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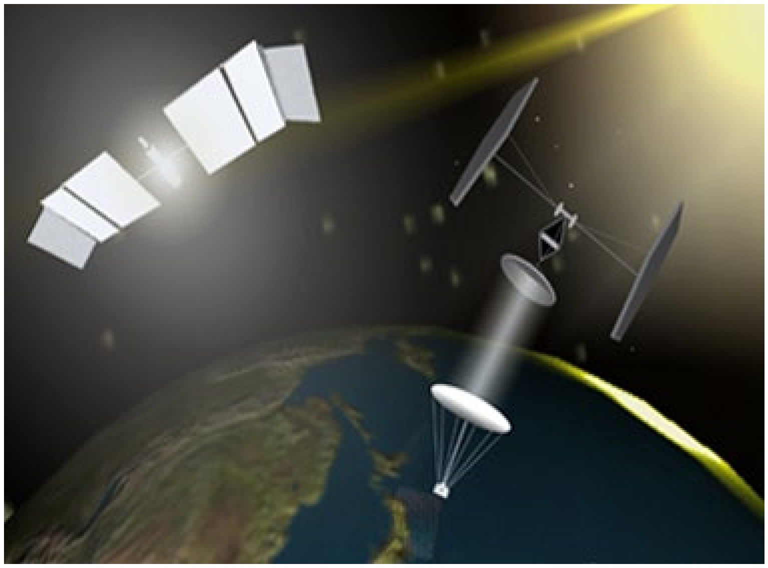

Space Solar Power for Disaster Relief

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ABSTRACT

Solar Powered satellites will have a future as an aid in disaster relief. These new satellites will not only be useful in gathering sun's energy from space and transmitting it to Earth as electrical power, it can be expected that they will also be used in restoring communication and providing remote sensing as well as illumination.

The recovery from disaster events is a timely stand-by service needed by all societies. In a collaborative effort of spacefaring nations and their partners, the launch of constellations of satellites that circle the globe will make rescue team response to saving lives quicker and more effective.

This idea was brought forth by Dean Davis, Aerospace Scientist/Engineer, Lockheed Martin. This visualization, a space-based solar power design project of students at Ohio University, was presented and critiqued at the May 2011 International Space Development Conference in Huntsville, Alabama USA.

TECHNICAL BRIEF

When a disaster strikes an area, rescue teams fly in from all over to give aid. But destruction caused by the disaster to the local infrastructure greatly slows rescue efforts, wasting precious recovery time. Finding ways to quickly recover from power outages and to restore communications in large scale disasters can help to ameliorate its devastating results. This visualization explains some of the problems encountered in a disaster relief effort and illustrates how solar power satellites might help in the recovery. Also noted below is a technical brief that explains how space solar power might be utilized in such recovery operations and a business brief that describes the value proposition.

Illumination

In the context of natural or man-made disasters, rescue workers need to be able to work around the clock. Due to the absence of lighting, they are often limited to working full force only during the day. The lack of illumination can in part be addressed by satellites orbiting the earth. Networked in constellations, specially designed satellites will act as mirrors to reflect sunlight upon the spot facing a disaster situation. Each of these satellites will host a 100-meter thin-film solar-reflecting mirror orbiting in a sun-synchronous orbit. This orbit will be 600 km above the earth inclining 98 degrees. Potentially, these satellites could focus between 10 to 20 thousand lumens of light, or about as much light as the sun gives off in the daytime. This space-based asset will enable rescue workers to continue working at nighttime, thus making it possible to save time and lives.

Power

Light alone will not be sufficient, as areas struck by disaster will also likely need electrical power. Terrestrial power can be replaced by space solar power. While the first constellation of sun-synchronous satellites provides light, imagine a second set of orbiting satellites. These satellites will convert the sun's energy into electricity and beam it to the earth via laser-focused light beams operating at safe IR (infrared) or microwave frequencies. With giant solar collectors onboard, the satellites will collect energy via their solar cells and convert the energy into electrical power, to be wirelessly transmitted to the ground. In large-scale emergencies, it can be expected that terrestrial sources of electrical energy will also be damaged, thus an intermediate power source is needed, which can be supplied with the help of a high-flying airship.

Navigable Airship

In this design, power in the form of microwave energy will be sent from space satellites to an intermediate platform hovering in the stratosphere. This dirigible-type airship, powered by solar power, is designed to continuously operate 60,000 to 100,000 feet altitude above the disaster area, with the capability to receive and refocus up to 1 GW (one billion watts) of energy to earth's surface via a laser or cloud-penetrating microwave beam of energy. 1 GW is sufficient to power a million homes during a crisis, matching the capacity of a coal or nuclear power plant. Portable receptor antennas can be erected on site to receive this energy, and these can run generators or be plugged into the existing electrical grid.

Communication

When a devastating catastrophe hits, one of the greatest constraints in providing relief will be the lack of communication. Phone towers for mobile telephony will often be knocked out, slowing the local team's ability to coordinate relief efforts. In this design, the same airship providing power will be equipped to serve as a tall multi-purpose telecommunications tower, a relay and hub for communication services via the same IR-lasers that beam down power.

Infrared Sensors

Such airships can also be equipped with passive Electro-Optical (EO) and active Radar sensors allowing rescue managers to quickly scan the debris and locate people trapped in the aftermath of the disaster. This task can be accomplished in a fraction of the time it would take to find them manually.

In brief, to save lives and restore order in the event of a disaster, solar power satellites have an important role to play. With access to space-based solar power produced by sun-synchronous satellite networks, rescue agencies will be able to direct electrical power to any location on the planet. Although still in the planning stages, this technology is paving the way for an alternative power grid that can be used to the benefit of all.

Students and Prof. Don Flournoy at the International Space Development Conference in Huntsville AL in May 2011.

BUSINESS PLAN

by Clinton Riddell and Mark Grady, students of the Ohio University College of Business

Value Proposition of the SSP Disaster Relief Project

A project of this scale would be the largest international project to ever take place, requiring participation of the entire world. In return, every country would have the luxury of quickly accessing energy, light, and communication during disastrous times. With the rising incidence and increasing severity of natural disasters, the cost of, both in terms of lost GDP and expenditure diverted to relief and rehabilitation is significant. The World Bank has estimated that, between 1990 and 2000, natural disasters caused damages valued between 2% and 15% of an exposed country's annual GDP[1].

A major factor in the cost of natural disasters is the recovery time involved. Three of the biggest factors in extending recovery time are the lack of energy, illumination at night, and communications. Countries that would join this international effort would be buying into an "insurance policy" against any future disasters within their nation. The price tag will be high, but no country can ever predict their future disasters and the potential costs that may result. This expenditure will be minimal compared to value it could bring world-wide for all future disaster relief.

For example, the total costs from Hurricane Katrina have been estimated at 125-200 billion dollars. Additionally, a non-partisan agency estimated the hurricane's impact to cut our nation's GDP by 60 billion dollars in the second half of 2006[2]. If this project were implemented, such disasters like Hurricane Katrina, or the most recent Tsunami could significantly be reduced. This disaster relief technology would provide almost instantaneous energy to any part of the world by simply redirecting the airship to the disaster site. Relief efforts could work around the clock because of its capability to transmit light during night hours. This alone would cut the recovery time in half because of the ability to work 24 hours/day.

Whenever a disaster is not occurring in the world, this system would allow energy to be sold at a high premium and beamed to any location in the world. The U.S. military with their extravagant expenditures and state of the art technology would particularly be interested in purchasing this product.

An unprecedented capability of this technology is its ability to provide light. This light could be sold for military operations, businesses, or other efforts. Light could also enhance solar farms on the ground by making them twice as efficient. This is because the light would allow their solar panels to collect an additional half year of light because it could now collect light 24 hours/day as opposed to solely daylight time.

If this project was implemented, disasters world-wide could be drastically reduced in terms of recovery time and economic losses. The value of time, light, and communication that this technology would provide is truly priceless. Currently, the technology needed to make this project a reality is in the research and development stage. This analysis was done to provide the value proposition for such technologies which can then be incorporated into a business plan once the cost analysis for these technologies can be completed.

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