the worldwide cumulative installed capacity of PV modules doubled more than thirteen times, from 95 kW to 950 MW, while costs ($/$W_P$) were reduced by an average of 20.2% for each doubling.[8] This process is shown in the chart below. Notice the inflection predicted, and now being reflected in market prices, for lower cost thin film.



Source: Zweibel, NREL Figure 5.

This Cumulative Production curve predicts $.30 per Watt PV at 100 Gigawatts cumulative production. Cumulative global PV production will easily pass 10 GW during 2008. If that 10 GW were in space it would produce 100 Gigawatts. Yes, that can't be done for various reasons, but we could educate our government representatives that we need subsidies for commercial space PV production, not just for terrestrial PV production.

This is why we suggest separate legislation to provide an 85% subsidy to new private or public/ private businesses, such as SunSat Corp, which are contracting for space photovoltaic arrays and 30 % subsidy to established businesses contracting for space photovoltaic arrays. These funds would go to those businesses buying space photovoltaic arrays as tax credits, for example. (Another 85% subsidy would be provided to new private

or public/ private businesses, such as SunSat Corp, to discount the price of space transportation.) Virtually all energy forms now being manufactured are being subsidized by the government, with the notable and glaring exception of SSP - the only clean baseload solution.

If we fail to strongly invest soon in increasing space PV production – moving terrestrial manufacturing production to space now, while oil prices are "modest" – we will find it greatly more difficult as rising oil prices all too swiftly increase prices for feedstock, labor, processing, transportation and an endless list of other cost increases. .

Numerous developments make clear our technological readiness to initiate SSP construction. For example, United Solar Ovonic's triple-junction modules, originally developed for terrestrial applications, were deposited on a 5-mil flexible stainless steel substrate. The radiation hardness and superior high-temperature performance of amorphous silicon have already been demonstrated to be attractive thin film PV material for space application. "By utilizing a polymeric substrate rather than stainless steel, new space cells will be developed that have a specific power density greater than 1,000 watts per kilogram (W/kg)."[9] Space qualified thin-film solar cells in the pipeline today can provide 4550 Watts/Kg. These specifications are adequate to begin SSP design and construction now. We anticipate that that performance can be tripled within 3-5 years, using current laboratory PV cells.[10]

Keshner and Arya's "Solar City" factory design would produce 2.1 – 3.6 GW of solar panels per year. This "Solar City" can produce solar panels at $1.00 per peak watt [terrestrial – e.g. US, Japan, Germany,.. or $0.10 peak watt at GSO – SSPW] This breakthrough in the price of solar energy comes without the need for any significant new invention. It comes entirely from the manufacturing scale of a large plant and the cost savings inherent in operating at such a large manufacturing scale. Further optimizations will lead to further improvements in cost.[11]

> *Concomitantly, we would suggest separate legislation to provide a 85% subsidy to* ***new*** *private or public/ private businesses, such as SunSat Corp, which are contracting for space photovoltaic arrays and 30 % subsidy to established businesses contracting for space photovoltaic arrays. These funds would go to those businesses buying space photovoltaic arrays as vouchers, not directly to space photovoltaic arrays companies. Other reasonable requirements in this legislation might be that the launch must be to LEO or higher.*

Coordinated planning of the nascent SSP market segments will thus be required in a wide variety of technologies — from thin-film solar array fabric and WPT components to high volume cargo transport to GSO. Working with many manufacturers, flexible estimates of the working subsidies necessary to develop groups of competing providers will be required. Some of these will share common demand cycles, technologies and customer bases with related technology providers which can ameliorate the risk and lower the cost of building these markets to levels required for full SSP construction.

As you know, WPT is perhaps the key technology which is both most central to SSP and least well developed in the commercial or private world. Just as Comsat Corp also created a space communications laboratory as part of the legislation, so SunSat Corp should also create a space communications laboratory as part of the enabling legislation. Comsat International through its subsidiaries still has many such laboratories from Latin America to Turkey. SunSat Corp's WPT laboratories would be an integral part of SunSat Corp and its partners and customers. Technologies which those laboratories developed would be shared in various contractual arrangements with customers, just as Comsat Corp. did.

Related activities

A SunSat Corporation has no business reason to and should not be permitted to pursue off-target enterprises and endeavors.

Its first task would be to design and build an SSP demonstration satellite. SunSat's single focus should be developing SSP -- its market and associated technology, such as WPT. However, an appropriate encapsulation of SunSat's risk into forms which would work for the mutual public and private benefit of many could begin with the formation of a Lunar Development Authority (LDA).

Some space analysts have concluded that if some preliminary lunar development were subsidized, as is planned by several nations including President Bush's "Moon, Mars and Beyond" plan, photovoltaic cells could be provided to an SSPS development at lower cost than the earth could provide these. This may be important, as most of the weight of an SSP system would be photovoltaic "fabric".

Considering that high purity silicon for PV manufacturing is becoming significantly more expensive and hard to obtain on earth and electric power in space seems to be declining in price, making PV from lunar silicon may be a very desirable product for an LDA to sell under contract to a SunSat Corp.

These cells, manufactured primarily from lunar regolith[12] would be useful to moon development, as well. Rather than lift such large masses of components, such as photovoltaic cells, the primary component by weight of SSPs, from earth to GSO, it may be shown to be more profitable to collect raw materials from the lunar surface, and even from asteroids and comets in convenient orbits.

The energy cost to transport a pound of cargo to GSO from the moon is twenty times smaller than the energy costs to transport a pound from earth. So if shipping costs from earth to GSO were $100 per kilogram; *once the infrastructure is in place on the moon,* shipping costs from the moon to GSO would approach $5 per kilogram. Of course, first developing such an industrial capacity on the moon, primarily through telerobotics, would first be required, probably through another public / private LDA corporation. Telemining and even telesurgery have been fully demonstrated on the earth.

A publicly chartered LDA would share and subsidize the cost of infrastructure needed by cis-lunar businesses to facilitate the rapid development of all. Separating this infrastructure development would reduce the risk attached to each and make a massive undertaking manageable. Candidate infrastructure areas might include:

transport,	power supply,
water,	meteorite defense,
oxygen (or air),	photovoltaic cell production
shelter, ...	legal other services & commodities

These infrastructure support contracts would support the nascent cis-lunar commercial manufacturing and other services. Under such special circumstances a separate lunar photovoltaic material manufacturer may very well be chartered to become a PV provider to a SunSat type corporation(s).

Conclusion

The US Army Corps of Engineers has joined a growing chorus of petroleum experts in predicting "World oil production is at or near its peak".[13] [14] Saudi Arabia, the bellweather for global oil production has not increased oil production in three years (since April 2003). In a recent report prepared for the Department of Energy's National Energy Technology Laboratory (NETL), lead author Robert Hirsch states that

> *"whatever the peak year turns out to be, 2005 is the time to get moving on energy policy. ... strong action must be taken at least 10, and preferably 20 years before we reach a world oil peak, if we are to avoid a long period of significant economic hardship worldwide. Under normal conditions, replacing half our automobile fleet would require 10-15 years; replacing half our light trucks, 9-14 years. Waiting until world conventional oil production peaks before implementing crash program mitigation leaves the world with a significant liquid fuel deficit for two decades or longer."*[15] *)*

It is crystal clear that the time to begin building SSP is here. The longer we delay making substantial improvements to our energy policy, centered on building SSP, the greater the danger to our environment, our energy supply and our world.

Let's take the brakes off space development!!

References

[1] A summary of the massive global work being done in these studies can be found at Chapter two "Climate Change - Weather Impacts" explains and explores the escalating impact of forced climate change" http://www.sspi.gatech.edu/weatherchg.pdf

[2] The idea for SSP may be traced back to Peter Glaser, who patented it in 1968, Nicola Tesla and others. The earliest mention may, however be David, the author of Psalms 19:4-5. Perhaps even the design for the Japanese flag may be traced to that same rising sun emblem of King David.

[3] "World food stocks dwindling rapidly, UN warns", By Elisabeth Rosenthal, December 17, 2007 http://www.iht.com/articles/2007/12/17/europe/food.php last accessed 12/18/07

4 "Annual Report Of The Commissioner Of Railroads To The Secretary Of The Interior, For The Year Ending June 30, 1883" http://cprr.org/Museum/Construction_1883.html last accessed 8/27/05

[5] The SunSat Corporation Act http://www.sspi.gatech.edu/sunsat_act.html

[6] "Japanese Scientists, Politicians Support Space Solar Power, by Stew Magnuson, *Space News* March 18, 2002, page 15

[7] "Space Sunshade Might Be Feasible", http://www.sciencedaily.com/releases/2006/11/061104090409.htm November, 2006 http://uanews.org/cgi-bin/WebObjects/UANews.woa/wa/MainStoryDetails?ArticleID=13269

[8] "Experience Curves of Photovoltaic Technology" by Christopher Harmon http://www.iiasa.ac.at/Publications/Documents/IR-00-014.pdf

[9] "United Solar Ovonic Receives Contract from the Air Force Research Laboratory to Continue Further Development of the UNI-SOLAR(R) Cells and Modules for Airship and Space Applications", August 16, 2005 http://www.renewableenergyaccess.com/rea/market/business/viewstory?id=35455

[10] "Early Commercial Demonstration Of Space Solar Power Using Ultra-Lightweight Arrays", by Mr. Kevin Reed, SESCRC/Welsom Space Solar, Seestetten/Vilshofen, Germany, IAC-07-C3.2.04, Co-Author: Dr. Harvey J. Willenberg, American Aerospace Advisors, Inc., Owens Cross Roads,

[11] "Study of Potential Cost Reductions Resulting from Super-Large-Scale Manufacturing of PV Modules", By M.S. Keshner and R. Arya
Hewlett Packard, Palo Alto, California, Final Subcontract Report October 2004 • NREL/SR-520-36846

[12] "Silicon PV cell production on the Moon as the basis for a new architecture for space exploration", by Michael B. Duke, Alex Ignatiev, Alex Freundlich, Sanders D. Rosenberg, and Darby Makel, 2001 Space Technology and Applications International Forum – AIP Conference Proceedings Vol 552(1) pp. 19-24. February 2, 2001 and
"First demonstration of photovoltaic diodes on lunar regolith-based substrate", by C. Horton, C. Gramajo, A. Alemu, L. Williams, A. Ignatiev, A. Freundlich, pp 537-545 ACTA ASTRONAUTICA, Volume 56 no. 5, March 2005 http://www.iaanet.org/publicat/last.html

[13] "Energy Trends and Their Implications for U.S. Army Installations" by D. Fournier and E. Westervelt, U S Army Corps of Engineers, September 2005 http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=A440265&Location=U2&doc=GetTRDoc.pdf

[14] Oil Depletion Analysis Center http://www.odac-info.org/ and http://www.odac-info.org/bulletin/bulletin.htm#usa_mil_po_report last accessed 4/6/06

[15] "Peaking of World Oil Production: Impacts, Mitigation and Risk Management", by Robert L. Hirsch et al., March 7, 2005, by Science Applications International Coporation (SAIC) http://www.energybulletin.net/4638.html *last accessed 4/5/05*