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Proposal for Forming an IAA Study Group

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Title of Study:

Solar Energy from Space: the First International Assessment of Opportunities, Issues and Potential Pathways Forward

Proposer(s):

John C. Mankins
Prof. Nobuyuki Kaya

Primary IAA Commission Preference:

Commission 3

Secondary IAA Commission Interests:

Supporting Participants from IAA Commissions 5 and 6 have asked to participate in the study (see annotation below)

Members of Study Team (proposed)

Chairs: John C. Mankins
Nobuyuki Kaya

Secretary: Jerry Grey

Other Members: Ivan Bekey
Henry Brandhorst, Ph.D.
Paul Eckert
Peter Glaser (ex officio)
Raghavan Gopaldaswami
Joe T. Howell
Greg Maryniak
Neville I. Marzwell, Ph.D.
Susumu Sasaki, Ph.D.
Michael Smith
Leopold Summerer
Didier Vasseaux
Robert Wegeng
Prof. Dr. Kai-Uwe Schrogl (representing IAA Commission V)
(Note: per P. Swan; should be regarded as "invited" at this time)
Peter Swan (representing IAA Commission VI)
Additional members, to be identified.

Short Description of Scope of Study

Introduction and Rationale

Past advances in the global quality of life have been enabled by rapid growth in *per capita* energy use, including both electricity and various fuels. During coming decades, global demand for affordable and abundant energy will continue to grow rapidly. However, it is also becoming increasingly urgent to take concerted action on a number of critical environmental issues – particularly with respect to greenhouse gasses and global climate change. Technology will play a vital role in this unfolding situation, because vast, new and sustainable sources of energy will be needed if the burgeoning per capita demand is to be satisfied without exacerbating climate change further.

In fact, during the past several decades, space systems and technologies have played significant roles in meeting environmental challenges. For example, space has proven to be one of humanity's best vantage points from which to observe and better understand our Earth. In coming decades, action will be required in addition to understanding. One option for such action is the development of space-based solar power systems (a.k.a., "space solar power" or "solar power satellites"), first proposed in the late 1960s.

International interest in the topic of space solar power has dramatically increased during the past decade—driven by increasing recognition of the risks of global warming and dramatic increases in the costs of energy—and enabled by a wide range of impressive advances in key component and subsystem technologies. This interest has been expressed through a variety of R&D efforts, including studies and technology development in the U.S. (NASA & NSF, 1995-2003), ongoing R&D in Japan (JAXA, USEF), recent and ongoing studies in Europe (ESA), more recent studies in the U.S. (for the first time under the leadership of the DOD), as well as interest in other space-faring countries of importance, such as India and China. The recent visionary statements (at the 2007 IAC in Hyderabad) endorsing space solar power by the former President of India, Dr. Abdul Kalam, have been particularly remarkable.

However, despite increasing interest in space solar power and despite various R&D activities and studies by individual countries, fundamental questions remain regarding the economic viability of the concept in the foreseeable future.

Despite the numerous SSPS efforts of individual countries and programs, and regardless of the need for greater understanding of the prospects for, and limitations of this concept, there has never been an integrated international assessment of the technological, market and legal conditions under which SSPS might become economically viable. In particular, the International Academy of Astronautics has (to the knowledge of Commission 3) never undertaken a technical study involving the concept of space solar power, and certainly not during the past two decades. Moreover, although there is a long-standing "Power Committee" within the International Astronautical Federation (IAF), that organization is limited to organizing meetings—e.g., a symposium at the International Astronautical Congress (IAC)—and has no charter to undertake a study of this or any other topic in the field of space power.

As a result of these considerations, it is entirely appropriate and timely for the IAA (through Commission III) to undertake a focused review and assessment of the SSPS concept for the purposes of accomplishing several important goals, described below.

Overall Goals:

The overall goals of this study is to determine what role solar energy from space might play in meeting the rapidly growing need for abundant and sustainable energy during the coming decades, to assess the technological readiness and risks associated with the SSPS concept, and (if appropriate) to frame a notional international roadmap that might lead the realization of this visionary concept.

Because significant advances in space solar power systems could have a profound and positive impact on human and robotic space exploration capabilities as well as a range of space applications, the study will also identify such opportunities and evaluate the potential for synergies (if any) between these benefits for space missions and SSPS for terrestrial markets. Finally, there have long been discussions of the potential role that extraterrestrial resources might play in SSPS architectures; the study will also attempt to identify these opportunities and assess potential connections between international lunar exploration programs now being undertaken and SSPS.

Intermediate Goals:

The following are the intermediate goals of the study:

- Identification of relevant markets and applications for new energy sources—including both ultimate applications in terrestrial markets, as well as interim applications in space programs.
- Identification and evaluation of the technical options that may exist for solar energy from space to contribute to meeting global energy needs.
- Identification and evaluation of the technical options that may exist for space solar power to contribute to ambitious government and commercial space mission concepts and markets
- Identification and evaluation of options for the utilization of extraterrestrial resources, in particular lunar resources in future space solar power systems\
- Preliminary determination of appropriate SSPS architecture level figures-of-merit, and values of these that must be achieved in order for solar energy from space is to become economically viable for a range of terrestrial market opportunities and space applications.
- Preliminary identification of other issues and policy questions that would require resolution for SSPS to become a reality (e.g., spectrum allocation).
- Assessment of the technical feasibility, technological maturity and degree of difficulty in the above space solar power options.
- Formulation of a strategic approach to realizing the potential of energy from space—and one or more technical / programmatic roadmaps implementing this strategy.
- Development of a summary report, documenting the results of the study and articulating the prospects for Energy from Space to make a substantial contribution to satisfying future global needs.

These initial intermediate goals will be updated during the course of the study.

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Methodology:

The study shall be organized within a functional work breakdown structure, emphasizing relevant systems and technologies, but including other factors as appropriate (e.g., market assessments), and implemented primarily through a web-based approach with periodic working meetings at IAA meetings and major conferences where appropriate (e.g., at the IAC IPC in spring 2008, the IAC in fall 2008, etc). In addition, one or more dedicated working meetings will be organized, and at least one major workshop/conference. In addition, sessions will be organized at future International Astronautical Congresses in full cooperation with the IAF Power Committee, with papers being invited that address key topics in support of the study objectives. The results of these efforts will be documented in a formal final report, plus supporting information.

Time Line:

Major milestones will include: (1) project start (September 2007); (2) working meeting (March 2008); (3) workshop and presented papers (October 2009); (4) working meeting (March 2009); (5) study conclusion and initial report delivery for peer review (Fall 2009); study completion and report publication (Spring 2010).

Final Product (Report, Publication, etc.):

The study will result in a formal final report for peer review and subsequent publication by the IAA, as well as appropriate interim reports and proceedings from working meetings and workshops, and working papers presented at IAC congresses.

Target Community:

The target community for this study includes (a) the membership of the Academy; (b) the broader academic and industry aerospace community; (c) the non-aerospace environmental and energy industry community; and, (d) policy makers, including international space agency leadership and stakeholders within the several space-faring nations.

Support Needed:

Working support (e.g., in organization of sessions) will be required. IAA support for eventual study publication will be sought consistent with Academy guidelines.

Potential Sponsors:

Sponsors may include industry, non-government organizations, and space agencies.

To be returned to IAA Secretariat Paris fax: 33 1 47 23 82 16 email: sgeneral@iaanet.org

Date: 23 September 2007

Signature:



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