# Octas

## Plan

#### The Department of Defense should acquire electricity from space solar power-produced energy in the United States.

## Hi Pappas

#### The DOD is interested in SPS – power procurement rapidly accelerates commercial development

Lemonick 9 – Michael D. Lemonick is the senior writer at Climate Central, a nonpartisan organization whose mission is to communicate climate science to the public. Prior to joining Climate Central, he was a senior writer at Time magazine, where he covered science and the environment for more than 20 years. He has also written four books on astronomical topics and has taught science journalism at Princeton University for the past decade. August 31st, 2009, "Solar Power from Space: Moving Beyond Science Fiction" e360.yale.edu/feature/solar\_power\_from\_space\_moving\_beyond\_science\_fiction/2184/

But the military’s interest in SBSP could give a major boost to the technology. According to Marine Corps Lt. Col. Paul Damphousse, Chief of Advanced Concepts for the National Security Space Office, the military is interested in SBSP for two main reasons.¶ The first, he said, is that “we’re **obviously interested in energy security**, and we’re also **interested in weaning ourselves off fossil fuels** because climate change could pose national security risks.” By being an early customer, the government can rapidly accelerate development of the technology. But there would also be a **tactical advantage to space-based solar**, Damphousse noted. When the military is operating in remote regions of countries like Iraq or Afghanistan, it uses diesel generators to supply forward bases with power.¶ “We have a significant footprint getting energy in,” says Damphousse, noting the need for frequent convoys of oil tankers, the soldiers to protect them, and air support — all of which is expensive and dangerous.¶ **Being able to tap into power beamed directly down from space would clearly have a lot of appea**l, says Damphousse, even if it were relatively costly. And **it’s not just useful for the battlefield, he says, but also for areas affected by natural disasters**, such as Hurricane Katrina.¶ For those reasons, Damphousse supports the idea of coordinated studies by the Pentagon and other agencies — such as NASA and the Department of Energy — that would have a stake in space-based power.

#### Procurement makes SPS economically feasible and catalyzes investment

NSSO 7 – National Security Space Office, Report to the Director, October 10, 2007, “Space-Based Solar Power As an Opportunity for Strategic Security; Phase 0 Architecture Feasibility Study” http://www.nss.org/settlement/ssp/library/final-sbsp-interim-assessment-release-01.pdf

FINDING:The SBSP Study Group found that industry has stated that the #1 driver and requirement for generating industry interest and investment in developing the initial operational SBSP systems is acquiring an anchor tenant customer, or customers, that are willing to sign contracts for high‐value SBSP services. Industry is particularly interested in the possibility that the DoD might be willing to pay for SBSP services delivered to the warfighter in forward bases in amounts of 5‐50 MWe continuous, **at a price of $1** or more per kilowatt‐hour. o Recommendation: The SBSP Study Group recommends that the DoD should immediately conduct a requirements analysis of underlying long‐term DoD demand for secure, reliable, and mobile energy delivery to the war‐fighter, what the DoD might be willing to pay for a SBSP service delivered to the warfighter and under what terms and conditions, and evaluate the appropriateness and effectiveness of various approaches to signing up as an anchor tenant customer of a commercially‐delivered service, such as the NextView acquisition approach pioneered by the National GeoSpatial‐imaging Agency. FINDING: The SBSP Study Group found that even with the DoD as an anchor tenant customer at a price of $1‐2 per kilowatt hour for 5‐50 megawatts continuous power for the warfighter, when considering the risks of implementing a new unproven space technology and other major business risks, the business case for SBSP still does not appear to close in 2007 with current capabilities (primarily launch costs). This study did not have the resources to adequately assess the economic viability of SBSP given current or projected capabilities, and this must be part of any future agenda to further develop this concept. Past investigations of the SBSP concept have indicated that the costs are dominated by costs of installation, which depend on the cost of launch (dollars per kilogram) and assembly and on how light the components can be made (kilograms per kilowatt). Existing launch infrastructure cannot close the business case, and any assessment made based upon new launch vehicles and formats are speculative. Greater clarity and resolution is required to set proper targets for technology development and private capital engagement. Ideally SBSP would want to be cost‐competitive with other baseload suppliers in developing markets which cannot afford to spend a huge portion of their GDP on energy (4c/kWh), and these requirements are extremely stringent, but other niche export markets may provide more relaxed criteria (35c/kWh), and **some customers, such as DoD, appear to be** spend**ing more than $1/kWh in forward deployed locations**. It would be helpful to develop a series of curves which examine technology targets for various markets, in addition to the sensitivities and opportunities for development. Some work by the European Space Agency (ESA) has suggested that in an “apples‐to‐apples” comparison, **SBSP may already be competitive with large‐scale terrestrial solar baseload power**. A great range of opinions were expressed during the study regarding the near‐term profitability. It is instructive to note that that there are American companies that have or are actively marketed SBSP at home and abroad, while another group feels the technology is sufficiently mature to create a dedicated public‐private partnership based upon the COMSAT model and has authored draft legislation to that effect. • **The business case is much more likely to close in the near future if the U.S. Government agrees to: o** Sign up as an anchor tenant customer, and o Make appropriate technology investment and risk‐reduction efforts by the U.S. Government, and o Provide appropriate financial incentives to the SBSP industry that are similar to the significant incentives that Federal and State Governments are providing for private industry investments in other clean and renewable power sources. • The business case may close in the near future with appropriate technology investment and risk‐reduction efforts by the U.S. Government, and with appropriate financial incentives to industry. Federal and State Governments are providing significant financial incentives for private industry investments in other clean and renewable power sources. o Recommendation: The SBSP Study Group recommends that in order to reduce risk and to promote development of SBSP, the U.S. Government should increase and accelerate its investments in the development and demonstration of key component, subsystem, and system level technologies that will be required for the creation of operational and scalable SBSP systems. Finding: The SBSP Study Group found that **a small amount of entry capital by the US Government is likely to** catalyze substantially more investment by the private sector**.** This opinion was expressed many times over from energy and aerospace companies alike. Indeed, there is anecdotal evidence that even the activity of this intermim study has already provoked significant activity by at least three major aerospace companies. Should the United States put some dollars in for a study or demonstration, it is likely to catalyze significant amounts of internal research and development. Study leaders likewise heard that the DoD could have a catalytic role by sponsoring prizes or signaling its willingness to become the anchor customer for the product.

#### **SPS-Alpha can be up and running in a few years with only a few billion dollars – new tech ensures feasibility and low costs**

Mankins 12 – John C. Mankins, President of Artemis Innovation Management Solutions LLC is an internationally recognized leader in space systems and technology innovation, spent 25 years at NASA and CalTech's Jet Propulsion Laboratory. He holds undergraduate (Harvey Mudd College) and graduate (UCLA) degrees in Physics and an MBA in Public Policy Analysis (The Drucker School at Claremont Graduate University). Mr. Mankins is a member of the International Academy of Astronautics (IAA) and Chair of the Academy Commission III (Space Systems and Technology Development); and a member of the International Astronautical Federation (IAF), the American Institute of Aeronautics and Astronautics (AIAA), and the Sigma Xi Research Society. Editor/Authors are :Brian Wang, Director of Research. Sander Olson, Interviews and other articles Phil Wolff, Communications and social technologist. Alvin Wang. Computer, technology, social networking, and social media expert. June 7th, 2012, "A New Paradigm for Space-Based Solar Power," nextbigfuture.com/2012/06/new-paradigm-for-space-based-solar.html

Question: How exactly has the technology evolved since the 1970s? ¶ There have been a number of improvements. The **efficiency of solar photovoltaics has improved** from less than 10% efficiency to more than 30% efficiency now. I'm confident that within the next decade, solar photovoltaics could achieve efficiencies of up to 50%. There have also been **substantial improvements in key electronic components**, such as solid-state power amplifiers. The efficiencies have gone from 15% in the 1970s to **70% now**. With focused investments, we should be able to get devices with efficiencies approaching 80% by 2020. This will further increase the viability of space-based solar power. A wide range of other technologies have also improved dramatically, including **light-weight and high-strength materials, robotics, in-space propulsion and others.** ¶ Question: You are the chief architect behind the SPS-ALPHA design. What are the central aspects of this new paradigm? ¶ The SPS-ALPHA concept facilitates the design and development of a very large solar power satellite out of a large number of very small pieces. Each piece weighs perhaps 25-100 kilograms, but there are tens of thousands of pieces in the final product. **The beauty of this system is that all of the parts of the design can be manufactured readily in a standard factory – resulting in very low costs for the system hardware.** ¶ Question: So the power satellite would be composed of vast numbers of identical modules? ¶ Yes, the modules would be stackable – like pizza boxes – for ease of transportation to space, and then unstacked and assembled once they reach the operational orbit for the satellite. There might be about 6 or 8 different types of modular elements, and each type would be mass produced with from hundreds to tens of thousands of copies. They would initially be launched into a low Earth orbit, and from there transferred to a higher orbit for integration into the SPS platform. We are looking at using robotic systems to assemble the panels. ¶ Question: So your plan employs robots for most of the construction? ¶ Yes. The SPS-ALPHA architecture would only employ people on the ground to supervise the robots operating in space. The goal would be to assume the intervention of astronauts only in the event of a problem that could not be resolved using robots. As a rule of thumb, we expect that it may cost from 100-times to 1000-times more to have a suited astronaut perform a task in a high Earth orbit than to have a remotely-supervised robot do it. This field of technology has advanced rapidly in the past decade, and so we plan to employ robots extensively. ¶ Question: How long would it take to get a prototype system up and running? ¶ With sufficient funding, we could have a ground based, rudimentary prototype up and running by 2014. **An early prototype in orbit could be** built by 2017-2018. And in about a decade, a larger pilot plant could be in geosynchronous Earth orbit, generating 10 megawatts. The total cost for this roadmap could be several billion dollars, with most of the cost coming in the last few years. As a point of comparison, the pilot plant would be approximately the same size as the International Space Station, which cost $100 billion to manufacture, launch into space and assemble. **The cost savings would result from using standard, mass-produced pieces, standard launch systems and robotic assembly in space.**

#### Recent studies prove that SPS tech exists now – terrestrial solar fails

Garretson 12 – Lt Col Peter Garretson is an airpower strategist currently serving on the CSAF’s Strategic Studies Group (HAF/CK). His previous assignment was at the Institute for Defence Studies and Analyses in New Delhi as an Air Force Fellow examining Indo–US long-term space collaboration under the sponsorship of the Council on Foreign Relations. Prior to that he was the chief of future science and technology exploration for the HQ USAF Directorate of Strategic Planning (AF/A8XC), Spring 2012, "Solar Power in Space?" Strategic Studies Quarterly Spring, <http://www.au.af.mil/au/ssq/2012/spring/garretson.pdf>

As of 2010, the fundamental research to achieve technical feasibility for the SPS [solar-power satellites] was already accomplished. Whether it requires 5–10 years or 20–30 years to mature the technologies for economically viable SPS now depends more on the development of appropriate platform systems concepts and the availability of adequate budgets. —International Academy of Astronautics (IAA), 2011 The world needs a constant supply of uninterrupted electrical power to enable and sustain economic growth; power its cities, factories, and vehicles; and provide energy for heating, cooling, lighting, cooking, and desalination. Long term, it is desirable to transition from an energy system based on fossil fuels—an exhaustible resource which alters the composition of our atmosphere with unknown long-term effects on our climate— to a system based upon renewable sources. Many see solar power as the answer, because the resource is so vast and available. However, traditional solar power has limitations that make it less than a perfect match for our society. It is highly intermittent (only a 20-percent duty cycle) due to weather effects (clouds, rain, dust), and its low density requires vast tracks of land. Worst of all, it is not available at night, requiring vast storage or nonrenewable backup systems. Space-based solar is an innovation designed to retain[s] the advantages of traditional solar power while sidestepping the disadvantages. The basics of the idea are quite simple. Rather than cope with the unpredictability and intermittency of solar power on the ground, go where the sun always shines. In geostationary orbit (GEO), the sun shines constantly and is 36 percent stronger, allowing a solar array to collect almost 10 times the amount of energy as the same array installed at mid latitude on the ground (see fig.1). Power can then be transferred (beamed) directly to where it is needed. The technologies to do this are not magic or unfamiliar—they are the same elements used every day to emplace, power, and communicate with every existing satellite. Building the SBSP system would rely on the same familiar solar cells, radio transceivers, and rockets to propel them to GEO, only assembled on a grand different scale. In a mature system-of-systems, multiple solar-power satellites would reside in geostationary orbit, each collecting vast amounts of power and transmitting it through active electronic beam steering, like routers in a vast orbiting power internet. While appearing to hover above a particular location, each SPS could service multiple markets, providing power on demand to urban centers or remote locations. For example, a single satellite south of Baja California could service markets across most of North and South America; a satellite over the Indian Ocean could service markets as far apart as Africa and Indonesia, and from Diego Garcia to as far north as Russia. 1 Power in this system-of-systems would be transmitted using a technique called retrodirective phased array, where an encrypted pilot signal from the ground handshakes with the satellite’s active electronic beam-steering system to link transmitter and receiver. The beam itself would be in the ISM band (typically 2.45 or 5.8 GHz), so that it passes nearly full strength through the atmosphere, clouds, and rain. Because of low atmospheric losses (<2 percent), extremely efficient reconversion (>80 percent), and most of all, constant illumination, the beam can be safely kept at an amazingly low intensity (only one-sixth the intensity of sunlight) and yet be significantly more energy productive than a comparably sized terrestrial solar plant. The location and diameter of the beam are predictable and well confined. Unlike communications satellites—which, because of their small-aperture antennas, cast continent-sized footprints and must be separated by degrees (and thousands of miles) on orbit to deconflict signals—SPSs have very large apertures and therefore can send very narrow beams, allowing them to be spaced much closer together. The beam itself terminates on a receiver called a rectenna, with peak intensity in its center and tapering to nearly nothing at the periphery. The rectenna, about the size of a municipal airport, is a mesh of dipole antennas that capture all the incident energy from the beam. It is nevertheless 80 percent transparent to sunlight, allowing the land beneath to remain available for agricultural uses.

#### SPS is resilient, cost-effective, and efficient

Reed & Willenberg 4 – Head of the Welsom Space Consortium, and Harvey, PhD, Independent Review Team Leader for Space Power Research for NASA, Former Chief Scientist of the ISS (Kevin and Harvey, , "Early commercial demonstration of space solar power using ultra-lightweight arrays,” Acta Astronautica, Volume 65, Issues 9-10, accessed on Science Direct)

Future systems will be even more sensitive to specific power. A number of conceptual design architecture studies have been performed that offer promise for terrestrial electrical power generation by [SSP] space solar power, i.e. a constellation of large Earth-orbiting spacecraft that collect solar power, convert it to laser or microwave beams, and beam that power to terrestrial collectors that, in turn, convert that power to electricity.[1-3] To make this concept economically attractive, they must compete with current large power plants by economically generating Gigawatts (GW) of power. At 100 W/kg, such a power station must weigh 2-5 ∙ 107 kg or more – a tall order for launch vehicles that currently place no more than 2-3 ∙ 103 kg into geosynchronous orbit. Recent technology advances in the area of thin film photovoltaic arrays offer a solution to the mass limitations of high power arrays. Thin film arrays, while the efficiency is only around 9-12%, are so lightweight that they offer specific powers in excess of 1,000 W/kg - a factor of ten or more above the current state of the art. Since these arrays are deployable, they can be packaged with minimum mass and volume, and readily deployed in space with **near-term demonstrable technologies**. This section provides an introduction to this possibility. The next section will discuss the specific advantages of lightweight arrays. Section 3 will describe near-term applications in the 50-500 kWe power range, both in space and in the high altitude atmosphere, as well as future directions for space power satellites and high-power electric thrusters. Section 4 discusses recent and ongoing plans for prototype testing of thin-film arrays in civil and military applications as well as commercial "NewSpace" applications. In Section 5, we discuss some key process steps required for commercial development of space solar power and wireless power transmission, with specific focus on the development pathway for these solar arrays. A development Roadmap is described in Section 6. A short summary is presented in Section 7, followed by references. 2. ADVANTAGES OF ULTRALIGHTWEIGHT ARRAYS Since the beginning of Earth-orbiting satellites, solar array technology has gone through two or three generations, and is on the verge of a new generation. Most early satellites were powered with crystalline silicon arrays, with power levels generally below about 6 kilowatts (kWe). These silicon arrays were heavy and operated at low efficiency, i.e. the amount of power produced per unit area of solar array started around 10-12% at beginning of life. These crystalline silicon arrays also degraded rapidly, dropping to 8-10% efficiencies after several years in space, as a result of radiation-induced degradation of the photovoltaic silicon and atomic oxygen-induced discoloration of the cover glass which protects the silicon from these environmental factors. In the 1990s, the technology for many, if not most, satellite solar arrays converted from these original silicon arrays to compound semiconductors, which generally used gallium arsenide plus a second or third semiconductor to capture a greater share of the solar spectrum and convert it to electricity. These compound dual-junction and triple-junction semiconductors are much more resistant to radiation and more efficient, with efficiencies of 20-24%. More recently, the ability to separate different wavelengths of the solar spectrum and tailor the incident light onto a stretched lens of selected semiconductors (separating red, yellow, green, and blue wavelengths) has shown indications of efficiencies as high as 40-50%.[4-5] Yet even at this nearly theoretical limit of efficiency, the power density level will reach only 300 W/kg. Until recently, the focus of most solar array technology development has been toward more efficient, more radiation-resistant arrays. This focus has been driven primarily by the challenge of deployment of large arrays. This challenge has limited the total array area that can be launched into space, and therefore the way to higher power arrays has been higher efficiencies. These rigid, higher efficiency solar arrays come at the cost, however, of relatively high mass - with the best rigid arrays able to produce about 80-100 Watts per kilogram (W/kg) at 30% efficiency, and the stretched lens arrays promising about 150 W/kg but limited to a total of around 10 kW by deployment considerations. Two dominant performance metrics in the selection of solar array technologies are this power/mass ratio (i.e. the amount of power that can be produced for each kilogram of total mass) and the volume of the stowed array as it is launched. These are important because of the mass and volume limitations on the launch vehicle that places the array into space, and the high cost of launching this limited mass and volume. Using launch vehicles available today, these limit the total power available to satellites in geostationary orbit to about 18 kWe. Higher powers will be highly desirable as the user demands for communications services continue to increase. Recent advances in the ability to place photovoltaic materials on very thin film substrates have produced a new generation of solar arrays. These advances allow arrays to be stowed in the launch vehicle in very compact configurations, and easily deployed to much larger arrays than have heretofore been achievable. These new, thin film arrays are much lighter - around 1200 W/kg, including the deployment systems. Laboratory test cells have been produced by Institut de Microtechnique at the University of Neuchatel, Switzerland using LaRCTM-CP1 thin-film substrates produced by SRS Technologies in Huntsville, AL that have the highest power/mass ratio on record - 4300 W/kg![6] These thin film arrays can be stowed in a rolled or folded configuration in the launch vehicle and deployed in space by simple boom extension or roller mechanisms. A well-designed 50 kW space solar array and deployment system using rolled mechanisms with this specific power would weigh 32 kg with a payload volume the size of a suitcase. This low mass and payload volume, combined with high power density, can provide 50 kW+ space solar arrays at 25% of the cost of current rigid solar arrays. There are two approaches to thin film arrays: amorphous silicon (a-Si:H) and polycrystalline Cu(Ga,In)Se2 (CIGS). The Neuchatel partners have developed an array configuration that deposits amorphous silicon on SRS 6 µm-thick CP1TM polymer films, referred to as CP1/a-Si:H arrays. CIGS cells are generally deposited on 30 µm-thick metal foil substrates, a fact that assures that CIGS cells will be heavier than CP1/a-Si:H cells. Some basic comparisons between these solar arrays are summarized in Table 1. Using deployable thin-film arrays with specific powers in excess of 1,000 W/kg opens opportunities for large power levels in space. With current launch vehicles, this means that communications satellites can have 200 kWe or more in geosynchronous orbit, or that commercial platforms such as manufacturing sites or tourist destinations, can approach a MWe. With such possibilities, **this technology might drive the economics of [SSP] space solar power satellites into the profitable arena**, thereby contributing greatly to a non-petroleum-based worldwide electrical power grid. 3. APPLICATIONS Deployable thin-film arrays would have immediate applications with communications satellites and with high altitude aircraft. A 60 kWe array which can be rolled out in 20 kWe segments would greatly extend the useful lifetime of communications satellites – essentially tripling the array lifetime by rolling out 20 kWe of beginning-of-life (BOL) arrays at the end of the array's useful lifetime. An alternative application would be for much higher-power communications satellites, from 50 to 200 kWe, for higher data rates or power. A unique application may also be realized for recharging mobile batteries. Such an orbiting power platform may provide a source of electrical power for very distributed demands, such as for cellular phones and laptop computers. A 200 kWe solar array would have a mass of less than 200 kg. This would make a thin-film array attractive for still higher-power commercial applications, such as orbiting hotels – with expected demands in the 250 kWe to 1 MWe – and manufacturing sites. The latter would be either for sites for in-space construction of larger platforms, or for processing of materials in the microgravity environment of space. As the technology matures to the megawatt range, additional applications appear promising. For example, electric thrusters in the megawatt range would be attractive for human transportation to Mars and its moons. This technology can be developed in stages, perhaps using high altitude airships as platforms to demonstrate megawatt arrays. As the technology for high power thin film arrays matures, the logical next step would be solar power satellites. With a launch vehicle capable of placing 50,000 kg to geosynchronous orbit, 50 MWe platforms can be considered as building blocks for the GWe stations that would be required to provide a primary source of power for the electrical power grid. 4. DEVELOPMENT OF ULTRALIGHTWEIGHT ARRAYS Recent advances in the ability to place photovoltaic materials on very thin film substrates have produced a new generation of solar arrays. These advances allow arrays to be stowed in the launch vehicle in very compact configurations and easily deployed to much larger arrays than have heretofore been achievable. These new, thin film arrays are much lighter - around 1200 W/kg, including the deployment systems. Problematic to most thin-film solar arrays are radiation and atomic oxygen erosion. Test solar cells are made on CP1TM polyimide that is space-rated for 10 years in Geosynchronous Earth Orbit ( GEO), or SRS CORIN which is the only transparent uncoated commercial polyimide that will not erode in LEO. These flexible, 6 micron thick, thin film arrays, can be rolled or folded into a very low stowed volume in the launch vehicle configuration, and then deployed in space by simple boom extension or roller mechanisms. Such a typical 50 kW space solar array and deployment system would weigh 32 kg with a payload volume the size of a suitcase. This low mass and payload volume, combined with high power density, can provide 50 kW+ space solar arrays at 25% of the cost of current rigid solar arrays. The key technologies are ultra-thin, deployable arrays that generate power at acceptable efficiencies with high power density, and are resistant to atomic oxygen and radiation in the operational space environment.

## And Ellis

#### Global race for SPS now---US must catalyze investment quickly to avoid losing out

Wood 12 – Elisa Wood, contributer to Renewable Energy World, April 16th, 2012, "Race for Renewables' Game-changers Heats Up" [www.renewableenergyworld.com/rea/news/article/2012/04/race-for-game-changing-technology-intensifies](http://www.renewableenergyworld.com/rea/news/article/2012/04/race-for-game-changing-technology-intensifies)

Virginia, U.S.A. -- First comes invention then comes prosperity. That's the theory of 'innovation economics,' a relatively new doctrine that underlies today's worldwide race to discover energy's next game changer and is triggering some intriguing tinkering in renewable energy. Will one of these new technologies lead us out of our economic malaise?¶ 'Hurry up with your work.’ That was the message delivered to energy innovators by Arun Majumdar, director of the U.S. government’s Advanced Research Projects Agency-Energy (ARPA-E) at a Washington, D.C. gathering in November. ‘Let there be no illusion that speed is of the essence right now,’ Majumdar said at the energy innovation conference sponsored by the Information Technology and Innovation Foundation, a public policy think tank.¶ **Why the haste?** The last 100 years brought us electricity, air travel, nuclear technology, fibre optics, wireless communication and more. Now the world needs the equivalent breadth and depth of innovation from the energy sector, but this time we don’t have a century to make the transformation. Dependent on a single fuel for transportation, **the US is vulnerable from both a security and an economic perspective**, particularly since it imports half of its oil - as does China. India also is an importer, as are Germany and Japan. ‘This is a global problem and people are looking for technological leadership in trying to solve it,’ Majumdar said.¶ At the same time, prosperity is arriving for large swathes of the undeveloped world, which creates new pressures and opportunities for energy innovators. Rural outposts have no transmission or distribution infrastructure, but they want electric lighting now, and they want it to be clean and affordable. **Energy innovators are being called upon for quick solutions, and** the victory will go to the swift, according to Majumdar.¶ **Clean energy represents the** ‘biggest business opportunity’ of the twenty-first century, Majumdar said, one that Bloomberg New Energy Finance expects to amount to a US$7 trillion investment by 2030. ‘**The question is: Are we going to stand on the sidelines and buy all that stuff? Or are we going to innovate and make it and sell it to the rest of the world? That is the battle**. That’s the fight.’¶ So how is it going on the battlefield? Are the energy innovators advancing? And will they prove that innovation economics is correct? Can we innovate our way out of today’s economic slowdown?¶ Towards the Heavens¶ Some are casting their gaze upward for the answer, very high upward — about 6700 metres where potential exists for space-based solar power or satellite solar. Not so long ago it seemed far-fetched that orbiting satellites could collect solar energy and beam it to earth. **But now,** the chase is on **to master the technology by researchers in the** U.S., U.K., Japan, India and China. If they succeed, solar satellites could become one of the most disruptive energy technologies yet. In theory they could collect solar energy 24 hours per day, with no interruption from weather or darkness, and provide the world with much of the baseload electricity it needs. Because there is nothing to block the sun’s rays in space, satellite solar panels could collect up to 25 times more power than those on earth, according to U.K.-based developer Orbital Power. Equipped with solar panels, the satellites would collect the sun’s energy, convert it to radio waves and then beam the energy to a collector on the earth’s surface where it would be converted to electricity and shipped to homes and businesses over existing transmission and distribution lines.

#### SPS is key to global economic competitiveness – specifically in aerospace and manufacturing

Matai 10 – DK Matai, PhD in Engineering, Chairman of the Asymmetric Threats Contingency Alliance (ATCA), won The Queen’s Award for Enterprise in the category of Innovation for Bespoke Security Architecture in 2003, authority on countering complex global threats; strategic risk management & visualisation; contingency planning; Information Operations (IO); electronic defence; biometric authentication; secure payment systems and Open Source hardened kernel solutions, June 13th, 2010, "Japan Takes Lead in Wireless Power? 21stC Global Energy Supply,” [www.mi2g.com/cgi/mi2g/frameset.php?pageid=http%3A//www.mi2g.com/cgi/mi2g/press/130610.php](http://www.mi2g.com/cgi/mi2g/frameset.php?pageid=http%3A//www.mi2g.com/cgi/mi2g/press/130610.php)

\***note: WPT = wireless power transmission**

Conclusion¶ The demand for power on Earth is growing exponentially, and associated environmental consequences are becoming significant. Global electric power production is about a USD 1 trillion per year market currently, and represents the largest market on Earth. In this new century, Space Solar Power **(SSP) may provide a clean, safe energy source, alleviating some of the problems we would otherwise expect from increasing nuclear and fossil fuel use.** SSP combined with Wireless Power Transmission (WPT), offers the far-term potential to solve major energy problems on Earth. WPT is an enabling technology for utilising renewable and inexhaustible energy sources on Earth and in space to **meet projected electrical energy demands in the 21st century on a global scale**.¶ With few energy resources of its own and heavily reliant on oil imports, Japan has long been a leader in solar and other renewable energies. The current opportunities that Japan's nascent Wireless Power Transmission (WPT) industry is providing will be the basis not only for energy independence domestically from imported energy sources, but as a supplier of "clean" energy, Japan is likely to gain significant political influence and leverage globally. Penetration of this market by gradually substituting WPT to access renewable and inexhaustible energy sources anywhere on Earth and in space is an opportunity that Japan has clearly recognised. The implications of successful developments of WPT systems by the Japanese are profound enough to **merit a deliberate US or European competitive decision either to pursue further coherent development of WPT or to abandon pursuit of WPT markets to other countries**. **The consequences of abandoning WPT may include** adverse impact on Western industrial competitiveness **in the 21st century and beyond.** It is now obvious that:¶ 1. Nikola Tesla and his early 20th century unique work in regard to Wireless Power generation and transmission was extremely far sighted and accurate; ¶ 2. The Japanese government and multi-nationals are committing tens of billions of dollars to the deployment of SSP and WPT because this is a lucrative area; and ¶ 3. **Given the fallout from the Gulf of Mexico oil catastrophe, there is going to be little choice left other than to move towards SSP and WPT type solutions**.¶ The Western nations including the US and Europe are still in a position to lead a Space Solar Power (SSP) and Wireless Power Transmission (WPT) effort but not for long. The question is not whether we harness power from Space**; but rather** who will get there first **to garner first mover advantage** with significant impact on global economic competitiveness. Now is the time to plan for the WPT future that can be discerned in broad outlines only. The inability to see the future except as a continuation of the present and not to plan for asymmetric threats and opportunities will prevent critical technological evolution and progress. Maximising the opportunities to participate in the development and applications of SSP and WPT systems would **provide not only an outlet for the considerable experience and talents residing in the global** aerospace and manufacturing **industries, but ensure that these industries remain** competitive in the markets for environmentally compatible energy sources where carbon based fuels are no longer the essential element for electrical power generation. The evolution of the human species into the cosmos, including harnessing the moon and immediate outer space, appears to provide a viable space solar and wireless power solution. There is no turning back from this final frontier in the 21st century and beyond!

#### Economic benefits occur even before space deployment

SEC 8 – Space Enterprise Council, 2008, NSS, http://www.nss.org/settlement/ssp/library/2008-SECSpaceBasedSolarPowerWhitePaper.pdf

SBSP is unusual among renewable energy options because it might satisfy all four of the following criteria critical to investment decisions: environmental cleanliness, sustainability of supply, flexibility of location, and capacity to generate continuous rather than intermittent power. The cost of SBSP-generated electricity would initially be greater than that provided by fossil fuel or nuclear power but could be comparable to other alternative energy sources, particularly for baseload power. In addition, SBSP might offer an attractive approach, not only for satisfying today's needs but also for meeting tomorrow’s much greater requirements. We cannot accurately predict environmental and other consequences of harvesting energy from natural Earthbound sources (e.g., wind, ocean current, geothermal, biofuels), when these methods are scaled up to considerably higher levels. By providing an additional source of renewable energy, SBSP might help avoid potentially negative consequences if limits to the costeffective expansion of other renewable sources become evident. Beyond enhancement of energy production per se, SBSP might help create new economic opportunities through resultant technology advances in space launch, space utilization, and technological spin-offs applicable to a host of materials and processes. For example, SBSP research might lead to improvements in the efficiency of solar cells that power communications satellites, as well as power management systems for terrestrial solar power systems. Also, to the extent that SBSP is integrated into terrestrial solar power production, development of SBSP ground infrastructure might generate revenue even before deployment of systems in space. In this and related applications, SBSP could emerge as an enhancement for, rather than a competitor with, terrestrial solar power generation.

#### US competitiveness is key to hegemony and independently solves great power war

Baru 9 – Sanjaya Baru is a Professor at the Lee Kuan Yew School in Singapore Geopolitical Implications of the Current Global Financial Crisis, Strategic Analysis, Volume 33, Issue 2 March 2009 , pages 163 - 168

Hence, economic policies and performance do have strategic consequences.2 In the modern era, the idea that strong economic performance is the foundation of power was argued most persuasively by historian Paul Kennedy. 'Victory (in war)', Kennedy claimed, 'has repeatedly gone to the side with more flourishing productive base'.3 Drawing attention to the interrelationships between economic wealth, technological innovation, and the ability of states to efficiently mobilize economic and technological resources for power projection and national defence, Kennedy argued that nations that were able to better combine military and economic strength scored over others. 'The fact remains', Kennedy argued, 'that all of the major shifts in the world's military-power balance have followed alterations in the productive balances; and further, that the rising and falling of the various empires and states in the international system has been confirmed by the outcomes of the major Great Power wars, where victory has always gone to the side with the greatest material resources'.4 In Kennedy's view, the geopolitical consequences of an economic crisis, or even decline, would be transmitted through a nation's **inability to** find adequate financial resources to simultaneously **sustain** economic growth and **military power**, the classic 'guns versus butter' dilemma.

#### SPS is key to technological innovation and leadership

WTC 11 – Want China Times, Online Journal of Space Communication, an international electronic journal, September 2nd, 2011, "China Unveils Plan for Solar Power Station in Space" spacejournal.ohio.edu/issue16/chinaunveils.html

"The development of a solar power station in space will fundamentally change the way in which people exploit and obtain power," Wang **Xiji, a space technology pioneer at the China Academy of Sciences, said** while presenting the results of his team's research on developing such a station.¶ Talking highly about China's ambitious space solar energy program, 90-year-old Wang said such a station could **promote international cooperation**. **"**Whoever takes the lead **in the development and utilization of clean and renewable energy and the space and aviation industry** will be the world leader," Wang said at the fourth China Energy Environment Summit Forum on Aug 28.¶ The program will utilize existing technology to launch solar-collector satellites into geostationary orbit. These satellites will convert the sun's radiation into electricity 24 hours a day, and safely transmit the electricity via microwaves to rectifying antennas on Earth. The concept was first proposed by US space expert Peter Glaser in 1968.¶ Currently, the United States, Japan, Europe and Russia have plans to invest several billion US dollars in establishing their own 1 million-kilowatt power stations to begin operation between 2030 and 2040. China has not yet taken its first step in this regard.¶ A team led by Wang completed research on the development, timelines and policy for space solar power station technology in August. The program offers guidelines for developing such a station. It aims to complete analysis of space solar power applications, detailed design of system solutions and key technologies as well as key technologies for authentication by 2020. Under the plan, a space solar energy station for commercial use will be completed by 2040.¶ Wang believes such a station will trigger a technical revolution in the fields of new energy, new material, solar power and electricity.¶ Wang said the area of space and aviation is an emerging strategic industry and the development of a space solar-energy station requires high-end technology. Such a program would lead to the emergence of several industries, Wang said. He believes it could lead to a technical revolution and possibly even an industrial revolution.¶ China's solar energy stations down on planet Earth have developed rapidly. In 2010, the country's solar photovoltaic power capacity was 800,000 kilowatts, while 168 million square meters of area used solar-powered water heating.¶ The government's 12th five-year plan also proposes increasing the country's solar photovoltaic power generation capacity to 10 million kilowatts by 2015 and 20 million kilowatts by 2020.¶ It is estimated that a solar power station in orbit could harness five times the solar energy captured by stations on the ground.¶ **Li Ming, a space technology expert, said that after 50 years of development, China's space and aviation industry has made significant progress and laid a sound foundation for a space solar power station.**

#### Technological leadership is key to science diplomacy – it creates international cooperation that independently de-escalates every impact and solves failed states

Federoff 8 – ina Fedoroff 8, Science and Technology Adviser to the Secretary of State and the Administrator of USAID, Testimony Before the House Science Subcommittee on Research and Science Education, 4/2, <http://www.state.gov/g/oes/rls/rm/102996.htm>

Chairman Baird, Ranking Member Ehlers, and distinguished members of the Subcommittee, thank you for this opportunity to discuss science diplomacy at the U.S. Department of State. The U.S. is recognized globally for its leadership in science and technology. Our scientific strength is both **a** tool of “soft power” – part of our strategic diplomatic arsenal – and a basis for creating partnerships with countries as they move beyond basic economic and social development. Science diplomacy is a central element of the Secretary’s transformational diplomacy initiative, because science and technology are essential to achieving stability and strengthening failed and fragile states. S&T advances have immediate and enormous influence on national and global economies, and thus on the international relations between societies. Nation states, nongovernmental organizations, and multinational corporations are largely shaped by their expertise in and access to intellectual and physical capital in science, technology, and engineering. Even as S&T advances of our modern era provide opportunities for economic prosperity, some also challenge the relative position of countries in the world order, and influence our social institutions and principles. America must remain at the forefront of this new world by maintaining its technological edge, and leading the way internationally through science diplomacy and engagement. The Public Diplomacy Role of Science Science by its nature facilitates diplomacy because it strengthens political relationships, embodies powerful ideals, and creates opportunities for all. The global scientific community embraces principles Americans cherish: transparency, meritocracy, accountability, the objective evaluation of evidence, and broad and frequently democratic participation. Science is inherently democratic, respecting evidence and truth above all. Science is also a common global language, able to bridge deep political and religious divides. Scientists share a common language. Scientific interactions serve to keep open lines of communication and cultural understanding. As scientists everywhere have a common evidentiary external reference system, members of ideologically divergent societies can use the common language of science to cooperatively address both domestic and the increasingly trans-national and global problems confronting humanity in the 21st century. There is a growing recognition that science and technology will increasingly drive the successful economies of the 21st century. Science and technology provide an immeasurable benefit to the U.S. by bringing scientists and students here, especially from developing countries, where they see democracy in action, make friends in the international scientific community, become familiar with American technology, and contribute to the U.S. and global economy. For example, in 2005, over 50% of physical science and engineering graduate students and postdoctoral researchers trained in the U.S. have been foreign nationals. Moreover, many foreign-born scientists who were educated and have worked in the U.S. eventually progress in their careers to hold influential positions in ministries and institutions both in this country and in their home countries. They also contribute to U.S. scientific and technologic development: According to the National Science Board’s 2008 Science and Engineering Indicators, 47% of full-time doctoral science and engineering faculty in U.S. research institutions were foreign-born. Finally, some types of science – particularly those that address the grand challenges in science and technology – are inherently international in scope and collaborative by necessity. The ITER Project, an international fusion research and development collaboration, is a product of the thaw in superpower relations between Soviet President Mikhail Gorbachev and U.S. President Ronald Reagan. This reactor will harness the power of nuclear fusion as a possible new and viable energy source by bringing a star to earth. ITER serves as a symbol of international scientific cooperation among key scientific leaders in the developed and developing world – Japan, Korea, China, E.U., India, Russia, and United States – representing 70% of the world’s current population. The recent elimination of funding for FY08 U.S. contributions to the ITER project comes at an inopportune time as the Agreement on the Establishment of the ITER International Fusion Energy Organization for the Joint Implementation of the ITER Project had entered into force only on October 2007. The elimination of the promised U.S. contribution drew our allies to question our commitment and credibility in international cooperative ventures. More problematically, it jeopardizes a platform for reaffirming U.S. relations with key states. It should be noted that even at the height of the cold war, the United States used science diplomacy as a means to maintain communications and avoid misunderstanding between the world’s two nuclear powers – the Soviet Union and the United States. In a complex multi-polar world, relations are more challenging, the threats perhaps greater, and the need for engagement more paramount. Using Science Diplomacy to Achieve National Security Objectives The welfare and stability of countries and regions in many parts of the globe require a concerted effort by the developed world to address the causal factors that render countries fragile and cause states to fail. Countries that are unable to defend their people against starvation, or fail to provide economic opportunity, are susceptible to extremist ideologies, autocratic rule, and abuses of human rights. As well, the world faces common threats, among them climate change, energy and water shortages, public health emergencies, environmental degradation, poverty, food insecurity, and religious extremism. These threats can undermine the national security of the United States, both directly and indirectly. Many are blind to political boundaries, becoming regional or global threats. The United States has no monopoly on knowledge in a globalizing world and the scientific challenges facing humankind are enormous. Addressing these common challenges demands common solutions and necessitates scientific cooperation, common standards, and common goals. We must increasingly harness the power of American ingenuity in science and technology through strong partnerships with the science community in both academia and the private sector, in the U.S. and abroad among our allies, to advance U.S. interests in foreign policy. There are also important challenges to the ability of states to supply their populations with sufficient food. The still-growing human population, rising affluence in emerging economies, and other factors have combined to create unprecedented pressures on global prices of staples such as edible oils and grains. Encouraging and promoting the use of contemporary molecular techniques in crop improvement is an essential goal for US science diplomacy. An essential part of the war on terrorism is a war of ideas. The creation of economic opportunity can do much more to combat the rise of fanaticism than can any weapon. The war of ideas is a war about rationalism as opposed to irrationalism. Science and technology put us firmly on the side of rationalism by providing ideas and opportunities that improve people’s lives. We may use the recognition and the goodwill that science still generates for the United States to achieve our diplomatic and developmental goals. Additionally, the Department continues to use science as a means to reduce the proliferation of the weapons’ of mass destruction and prevent what has been dubbed ‘brain drain’. Through cooperative threat reduction activities, former weapons scientists redirect their skills to participate in peaceful, collaborative international research in a large variety of scientific fields. In addition, new global efforts focus on improving biological, chemical, and nuclear security by promoting and implementing best scientific practices as a means to enhance security, increase global partnerships, and create sustainability.

#### Failed states cause nuclear war

AFC 3 – African Studies Centre et al, The Transnational Institute, The Center of Social Studies, Coimbra University, and The Peace Research Center – CIP-FUHEM, December 2007, “Failed and Collapsed States in the International System,” http://www.tni.org/sites/www.tni.org/archives/reports/failedstates.pdf

In the malign scenario of global developments the number of collapsed states would grow significantly. This would mean that several more countries in the world could not be held to account for respecting international agreements in various fields, be it commercial transactions, debt repayment, the possession and proliferation of weapons of mass destruction and the use of the national territory for criminal or terrorist activities. The increase in **failed states would immediately lead to** an increase in **international migration**, which could have a knock-on effect, first in **neighbouring countries** which, having similar politico-economic structures, **could suffer** increased destabilization and collapse as well. Developments in West Africa during the last decade may serve as an example. Increased international migration would, secondly, have serious implications for the Western world. In Europe it would put social relations between the population and immigrant communities under further pressure, polarizing politics. An increase in collapsed states would also endanger the security of Western states and societies. Health conditions could deteriorate as contagious diseases like Ebola or Sars would spread because of a lack of measures taken in collapsed areas. **Weapons of mass destruction could come into the hands of** various sorts of political entities, be they **terrorist groups**, political factions in control of part of a collapsed state or an aggressive political elite still in control of a national territory and intent on expansion. Not only North Korea springs to mind; one could very well imagine such states in (North) Africa. Since the multilateral system of control of such weapons would have ended in part because of the decision of the United States to try and check their spread through unilateral action - a system that would inherently be more unstable than a multilateral, negotiated regime - one could be faced with an arms race that **would** sooner or later **result in** the actual use of these weapons. In the malign scenario, relations between the US and Europe would also further deteriorate, in questions of a military nature as well as trade relations, thus **undercutting any possible consensus on stemming the growth of collapsed states and the introduction of stable multilateral regimes towards matters like terrorism, nuclear weapons and international migration**. Disagreement is already rife on a host of issues in these fields. At worst, even the Western members of the Westphalian system - especially those bordering on countries in the former Third World, i.e. the European states - could be faced with direct attacks on their national security.

#### Technological leadership is key to hegemony

Segal 4 – Maurice R. Greenberg Senior Fellow in China Studies at the Council on Foreign Relations. Foreign Affairs, November 2004 - December 2004, Is America Losing Its Edge?, Adam Segal, Pg. 2 Vol. 83 No. 6, Technology Enterprises in China.

The United States' **global primacy** **depends** in large part **on its ability to** develop new technologies and industries **faster than anyone else.** **For** the last five decades, **U.S. scientific innovation and** technological **entrepreneurship** **have** ensured the country'seconomic prosperity and military power. It was Americans who invented and commercialized the semiconductor, the personal computer, and the Internet; other countries merely followed the U.S. lead.¶ Today, however, **this technological edge**-so long taken for granted-may be slipping, and the most serious challenge is coming from Asia. Through competitive tax policies, increased investment in research and development (R&D), and preferential policies for science and technology (S&T) personnel, Asian governments are improving the quality of their science and ensuring the exploitation of future innovations. The percentage of patents issued to and science journal articles published by scientists in China, Singapore, South Korea, and Taiwan is rising. Indian companies are quickly becoming the second-largest producers of application services in the world, developing, supplying, and managing database and other types of software for clients around the world. South Korea has rapidly eaten away at the U.S. advantage in the manufacture of computer chips and telecommunications software. And even China has made impressive gains in advanced technologies such as lasers, biotechnology, and advanced materials used in semiconductors, aerospace, and many other types of manufacturing.¶ **Although the** United States' **technical dominance** remains solid**, the globalization** of research and development **is exerting** **considerable pressures on the American system**. Indeed, as the United States is learning, globalization cuts both ways: it is both a potent catalyst of U.S. technological innovation and a significant threat to it. **The** United States **will never be able to** prevent rivals from developing new technologies**; it can** remain dominant only **by** continuing to innovate faster **than everyone else.** But this won't be easy; to keep its privileged position in the world, **the** United States **must get better at** fostering technological entrepreneurship at home.

#### Studies prove the effectiveness of US hegemony

Barnett 11 – Thomas P.M. Barnett is Former Senior Strategic Researcher and Professor in the Warfare Analysis & Research Department, Center for Naval Warfare Studies, U.S. Naval War College American military geostrategist and Chief Analyst at Wikistrat., worked as the Assistant for Strategic Futures in the Office of Force Transformation in the Department of Defense, March 7th, 2011, “The New Rules: Leadership Fatigue Puts U.S., and Globalization, at Crossroads,” http://www.worldpoliticsreview.com/articles/8099/the-new-rules-leadership-fatigue-puts-u-s-and-globalization-at-crossroads

It is worth first examining the larger picture: We live in a time of arguably **the greatest structural change in the global order yet endured**, with this historical moment's most amazing feature being its relative and absolute lack of mass violence. That is something to consider when Americans contemplate military intervention in Libya, because if we do take the step to prevent larger-scale killing by engaging in some killing of our own, we will not be adding to some fantastically imagined global death count stemming from the ongoing "megalomania" and "evil" of American "empire." We'll be engaging in the same sort of system-administering activity that has marked our stunningly successful stewardship of global order since World War II. Let me be more blunt: As the **guardian of globalization**, the U.S. military has been the greatest force for peace the world has ever known. Had America been removed from the global dynamics that governed the 20th century, the **mass murder never would have ended**. Indeed, it's entirely conceivable there would now be no identifiable human civilization left, once nuclear weapons entered **the killing equation.** But the world did not keep sliding down that **path of perpetual war**. Instead, America stepped up and changed everything by **ushering in our now-**perpetual great-power peace. We introduced the **international liberal trade order known as globalization** and played loyal Leviathan over its spread. What resulted was the collapse of empires, an explosion of **democracy,** the persistent spread of **human rights**, the liberation of women, the doubling of life expectancy, a roughly 10-fold increase in adjusted global GDP and a **profound** and persistent **reduction in** battle deaths from state-based **conflicts**. That is what American "hubris" actually delivered. Please remember that the next time some TV pundit sells you the image of "unbridled" American military power as the cause of global disorder instead of its cure. With self-deprecation bordering on self-loathing, we now imagine a post-American world that is anything but. Just watch who scatters and who steps up as the Facebook revolutions erupt across the Arab world. While we might imagine ourselves the status quo power, we remain the world's most vigorously revisionist force. ¶ As for the sheer "evil" that is our military-industrial complex, again, let's examine what the world looked like before that establishment reared its ugly head. The last great period of global structural change was the first half of the 20th century, a period that saw **a death toll of about 100 million across two world wars**. That comes to an average of 2 million deaths a year in a world of approximately 2 billion souls. Today, with far more comprehensive worldwide reporting, researchers report an average of less than 100,000 battle deaths annually in a world fast approaching 7 billion people. Though admittedly crude, these calculations suggest a 90 percent absolute drop and a 99 percent relative drop in deaths due to war. We are **clearly headed for a world order characterized by multipolarity**, something the American-birthed system was designed to both encourage and accommodate. But given how things turned out the last time we collectively faced such a fluid structure, we would do well to keep U.S. power, in all of its forms, deeply embedded in the geometry to come.

#### Perception of decline causes US lashout – triggers hegemonic wars

Goldstein 7 – Professor of Global Politics and International Relations @ University of Pennsylvania “Power transitions, institutions, and China's rise in East Asia: Theoretical expectations and evidence,” Journal of Strategic Studies, Volume 30, Issue 4 & 5 August 2007, pages 639 – 682

Two closely related, though distinct, theoretical arguments focus explicitly on the consequences for international politics of a shift in power between a dominant state and a rising power. In War and Change in World Politics, Robert Gilpin suggested that peace prevails when a dominant state’s capabilities enable it to ‘govern’ an international order that it has shaped. Over time, however, as economic and technological diffusion proceeds during eras of peace and development, other states are empowered. Moreover, the burdens of international governance drain and distract the reigning hegemon, and challengers eventually emerge who seek to rewrite the rules of governance. As the power advantage of the erstwhile hegemon ebbs, **it may become desperate enough to resort to** the ultima ratio of international politics, **force,** to forestall the increasingly urgent demands of a rising challenger. Or as the power of the challenger rises, it may be tempted to press its case with threats to use force. It is the rise and fall of the great powers that creates the circumstances under which major wars, what Gilpin labels ‘hegemonic wars’, break out.13 Gilpin’s argument logically encourages pessimism about the implications of a rising China. It leads to the expectation that international trade, investment, and technology transfer will result in a steady diffusion of American economic power, benefiting the rapidly developing states of the world, including China. As the US simultaneously scurries to put out the many brushfires that threaten its far-flung global interests (i.e., the classic problem of overextension), it will be unable to devote sufficient resources to maintain or restore its former advantage over emerging competitors like China. While the erosion of the once clear American advantage plays itself out, the US will find it ever more difficult to preserve the order in Asia that it created during its era of preponderance. The expectation is an increase in the likelihood for the use of force – either by a Chinese challenger able to field a stronger military in support of its demands for greater influence over international arrangements in Asia, or by a besieged American hegemon desperate to head off further decline. Among the trends that alarm those who would look at Asia through the lens of Gilpin’s theory are China’s expanding share of world trade and wealth (much of it resulting from the gains made possible by the international economic order a dominant US established); its acquisition of technology in key sectors that have both civilian and military applications (e.g., information, communications, and electronics linked with to forestall, and the challenger becomes increasingly determined to realize the transition to a new international order whose contours it will define. the ‘revolution in military affairs’); and an expanding military burden for the US (as it copes with the challenges of its global war on terrorism and especially its struggle in Iraq) that limits the resources it can devote to preserving its interests in East Asia.14 Although similar to Gilpin’s work insofar as it emphasizes the importance of shifts in the capabilities of a dominant state and a rising challenger, the power-transition theory A. F. K. Organski and Jacek Kugler present in The War Ledger focuses more closely on the allegedly dangerous phenomenon of ‘crossover’– the point at which a dissatisfied challenger is about to overtake the established leading state.15 In such cases, when the power gap narrows, the dominant state becomes increasingly desperate. Though suggesting why a rising China may ultimately present grave dangers for international peace when its capabilities make it a peer competitor of America, Organski and Kugler’s power-transition theory is less clear about the dangers while a potential challenger still lags far behind and faces a difficult struggle to catch up. This clarification is important in thinking about the theory’s relevance to interpreting China’s rise because a broad consensus prevails among analysts that Chinese military capabilities are at a minimum two decades from putting it in a league with the US in Asia.16 Their theory, then, points with alarm to trends in China’s growing wealth and power relative to the United States, but especially looks ahead to what it sees as the period of maximum danger – that time when a dissatisfied China could be in a position to overtake the US on dimensions believed crucial for assessing power. Reports beginning in the mid-1990s that offered extrapolations suggesting China’s growth would give it the world’s largest gross domestic product (GDP aggregate, not per capita) sometime in the first few decades of the twentieth century fed these sorts of concerns about a potentially dangerous challenge to American leadership in Asia.17 The huge gap between Chinese and American military capabilities (especially in terms of technological sophistication) has so far discouraged prediction of comparably disquieting trends on this dimension, but inklings of similar concerns may be reflected in occasionally alarmist reports about purchases of advanced Russian air and naval equipment, as well as concern that Chinese espionage may have undermined the American advantage in nuclear and missile technology, and speculation about the potential military purposes of China’s manned space program.18 Moreover, because a dominant state may react to the prospect of a crossover and believe that it is wiser to embrace the logic of **preventive war** and act early to delay a transition while the task is more manageable, Organski and Kugler’s power-transition theory also provides grounds for concern about the period prior to the possible crossover.19 pg. 647-650

#### SPS is key to flexible power projection

NSSO 7 – National Security Space Office, Report to the Director, October 10, 2007, “Space-Based Solar Power As an Opportunity for Strategic Security; Phase 0 Architecture Feasibility Study” http://www.nss.org/settlement/ssp/library/final-sbsp-interim-assessment-release-01.pdf

For the DoD specifically, beamed energy from space in quantities greater than 5 MWe has the potential to be a disruptive game changer on the battlefield. SBSP and its enabling wireless power transmission technology could facilitate extremely **flexible “energy on demand” for combat units and installations across an entire theater, while significantly reducing dependence on vulnerable over‐land fuel deliveries**. SBSP could also enable entirely new force structures and capabilities such as ultra long‐endurance airborne or terrestrial surveillance or combat systems to include the individual soldier himself. More routinely, SBSP could provide the ability to deliver rapid and sustainable **humanitarian energy** to a disaster area or to a local population undergoing nation‐building activities. **SBSP could also facilitate** base “islanding” such that each installation has the ability to operate independent of vulnerable ground‐ based energy delivery infrastructures. In addition to helping American and Allied defense establishments remain relevant over the entire 21st Century through more secure supply lines, perhaps the greatest military benefit of SBSP is to **lessen the chances of conflict** due to energy scarcity by providing access to a strategically secure energy supply.

#### Flexible power projection prevents multiple scenarios for nuclear war

Kagan & O’Hanlon 7 – Frederick Kagan and Michael O’Hanlon, Frederick Kagan is a resident scholar at AEI, AND\*\*\* Michael O’Hanlon is a senior fellow in foreign policy at Brookings, “The Case for Larger Ground Forces”, April 2007, <http://www.aei.org/files/2007/04/24/20070424_Kagan20070424.pdf>

We live at a time when wars not only rage in nearly every region but threaten to erupt in many places where the current relative calm is tenuous. To view this as a strategic military challenge for the United States is not to espouse a specific theory of America’s role in the world or a certain political philosophy. Such an assessment flows directly from the basic bipartisan view of American foreign policy makers since World War II that overseas threats must be countered before they can directly threaten this country’s shores, that the basic stability of the international system is essential to American peace and prosperity, and that no country besides the United States is in a position to lead the way in countering major challenges to the global order. Let us highlight the threats and their consequences with a few concrete examples, emphasizing those that involve key strategic regions of the world such as the Persian Gulf and East Asia, or key potential threats to American security, such as the spread of nuclear weapons and the strengthening of the global Al Qaeda/jihadist movement. The Iranian government has rejected a series of international demands to halt its efforts at enriching uranium and submit to international inspections. What will happen if the US—or Israeli—government becomes convinced that Tehran is on the verge of fielding a nuclear weapon? North Korea, of course, has already done so, and the ripple effects are beginning to spread. Japan’s recent election to supreme power of a leader who has promised to rewrite that country’s constitution to support increased armed forces—and, possibly, even nuclear weapons— may well alter the delicate balance of fear in Northeast Asia fundamentally and rapidly. Also, in the background, at least for now, SinoTaiwanese tensions continue to flare, as do tensions between India and Pakistan, Pakistan and Afghanistan, Venezuela and the United States, and so on. Meanwhile, the world’s nonintervention in Darfur troubles consciences from Europe to America’s Bible Belt to its bastions of liberalism, yet with no serious international forces on offer, the bloodletting will probably, tragically, continue unabated. And as bad as things are in Iraq today, they could get worse. What would happen if the key Shiite figure, Ali al Sistani, were to die? If another major attack on the scale of the Golden Mosque bombing hit either side (or, perhaps, both sides at the same time)? Such deterioration might convince many Americans that the war there truly was lost—but the costs of reaching such a conclusion would be enormous. Afghanistan is somewhat more stable for the moment, although a major Taliban offensive appears to be in the offing. Sound US grand strategy must proceed from the recognition that, over the next few years and decades, the world is going to be a very unsettled and quite dangerous place, with Al Qaeda and its associated groups as a subset of a much larger set of worries. The only serious response to this international environment is to develop armed forces capable of protecting America’s vital interests throughout this dangerous time. Doing so requires a military capable of a wide range of missions—including not only deterrence of great power conflict in dealing with potential hotspots in Korea, the Taiwan Strait, and the Persian Gulf but also associated with a variety of Special Forces activities and stabilization operations. For today’s US military, which already excels at high technology and is increasingly focused on re-learning the lost art of counterinsurgency, this is first and foremost a question of finding the resources to field a large-enough standing Army and Marine Corps to handle personnel intensive missions such as the ones now under way in Iraq and Afghanistan. Let us hope there will be no such large-scale missions for a while. But preparing for the possibility, while doing whatever we can at this late hour to relieve the pressure on our soldiers and Marines in ongoing operations, is prudent. At worst, the only potential downside to a major program to strengthen the military is the possibility of spending a bit too much money. Recent history shows no link between having a larger military and its overuse; indeed, Ronald Reagan’s time in office was characterized by higher defense budgets and yet much less use of the military, an outcome for which we can hope in the coming years, but hardly guarantee. While the authors disagree between ourselves about proper increases in the size and cost of the military (with O’Hanlon preferring to hold defense to roughly 4 percent of GDP and seeing ground forces increase by a total of perhaps 100,000, and Kagan willing to devote at least 5 percent of GDP to defense as in the Reagan years and increase the Army by at least 250,000), we agree on the need to start expanding ground force capabilities by at least 25,000 a year immediately. Such a measure is not only prudent, it is also badly overdue.

## And DHeidt if he looks at the speech doc

#### Energy shortages in the Air Force prevent space radar development – SPS is key

David 12 – Leonard David has been reporting on the space industry for more than five decades. He is a winner of last year's National Space Club Press Award and a past editor-in-chief of the National Space Society's Ad Astra and Space World magazines. He has written for SPACE.com since 1999. February 22nd, 2012, "Air Force Eyes Nuclear Reactors, Beamed Power for Spacecraft," [www.space.com/14643-air-force-space-nuclear-reactors-power-beaming.html](http://www.space.com/14643-air-force-space-nuclear-reactors-power-beaming.html)

For example, the Air Force is currently limited to 27 kilowatt (kW) arrays for satellite power. But more power is required for some future space missions, the report states, such as flights currently being eyed by the Air Force, national security organizations and NASA. "Employing larger and more efficient arrays will enable missions that require very high power, **such as** space-based radaror space-based laser missions," the report states.¶ In the long term, the report says, **increased solar cell efficiencies and revolutionary materials foreshadow the potential of 500 kW on-orbit power generation technologies**, "which would be transformational for performing missions from space-based systems."¶ Furthermore, there are other breakthrough space energy technologies that have the potential of achieving up to 70 percent efficiency, the report adds. Examples include quantum dots and dilute nitrides in solar cells. But there are also totally new technologies such as space tethers that could harvest energy from the Earth's geomagnetic field.

#### SPS is key to space radar – it fills in the gaps of existing space situational awareness

Dinerman 7 – Taylor Dinerman, DoD Consultant, senior editor at the Gatestone Institute in New York. He specializes in the areas of space, missile defense and geopolitics affairs, July 16th, 2007, “Solar power satellites and space radar” <http://integrator.hanscom.af.mil/2007/July/07262007/07262007-16.htm>

One of **the great showstoppers for** the **Space Radar** (SR) program, formerly known as Space Based Radar, **is** **power**. It takes a lot of energy to transmit radar beams powerful enough to track a moving target on Earth from space. What is called the Ground Moving Target Indicator (GMTI) is what makes SR so much better than other space radar systems, such as the recently-launched German SAR-Lupe or the NRO’s Lacrosse system. While many of the details are classified, **the power problem seems to be the main reason that the US Congress, on a bipartisan basis, has been extremely reluctant to fund this program.**¶In order to achieve the power levels needed for an effective GMTI system using current technology, very large solar arrays would be needed. Even if these were to use the new Boeing solar cells that, according to the company, are more than 30% efficient, the arrays would still be much bigger than anything on any operational satellite. Such large arrays would make the SR spacecraft easy targets for enemy antisatellite weapons and would also produce so much drag while in LEO that their lifespan would be shorter—perhaps much shorter—than current-generation reconnaissance satellites.¶ Why, then, does such a system need to rely 100% on its own power? If solar power satellites (SPS) were available in geosynchronous orbit and could beam electricity to the SR satellites in LEO, this might **allow the radar satellites to have as much power as their power control systems and heat radiators could handle**. Power could be transmitted by a tightly focused laser or microwave beam to one or two receptors, integrated into the spacecraft’s bus. If the radar antenna were integrated into the skin of the satellite the way it is on a B-2 bomber, such satellite would be difficult to detect and track.¶ **Using power from an SPS, such a satellite would be able to liberally use its ion engines to change its orbit**. These engines would never be powerful enough to make the kind of quick responsive maneuvers that some space operations commanders would like to see in future LEO-based spacecraft, but they would be a step in the right direction.¶ The demise of the E-10 program that had been intended to replace the Air Force’s JSTARS and AWACS surveillance aircraft has left a hole in future US situational awareness capabilities that neither unmanned aerial vehicles (UAVs), such as the Predator and Global Hawk, **nor existing satellite programs can possibly fill**. Space Radar could do so, but only if the program is restructured to make it at once more ambitious in terms of future capability and less ambitious in terms of near-term operations.

#### Space radar is key to early warning systems that solve debris

Marques 5 Marta Marti-Marques, Technical University of Valencia, Spain, "SPACE-BASED RADAR SYSTEM FOR GEOSTATIONARY DEBRIS DETECTION AND TRACKING AT MEO", 2005, www.iafastro.net/iac/archive/browse/IAC-05/B6/1/1965/

Since the first known satellite fragmentation occurred just four years after Sputnik 1 was successfully put into orbit around our planet, it is believed that a total of 173 satellites have broken up, making the scientific community aware of the potential risks that space debris poses. In order to decrease the threat of operational spacecraft colliding with non-functional objects and to assess current and future population of space debris, cost-effective measurement techniques and devices capable of supplying us with the data required to conduct collision avoidance manoeuvres should be developed.¶ Our research aims to design a space-based detection and tracking radar system, which would provide much more accurate measurements of debris size and orbital parameters from densely populated GEO (Geostationary Earth Orbit). The orbiting device should be placed at MEO (Medium Earth Orbit), so that it allows full tracking of the geostationary arc in order to search GEO for non-functional spacecraft as well as for debris fragments and thereby update the current database of catalogued on-orbit debris population.¶ The detection and tracking radar system operating at Ka-band would supply us with valuable information for the characterisation of the near-Earth debris environment and the validation of space debris models. A directive large antenna would be required to generate short wavelengths and achieve high frequencies, as well as to provide a narrow beamwidth (high gain) capable of searching for non-operational spacecraft and debris clouds. Recent advances on microstrip patch antennas nevertheless prove that the building of such high performance radar would be cost-effective using planar technology.¶ Debris data would be collected by means of an electronically steerable phased array antenna, which could have its beam electronically steered in angle by changing the phase of the current at each radiating element, so that the region of constructive interference could be swept from side to side and look for targets. Despite the fact that attenuation of electromagnetic signals when propagating through the atmosphere or in adverse weather conditions can seriously degrade radar performance at high microwave frequencies, our in situ radar system does not have to face this challenge as it is a space-based device. Now then, on-board signal and data processing should be conducted before transmission by radio link to an Earth-based receiving station.¶ As it is not technically feasible to provide accurate enough ground-based measurements of targets located 36,000 km above the Earth surface, a MEO space-based radar would be the perfect solution due to the potential decrease of the distance between the observer and the object. The database built up from ground-based optical and radar facilities by means of traditional measurement techniques would be definitely improved if we update it with the accurate data our space-based radar will acquire. Functional spacecraft could use this database for advance warning of collisions with debris in order to manoeuvre out of the collision path.¶ In the final analysis, we believe that the proposed orbiting radar system would make a significant contribution to achieve a better understanding of the threats posed by the debris environment so that its impact on future space missions is minimised. For this reason, international cooperation is needed to evolve both technically and economically feasible alternatives to debris threats so that future space activities develop in a debris-free orbital environment. In this paper our space-based radar system will be described in detail and its operating parameters will be calculated to prove the feasibility of this new proposal and demonstrate its effectiveness in preserving the orbital environment for future generations.

#### The US is key

Weeden 9-30 – Brian Weeden, Bachelor's in Science (B.S.) in Electrical Engineering from Clarkson University and a Masters in Science (M.S) in Space Studies from the University of North Dakota. He is also a graduate of the International Space University Space Studies Program, has over a decade of professional technical and operations experience in the national and international space security arena. His wealth of technical knowledge has established him as a thought leader for providing critical analysis that supports development of space policy on a global scale. Prior to joining the Foundation, Mr. Weeden served nine years on active duty as an officer in the United States Air Force working in space and ICBM operations. As part of U.S. Strategic Command's Joint Space Operations Center (JSpOC), Captain Weeden directed the orbital analyst training program and developed tactics, techniques and procedures for improving space situational awareness. In his current role as Technical Advisor, Mr. Weeden conducts research on global space situational awareness, space traffic management, protection of space assets, and prevention of conflict in space. September 30th, 2012, "Space Situational Awareness Bigger Than U.S. Military" [www.defensenews.com/article/20120930/DEFFEAT05/309300008/Space-Situational-Awareness-Bigger-Than-U-S-Military](http://www.defensenews.com/article/20120930/DEFFEAT05/309300008/Space-Situational-Awareness-Bigger-Than-U-S-Military)

The February 2009 collision between an active Iridium satellite and a dead Russian satellite was a wake-up call to the world that demonstrated that space weapons and hostile activities in orbit were not the only, or even the most probable, threats to satellites and space-based capabilities.¶ Measures have been taken since to improve the tracking and warning systems to avoid collisions, but **they are not enough**. And these measures are still being managed and conducted largely by the U.S. military; the constraints of this approach are hindering progress.¶ As the country with the greatest reliance on satellites for national security and economic benefits, the United States realizes the dangers of collisions and large amounts of space debris. The United States also possesses the best space situational awareness capabilities, and in the aftermath of the collision was faced with either releasing the highly accurate satellite-location information maintained by the U.S. military so all satellite operators could calculate their own collision warnings or directing the military to provide a collision-warning service for all of the estimated 1,000 active satellites.¶ Largely because of the desire to control the information and hide some of its national security space assets, the U.S. government became the space collision warning agency for the world**.**¶ Three years later, the benefits and consequences of that choice are being felt. The close-approach warnings provided by the U.S. military to all satellite operators, numbering more than 150 a year, have greatly increased the visibility and awareness of the space debris problem and caused many satellite operators to become more responsible. However, everyone who enjoys the benefits derived from a space presence has become reliant on the U.S. military’s space situational awareness capabilities, **which have not been upgraded to deal with the task they are now depended upon to perform**.¶ The foundation of these capabilities **is space surveillance**, and in particular the production and maintenance of a database of objects in orbit and their locations. This database, known as a satellite catalog, is maintained by two computer systems that have been scheduled for replacement for more than a decade. Several programs to replace these systems have been proposed, announced, attempted and subsequently killed with few results.

#### Debris will knock out satellites and cause extinction

Dunstan 9 – James, JD, Space and Technology Lawyer – Garvey Schubert Barer, and Berin Szoka, Senior Feelow – Progress and Freedom Foundation, Director – Space Frontier Foundation, and Member of the Commerical Space Transportation Advisory Committee – Federal Aviation Administration, “Beware Of Space Junk: Global Warming Isn’t the Only Major Environmental Problem”,<http://techliberation.com/2009/1t2/18/beware-of-space-junk-global-warming-isnt-the-only-major-environmental-problem/>

As world leaders meet in Copenhagen to consider drastic carbon emission restrictions that could require large-scale de-industrialization, experts gathered last week just outside Washington, D.C. to discuss another environmental problem:  Space junk.[1] Unlike with climate change, there’s no difference of scientific opinion about this problem—orbital debris counts increased 13% in 2009 alone, with the catalog of tracked objects swelling to 20,000, and estimates of over 300,000 objects in total; most too small to see and all racing around the Earth at over 17,500 miles per hour.  Thoseare speeding bullets, some the size of school buses, and all capable of knocking out a satellite or manned vehicle.  At stake are much more than the $200 billion a year satellite and launch industries and jobs that depend on them.  Satellites connect the remotest locations in the world; guide us down unfamiliar roads; allow Internet users to view their homes from space; discourage war by making it impossible to hide armies on another country’s borders; are utterlyindispensable toAmericantroops in the field; and play a critical roleinmonitoring climate change and other environmental problems.  Orbital debris could block all thesebenefits for centuries, and prevent us from developing clean energy sources like space solar power satellites, exploring our Solar System and some day making humanity a multi-planetary civilization capable of surviving true climatic catastrophes. The engineering wizards who have fueled the Information Revolution through the use of satellites as communications and information-gathering tools also overlooked the pollution they were causing.  They operated under the “Big Sky” theory: Space is so vast, you don’t have to worry about cleaning up after yourself.  They were wrong. Just last February, two satellites collided for the first time, creating over 1,500 new pieces of junk.   Many experts believe we are nearing the “tipping point”where these collisions will cascade, making many orbits unusable. But the problem can be solved.  Thus far, governments have simply tried to mandate “mitigation” of debris-creation.  But just as some warn about “runaway warming,” we know that mitigation alone will not solve the debris problem.  The answer lies in “remediation”: removing just five large objects per year could prevent a chain reaction.  If governments attempt to clean up this mess themselves, the cost could run into the trillions—rivaling even some proposed climate change solutions.

#### Debris will strike early-warning satellites---causes US Russia nuclear war

Lewis 4 (Jeffrey Lewis, postdoctoral fellow in the Advanced Methods of Cooperative Study Program; worked in the office of the Undersecretary of Defense for Policy, Center for Defense Information, “What if Space were Weaponized?” July 2004, http://www.cdi.org/PDFs/scenarios.pdf)

This is the second of two scenarios that consider how U.S. space weapons might create incentives for America’s opponents to behave in dangerous ways. The previous scenario looked at the systemic risk of accidents that could arise from keeping nuclear weapons on high alert to guard against a space weapons attack. This section focuses on the risk that a single accident in space, such as a piece of space debris striking a Russian early-warning satellite, might be the catalyst for an accidental nuclear war. As we have noted in an earlier section, the United States canceled its own ASAT program in the 1980s over concerns that the deployment of these weapons might be deeply destabiliz- ing. For all the talk about a “new relationship” between the United States and Russia, both sides retain thousands of nuclear forces on alert and configured to fight a nuclear war. When briefed about the size and status of U.S. nuclear forces, President George W. Bush reportedly asked “What do we need all these weapons for?”43 The answer, as it was during the Cold War, is that the forces remain on alert to conduct a number of possible contingencies, including a nuclear strike against Russia. This fact, of course, is not lost on the Rus- sian leadership, which has been increasing its reliance on nuclear weapons to compensate for the country’s declining military might. In the mid-1990s, Russia dropped its pledge to refrain from the “•rst use” of nuclear weapons and conducted a series of exercises in which Russian nuclear forces prepared to use nuclear weapons to repel a NATO invasion. In October 2003, Russian Defense Minister Sergei Ivanov reiter- ated that Moscow might use nuclear weapons “preemptively” in any number of contingencies, including a NATO attack.44 So, it remains business as usual with U.S. and Russian nuclear forces. And business as usual includes the occasional false alarm of a nuclear attack. There have been several of these incidents over the years. In September 1983, as a relatively new Soviet early-warning satellite moved into position to monitor U.S. missile •elds in North Dakota, the sun lined up in just such a way as to fool the Russian satellite into reporting that half a dozen U.S. missiles had been launched at the Soviet Union. Perhaps mindful that a brand new satel- lite might malfunction, the of•cer in charge of the command center that monitored data from the early-warning satellites refused to pass the alert to his superiors. He reportedly explained his caution by saying: “When people start a war, they don’t start it with only •ve missiles. You can do little damage with just •ve missiles.”45 In January 1995, Norwegian scientists launched a sounding rocket on a trajectory similar to one that a U.S. Trident missile might take if it were launched to blind Russian radars with a high altitude nuclear detonation. The incident was apparently serious enough that, the next day, Russian President Boris Yeltsin stated that he had activated his “nuclear football” – a device that allows the Russian president to communicate with his military advisors and review his options for launching his arsenal. In this case, the Russian early-warning satellites could clearly see that no attack was under way and the crisis passed without incident.46 In both cases, Russian observers were con•-dent that what appeared to be a “small” attack was not a fragmentary picture of a much larger one. In the case of the Norwegian sounding rocket, space-based sensors played a crucial role in assuring the Russian leadership that it was not under attack. The Russian command sys-tem, however, is no longer able to provide such reliable, early warning. The dissolution of the Soviet Union cost Moscow several radar stations in newly independent states, creating “attack cor-ridors” through which Moscow could not see an attack launched by U.S. nuclear submarines.47 Further, Russia’s constellation of early-warn-ing satellites has been allowed to decline – only one or two of the six satellites remain operational, leaving Russia with early warning for only six hours a day. Russia is attempting to reconstitute its constellation of early-warning satellites, with several launches planned in the next few years. But Russia will still have limited warning and will depend heavily on its space-based systems to provide warning of an American attack.48 As the previous section explained, the Penta- gon is contemplating military missions in space that will improve U.S. ability to cripple Russian nuclear forces in a crisis before they can execute an attack on the United States. Anti-satellite weapons, in this scenario, would blind Russian reconnaissance and warning satellites and knock out communications satellites. Such strikes might be the prelude to a full-scale attack, or a limited ef- fort, as attempted in a war game at Schriever Air Force Base, to conduct “early deterrence strikes” to signal U.S. resolve and control escalation.49 By 2010, the United States may, in fact, have an arsenal of ASATs (perhaps even on orbit 24/7) ready to conduct these kinds of missions – to coerce opponents and, if necessary, support preemptive attacks. Moscow would certainly have to worry that these ASATs could be used in conjunction with other space-enabled systems – for example, long-range strike systems that could attack targets in less than 90 minutes – to disable Russia’s nuclear deterrent before the Rus- sian leadership understood what was going on. What would happen **if a piece of space debris were to disable a Russian early-warning satellite** under these conditions? Could the Russian military distinguish between an accident in space and the first phase of a U.S. attack? Most Russian early-warning satellites are in elliptical Molniya orbits (a few are in GEO) and thus dif•cult to attack from the ground or air. At a minimum, Moscow would probably have some tactical warn-ing of such a suspicious launch, but given the sorry state of Russia’s warning, optical imaging and signals intelligence satellites there is reason to ask the question. Further, the advent of U.S. on-orbit ASATs, as now envisioned50 could make both the more dif•cult orbital plane and any warning systems moot. The unpleasant truth is that the Russians likely would have to make a judgment call. No state has the ability to de•nitively deter-mine the cause of the satellite’s failure. Even the United States does not maintain (nor is it likely to have in place by 2010) a sophisticated space surveillance system that would allow it to distinguish between a satellite malfunction, a debris strike or a deliberate attack – and Russian space surveillance capabilities are much more limited by comparison. Even the risk assessments for col-lision with debris are speculative, particularly for the unique orbits in which Russian early-warning satellites operate. During peacetime, it is easy to imagine that the Russians would conclude that the loss of a satellite was either a malfunction or a debris strike. But how con•dent could U.S. planners be that the Russians would be so calm if the accident in space occurred in tandem with a second false alarm, or occurred during the middle of a crisis? What might happen if the debris strike oc-curred shortly after a false alarm showing a mis-sile launch? False alarms are appallingly common – according to information obtained under the Freedom of Information Act, the U.S.-Canadian North American Aerospace Defense Command (NORAD) experienced 1,172 “moderately seri-ous” false alarms between 1977 and 1983 – an average of almost three false alarms per week. Comparable information is not available about the Russian system, but there is no reason to believe that it is any more reliable.51 Assessing the likelihood of these sorts of co- incidences is dif•cult because Russia has never provided data about the frequency or duration of false alarms; nor indicated how seriously early- warning data is taken by Russian leaders. More- over, there is no reliable estimate of the debris risk for Russian satellites in highly elliptical orbits.52 The important point, however, is that such a coincidence would only appear suspicious if the United States were in the business of disabling satellites – in other words, there is much less risk if Washington does not develop ASATs. The loss of an early-warning satellite could look rather ominous if it occurred during a period of major tension in the relationship. While NATO no longer sees Russia as much of a threat, the same cannot be said of the converse. Despite the warm talk, Russian leaders remain wary of NATO expansion, particularly the effect expan- sion may have on the Baltic port of Kaliningrad. Although part of Russia, Kaliningrad is separated from the rest of Russia by Lithuania and Poland. Russia has already complained about its decreas- ing lack of access to the port, particularly the uncooperative attitude of the Lithuanian govern- ment.53 News reports suggest that an edgy Russia may have moved tactical nuclear weapons into the enclave.54 If the Lithuanian government were to close access to Kaliningrad in a •t of pique, this would trigger a major crisis between NATO and Russia. Under these circumstances, the loss of an early-warning satellite would be extremely suspi-cious. It is any military’s nature during a crisis to interpret events in their worst-case light. For ex- ample, consider the coincidences that occurred in early September 1956, during the extraordinarily tense period in international relations marked by the Suez Crisis and Hungarian uprising.55 On one evening the White House received messages indicating: 1. the Turkish Air Force had gone on alert in response to unidentified aircraft penetrat- ing its airspace; 2. one hundred Soviet MiG-15s were •ying over Syria; 3. a British Canberra bomber had been shot down over Syria, most likely by a MiG; and 4. The Russian fleet was moving through the Dardanelles. Gen. Andrew Goodpaster was reported to have worried that the confluence of events “might trigger off … the NATO operations plan” that called for a nuclear strike on the Soviet Union. Yet, all of these reports were false. The “jets” over Turkey were a flock of swans; the Soviet MiGs over Syria were a smaller, routine escort returning the president from a state visit to Mos- cow; the bomber crashed due to mechanical dif•culties; and the Soviet fleet was beginning long-scheduled exercises. In an important sense, these were not “coincidences” but rather different manifestations of a common failure – human er- ror resulting from extreme tension of an interna- tional crisis. As one author noted, “The detection and misinterpretation of these events, against the context of world tensions from Hungary and Suez, was the first major example of how the size and complexity of worldwide electronic warning systems could, at certain critical times, create momentum of its own.” Perhaps most worrisome, the United States might be blithely unaware of the degree to which the Russians were concerned about its actions and inadvertently escalate a crisis. During the early 1980s, the Soviet Union suffered a major “war scare” during which time its leadership concluded that bilateral relations were rapidly declining. This war scare was driven in part by the rhetoric of the Reagan administration, fortified by the selective reading of intelligence. During this period, NATO conducted a major command post exercise, Able Archer, that caused some elements of the Soviet military to raise their alert status. American officials were stunned to learn, after the fact, that the Kremlin had been acutely nervous about an American first strike during this period.56 All of these incidents have a common theme – that confidence is often the difference between war and peace. In times of crisis, **false alarms** can have a momentum of their own. As in the second scenario in this monograph, the lesson is that commanders rely on the steady flow of reli-able information. When that information flow is disrupted – whether by a deliberate attack or an accident – confidence collapses **and** the result is panic and escalation. Introducing ASAT weapons into this mix is all the more dangerous, because such weapons target the elements of the command system that keep leaders aware, informed and in control. As a result, the mere presence of such weapons is corrosive to the con•dence that allows national nuclear forces to operate safely.

#### Extinction

Helfand and Pastore 9 | Presidents of Physicians for Social Responsibility (Ira and John, MD's and Past Presidents of the Physicians for Social Responsbility, "US-Russia nuclear war still a threat," 3/31)

Since the end of the Cold War, many have acted as though the danger of nuclear war has ended. It has not. There remain in the world more than 20,000 nuclear weapons. Alarmingly, more than 2,000 of these weapons in the U.S. and Russian arsenals remain on ready-alert status, commonly known as hair-trigger alert. They can be fired within five minutes and reach targets in the other country 30 minutes later. Just one of these weapons can destroy a city. A war involving a substantial number would cause devastation on a scale unprecedented in human history. A study conducted by Physicians for Social Responsibility in 2002 showed that if only 500 of the Russian weapons on high alert exploded over our cities, 100 million Americans would die in the first 30 minutes. An attack of this magnitude also would destroy the entire economic, communications and transportation infrastructure on which we all depend. Those who survived the initial attack would inhabit a nightmare landscape with huge swaths of the country blanketed with radioactive fallout and epidemic diseases rampant. They would have no food, no fuel, no electricity, no medicine, and certainly no organized health care. In the following months it is likely the vast majority of the U.S. population would die. Recent studies by the eminent climatologists Toon and Robock have shown that such a war would have a huge and immediate impact on climate world wide. If all of the warheads in the U.S. and Russian strategic arsenals were drawn into the conflict, the firestorms they caused would loft 180 million tons of soot and debris into the upper atmosphere — blotting out the sun. Temperatures across the globe would fall an average of 18 degrees Fahrenheit to levels not seen on earth since the depth of the last ice age, 18,000 years ago. Agriculture would stop, eco-systems would collapse, and many species, including perhaps our own, would become extinct. It is common to discuss nuclear war as a low-probabillity event. But is this true? We know of five occcasions during the last 30 years when either the U.S. or Russia believed it was under attack and prepared a counter-attack. The most recent of these near misses occurred after the end of the Cold War on Jan. 25, 1995, when the Russians mistook a U.S. weather rocket launched from Norway for a possible attack. Jan. 25, 1995, was an ordinary day with no major crisis involving the U.S. and Russia. But, unknown to almost every inhabitant on the planet, a misunderstanding led to the potential for a nuclear war. The ready alert status of nuclear weapons that existed in 1995 remains in place today. The nuclear danger will not pass until the U.S. and Russia lead the other nuclear states to a Nuclear Weapons Convention that seeks to abolish these weapons forever. As a critical first step the U.S. and Russia must take their weapons off ready-alert status. Presidents Obama and Medvedev can do this on their own by executive order.

#### Satellite arctic monitoring prevents war

**Hodges 11** (Jim Hodges, “Commanding the Arctic,” C4ISR Journal, March 1, 2011, http://www.c4isrjournal.com/story.php?F=5508063)

It was simpler during the Cold War. The United States and Canada set up a string of U.S.-built Defense Early Warning radars in the Arctic to watch for bombers and missiles that might be headed from the Soviet Union toward U.S. military bases and cities. Melting Arctic sea ice has created a vastly more complicated situation for the U.S., Canada and the joint North American Aerospace Defense Command (NORAD). Strategists worry that terrorists could use ice-free waterways as infiltration routes or other nations with stakes in the Arctic could try to tap the lion’s share of the region’s undiscovered petroleum reserves. NORAD is in planning mode when it comes to this new reality, but Canada, with arguably more at risk than the U.S., wants to move faster. Canada has set a goal of asserting sovereignty over its region of the Arctic. Canadian officials want to protect their share of the Arctic’s oil and also of the diamonds recently discovered under the thawing Arctic tundra — Canada is now third in the world in diamond mining. Canada also argues that the Northwest Passage shipping routes, which remain ice-free for longer periods each year, are internal to Canada, a claim that the U.S. and other nations dispute. With so many national interests in an area larger than continental Europe but with only 104,000 inhabitants, Canadian officials are testing new sonars and ship-spotting radars. They are mapping the continental shelf below the Arctic to make an international legal case for control of more waters. They are eyeing improvements to satellite communications and making plans to launch new versions of their cloud-penetrating Radarsat satellites. And they must do all this within the constraints of a $21.8 billion defense budget that some in Parliament want to reduce.

#### Arctic conflict causes nuclear war

Wallace & Staples 10 – Michael Wallace is Professor Emeritus at the University of British Columbia; Steven Staples is President of the Rideau Institute in Ottawa, March 2010, “Ridding the Arctic of Nuclear Weapons A Task Long Overdue”, http://www.arcticsecurity.org/docs/arctic-nuclear-report-web.pdf

The fact is, the Arctic is becoming a zone of increased military competition. Russian President Medvedev has announced the creation of a special military force to defend Arctic claims. Last year Russian General Vladimir Shamanov declared that Russian troops would step up training for Arctic combat, and that Russia’s submarine fleet would increase its “operational radius.” Recently, two Russian attack submarines were spotted off the U.S. east coast for the first time in 15 years. ¶ In January 2009, on the eve of Obama’s inauguration, President Bush issued a National Security Presidential Directive on Arctic Regional Policy. It affirmed as a priority the preservation of U.S. military vessel and aircraft mobility and transit throughout the Arctic, including the Northwest Passage, and foresaw greater capabilities to protect U.S. borders in the Arctic. ¶ The Bush administration’s disastrous eight years in office, particularly its decision to withdraw from the ABM treaty and deploy missile defence interceptors and a radar station in Eastern Europe, have greatly contributed to the instability we are seeing today, even though the Obama administration has scaled back the planned deployments. **The Arctic has figured in this renewed interest in Cold War weapons systems**, particularly the upgrading of the Thule Ballistic Missile Early Warning System radar in Northern Greenland for ballistic missile defence. ¶ **The Canadian government, as well, has put forward new military capabilities to protect Canadian sovereignty claims in the Arctic**, including proposed ice-capable ships, a northern military training base and a deep-water port. Earlier this year Denmark released an all-party defence position paper that suggests the country should create a dedicated Arctic military contingent that draws on army, navy and air force assets with shipbased helicopters able to drop troops anywhere. Danish fighter planes would be tasked to patrol Greenlandic airspace. ¶ Last year Norway chose to buy 48 Lockheed Martin F-35 fighter jets, partly because of their suitability for Arctic patrols. In March, that country held a major Arctic military practice involving 7,000 soldiers from 13 countries in which a fictional country called Northland seized offshore oil rigs. ¶ The manoeuvres prompted a protest from Russia – which objected again in June after Sweden held its largest northern military exercise since the end of the Second World War. About **12,000 troops, 50 aircraft and several warships were involved**. ¶ Jayantha Dhanapala, President of Pugwash and former UN under-secretary for disarmament affairs, summarized the situation bluntly: “From those in the international peace and security sector, deep concerns are being expressed over the fact that two nuclear weapon states – the United States and the Russian Federation, which together own 95 per cent of the nuclear weapons in the world – converge on the Arctic and have competing claims. These claims, together with those of other allied NATO countries – Canada, Denmark, Iceland, and Norway – could, if unresolved, lead to conflict escalating into the threat or use of nuclear weapons.” Many will no doubt argue that this is excessively alarmist, but **no circumstance in which nuclear powers find themselves in military confrontation can be taken lightly.** ¶ The current geo-political threat level is nebulous and low – for now, according to Rob Huebert of the University of Calgary, “[**the] issue is the uncertainty** as Arctic states and non-Arctic states begin to recognize the geo-political/economic significance of the Arctic because of climate change.”

#### Space radar is key to ISR---solves naval effectiveness and dampens the impact of bioweapons attacks

National Research Council 5 – Committee on the Navy's Needs in Space for Providing Future Capabilites, National Research Council. 2005. "The Navy's Needs in Space for Providing Future Capabilities" [www.nap.edu/catalog.php?record\_id=11299](http://www.nap.edu/catalog.php?record_id=11299)

[NSS = Naval Support System]

Today, strike targets are identified, classified, tracked, and geolocated through a combination of sensors on NSS systems, airborne platforms, and naval platforms. NSS and airborne systems are generally used cooperatively to support time-sensitive requirements of strikes. The requirements of the Navy for overland targeting are essentially identical to those of the other Services; however, the Navy will need to carefully manage and guide the course of progress on its requirements for over-water targeting to ensure that they are included in future programs. In particular, many satellite systems do not operate over the open ocean (this includes early plans for the SBR described above)—pointing out the Navy’s need to track even its most basic requirements on availability. During a system’s development and operational phases, technical and funding support is typically needed to improve performance and adapt the system to changing threat and target conditions. Additionally, **the Navy will need to explore the potential of other new** space ISR capabilities, such as hyperspectral imaging to assist in separating targets from background and camouflage, especially in the open-ocean and littoral areas unique to the operations of Navy and Marine Corps forces. In general, the future FIA and SBR systems could greatly enhance NSS support **for Sea Strike by— Improving persistence through increased numbers of satellites, and Improving image resolution, thereby strengthening the ability of naval forces to identify, track, and target terrorist and other small-unit threats.**¶ Sea Shield¶ To maintain littoral superiority for naval and joint force components, ISR resources must be able to support protection against conventional and unconventional (i.e., chemical, biological, radiological, nuclear, and environmental) threats from special operations and terrorist forces. Information from space-, ground-, and sea-based and airborne ISR resources need to be used, where possible, to identify and locate near-horizon and over-the-horizon threats, to enable afloat operations by supporting self-defense against and/or neutralization of undersea threats (including those from submarines, mines, submerged barriers, and obstacles), and to provide defense over land and over sea against theater air and ballistic missile threats. **The support of all of these defensive operations currently challenges NSS ISR resources and will continue to do so for the foreseeable future.** One of the limitations of current NSS systems in contributing significantly to defensive antisubmarine warfare (ASW) and countermine operations is the lack of persistence in making observations of offensive enemy operations. It is possible to observe enemy submarines at shallow depth from space, and also to observe the laying of mine fields or the navigation by enemy combatants through mine fields they have laid. However, **the long time lapses between overhead satellite observations by** current **NSS systems do not support the near-continuous observations needed**.3 As described above, the future FIA and SBR systems, if fielded, should significantly improve overall observational persistence.¶ Today, most operations rely largely on theater assets (the SPY-1D radar system on the Navy’s Aegis ships, sensors on E-2C and E-3 aircraft, and so on) to provide the ISR information necessary to support Sea Shield operations effectively. For surface warfare, **Sea Shield requires that ISR capability provide near-horizon and over-the-horizon warning, tracking, and targeting information against surface targets; these requirements are similar in many regards to the Sea Strike capability needs.** In addition to the improvements noted above that would enhance NSS support for Sea Strike, the future FIA and **SBR systems should greatly improve NSS support for Sea Shield by— Increasing coverage areas, thereby extending the engagement distance to distances beyond the threat range from enemy combatants; and Establishing a space-based GMTI capability (with SBR), thereby enabling space-based, near-continuous tracking of moving surface vessels**. Similarly, undersea warfare support can be extended in area by improved persistence of SBR and FIA, provided that these systems are designed and operated specifically to address the special needs of large-area search in ocean areas. These forms of support are just the beginning, however, and long-term S&T is needed in support of effective naval specification and use of SBR. As an example, further S&T funding could be provided to support a comparison of the expected performance of radars with which the Navy is familiar (such as the E-2C aircraft radar and its upgrades) with the various options for SBR. Such analysis would help establish and maintain the connection between specialized maritime radar experts, the operational Navy, and sthe SBR office.

#### Left uncheck, bioweapons cause extinction

Ochs 2 | Past president of the Aberdeen Proving Ground Superfund Citizens Coalition, Member of the Depleted Uranium Task force of the Military Toxics Project, and M of the Chemical Weapons Working Group [Richard Ochs, , June 9, 2002, “Biological Weapons Must Be Abolished Immediately,” <http://www.freefromterror.net/other_articles/abolish.html>]

Of all the weapons of mass destruction, the genetically engineered biological weapons, many without a known cure or vaccine, are an extreme danger to the continued survival of life on earth. Any perceived military value or deterrence pales in comparison to the great risk these weapons pose just sitting in vials in laboratories. While a “nuclear winter,” resulting from a massive exchange of nuclear weapons, could also kill off most of life on earth and severely compromise the health of future generations, they are easier to control. Biological weapons, on the other hand, can get out of control very easily, as the recent anthrax attacks has demonstrated. There is no way to guarantee the security of these doomsday weapons because very tiny amounts can be stolen or accidentally released and then grow or be grown to horrendous proportions. The Black Death of the Middle Ages would be small in comparison to the potential damage bioweapons could cause. Abolition of chemical weapons is less of a priority because, while they can also kill millions of people outright, their persistence in the environment would be less than nuclear or biological agents or more localized. Hence, chemical weapons would have a lesser effect on future generations of innocent people and the natural environment. Like the Holocaust, once a localized chemical extermination is over, it is over. With nuclear and biological weapons, the killing will probably never end. Radioactive elements last tens of thousands of years and will keep causing cancers virtually forever. Potentially worse than that, bio-engineered agents by the hundreds with no known cure could wreck even greater calamity on the human race than could persistent radiation. AIDS and ebola viruses are just a small example of recently emerging plagues with no known cure or vaccine. Can we imagine hundreds of such plagues? HUMAN EXTINCTION IS NOW POSSIBLE. Ironically, the Bush administration has just changed the U.S. nuclear doctrine to allow nuclear retaliation against threats upon allies by conventional weapons. The past doctrine allowed such use only as a last resort when our nation’s survival was at stake. Will the new policy also allow easier use of US bioweapons? How slippery is this slope?

#### Collapse of the navy causes great power wars

Conway et al. 7 [James T., General, U.S. Marine Corps, Gary Roughead, Admiral, U.S. Navy, Thad W. Allen, Admiral, U.S. Coast Guard, “A Cooperative Strategy for 21st Century Seapower,” October, http://www.navy.mil/maritime/MaritimeStrategy.pdf]

No other disruption is as potentially disastrous to global stability as war among major powers. Maintenance and extension of this Nation’s comparative seapower advantage is a key component of deterring major power war. While war with another great power strikes many as improbable, the near-certainty of its ruinous effects demands that it be actively deterred using all elements of national power. The expeditionary character of maritime forces—our lethality, global reach, speed, endurance, ability to overcome barriers to access, and operational agility—provide the joint commander with a range of deterrent options. We will pursue an approach to deterrence that includes a credible and scalable ability to retaliate against aggressors conventionally, unconventionally, and with nuclear forces. Win our Nation’s wars. In times of war, our ability to impose local sea control, overcome challenges to access, force entry, and project and sustain power ashore, makes our maritime forces an indispensable element of the joint or combined force. This expeditionary advantage must be maintained because it provides joint and combined force commanders with freedom of maneuver. Reinforced by a robust sealift capability that can concentrate and sustain forces, sea control and power projection enable extended campaigns ashore.

#### The navy solves piracy

Hilley 8 – Mass Communication Specialist 1st Class (Monique, “Coalition Forces Work To Deter Piracy In Gulf Of Aden”, The United States Department of the Navy, 1/17/09, Story Number: NNS090117-01, Online @ http://www.navy.mil/submit/display.asp?story\_id=41897)

USS SAN ANTONIO, At sea (NNS) -- Combined Task Force (CTF) 151 is working closely with international navies in the Gulf of Aden to conduct counterpiracy operations and ensure a lawful maritime order in the region. "We're out here as a force, with the coalition nations, to ensure commerce flows freely throughout the world," explained Rear Adm. Terry McKnight, commander, CTF 151. "We are working to achieve an objective of preventing piracy at sea. Over the past few years, we've learned from many combined operations that working with the coalition is key to our success throughout the world." The mission of CTF 151 is to prevent and deter piracy operations in the Gulf of Aden. The task force, which has assembled on board the amphibious transport dock ship USS San Antonio (LPD 17), has many capabilities which are enhanced by the ship's crew. The personnel currently embarked aboard San Antonio in support of CTF 151 counterpiracy operations include a helicopter squadron, fleet surgical team, boarding teams and several elements from the U.S. Marine Corps and U.S. Coast Guard. "This mission is very important for the maritime strategy of our nation and also to work with our coalition nations," said McKnight. "We are out here to demonstrate that the United States Navy will not allow criminal acts on the high seas and that we want, as best we can, to improve the open trade agreements throughout the world." Piracy acts spiked in the region in mid-August due to a very aggressive increase in activity by a clan on the north coast of Somalia. In response to the activity, Vice Adm. William Gortney, commander, Combined Maritime Forces, directed the establishment of the maritime security patrol area (MSPA), an area coalition ships and aircraft patrol to prevent destabilizing activity. "Because of the complexity of the operations, I determined it was necessary to establish CTF 151 to create a task force with a mission and a mandate from the United Nations to conduct counterpiracy operations throughout the area of responsibility," said Gortney during a press briefing at the Pentagon Jan. 15. Although the Combined Maritime Forces (CMF) do not have a mandate to conduct counterpiracy operations, combined task forces each have a particular mandate under which they operate. Any nation that does not yet have the authority to conduct counterpiracy operations will continue to work in Combined Task Force 150, while those that seek the authority to operate with CTF 151 will bring their collective capabilities together to deter, disrupt and eventually bring to justice the maritime criminals involved in the piracy events. "It's really a fascinating story to watch unfold as, at this point, 14 nations have sent their navies to work against the destabilizing activity," added Gortney. CTF 151, with the International Maritime Organization, created the maritime security patrol area as a place to channel the shipping so that they could concentrate naval activity. The task force includes three phases, which outline critical mission goals. The first phase is focused on bringing more international navies into the efforts to help solve this international problem. The second phase involves working with the shipping industry to develop and share practices that prevent pirates from successfully boarding their vessels. The third phase, once authorized, will allow the task force to deliver suspected pirates to court, where they will be held accountable for their actions. "We've had great effects on the first two," explained Gortney. "Fourteen nations are down there. The shipping industry is having the greatest impact. They're doing a terrific job of sharing best practices, speed, maneuver and non-kinetic defensive measures that will prevent pirates from getting aboard the vessel. We have had a great effect on that. In the last six weeks, there have only been four successful piracy attacks." CTF 151 is working very closely with the U.S. State Department to finalize an agreement with one of the nations in the area that will allow CTF 151 and coalition forces to disrupt, deter, capture and hold suspected pirates accountable for their actions. The task force expects that authority to be granted within the next week. "We are going to aggressively go after the pirates that are conducting pirate activity," said Gortney. "We have to make it unpleasant to be a pirate." CTF 151 is a multinational task force conducting counterpiracy operations to detect and deter piracy in and around the Gulf of Aden, Arabian Sea, Indian Ocean and Red Sea. It was established to create a lawful maritime order and develop security in the maritime environment.

#### Piracy causes oil spills that destroy ocean ecosystems

Middleton 8—Roger, consultant reseacher in the Africa Programme at the Chatham House, the Royal Institute of Economic Affairs, "Piracy in Somalia", October, <http://www.chathamhouse.org/sites/default/files/public/Research/Africa/1008piracysomalia.pdf>

Large oil tankers pass through the Gulf of Aden and the danger exists that **a pirate attack could cause a major oil spill** in what is a very sensitive and important ecosystem. During the attack on the Takayama the ship’s fuel tanks were penetrated and oil spilled into the sea. The consequences of a more sustained attack could be much worse. As pirates become bolder and use ever more powerful weaponry a tanker could be set on fire, sunk or forced ashore, any of **which could result in an** environmental catastrophe that would devastate marine and bird life for years to come. The pirates’ aim is to extort ransom payments and to date that has been their main focus; however, the possibility that they could destroy shipping is very real.

#### Ocean destruction causes extinction

Craig 3 (Robin, Professor of Law at Indiana, “Taking Steps,” 34 McGeorge Law Review. 155, Lexis)

Biodiversity and ecosystem function arguments for conserving marine ecosystems also exist, just as they do for terrestrial ecosystems, but these arguments have thus far rarely been raised in political debates. For example, besides significant tourism values - the most economically valuable ecosystem service coral reefs provide, worldwide - coral reefs protect against storms and dampen other environmental fluctuations, services worth more than ten times the reefs' value for food production. Waste treatment is another significant, non-extractive ecosystem function that intact coral reef ecosystems provide. More generally, "ocean ecosystems play a major role in the global geochemical cycling of all the elements that represent the **basic building blocks of living organisms**, carbon, nitrogen, oxygen, phosphorus, and sulfur, as well as other less abundant but necessary elements." In a very real and direct sense, therefore, human degradation of marine ecosystems impairs the planet's ability to support life. Maintaining biodiversity is often critical to maintaining the functions of marine ecosystems. Current evidence shows that, in general, **an ecosystem's ability to keep functioning in the face of disturbance is strongly dependent on its biodiversity**, "indicating that more diverse ecosystems are more stable." Coral reef ecosystems are particularly dependent on their biodiversity. Most ecologists agree that the complexity of interactions and degree of interrelatedness among component species is higher on coral reefs than in any other marine environment. This implies that the ecosystem functioning that produces the most highly valued components is also complex and that many otherwise insignificant species have strong effects on sustaining the rest of the reef system. Thus, maintaining and restoring the biodiversity of marine ecosystems is critical to maintaining and restoring the ecosystem services that they provide. Non-use biodiversity values for marine ecosystems have been calculated in the wake of marine disasters, like the Exxon Valdez oil spill in Alaska. Similar calculations could derive preservation values for marine wilderness. However, economic value, or economic value equivalents, should not be "the sole or even primary justification for conservation of ocean ecosystems. Ethical arguments also have considerable force and merit." At the forefront of such arguments should be a recognition of how little we know about the sea - and about the actual effect of human activities on marine ecosystems. The United States has traditionally failed to protect marine ecosystems because it was difficult to detect anthropogenic harm to the oceans, but we now know that such harm is occurring - even though we are not completely sure about causation or about how to fix every problem. Ecosystems like the NWHI coral reef ecosystem should inspire lawmakers and policymakers to admit that most of the time we really do not know what we are doing to the sea and hence should be preserving marine wilderness whenever we can - especially when the United States has within its territory relatively pristine marine ecosystems that may be unique in the world. We may not know much about the sea, but we do know this much: **if we kill the ocean** we kill ourselves**, and we will take** most of the biosphere with us**.** The Black Sea is almost dead, its once-complex and productive ecosystem almost entirely replaced by a monoculture of comb jellies, "starving out fish and dolphins, emptying fishermen's nets, and converting the web of life into brainless, wraith-like blobs of jelly." More importantly, the Black Sea is not necessarily unique. The Black Sea is a microcosm of what is happening to the ocean systems at large. The stresses piled up: overfishing, oil spills, industrial discharges, nutrient pollution, wetlands destruction, the introduction of an alien species. The sea weakened, slowly at first, then collapsed with shocking suddenness. The lessons of this tragedy should not be lost to the rest of us, because much of what happened here is being repeated all over the world. The ecological stresses imposed on the Black Sea were not unique to communism. Nor, sadly, was the failure of governments to respond to the emerging crisis. Oxygen-starved "dead zones" appear with increasing frequency off the coasts of major cities and major rivers, forcing marine animals to flee and killing all that cannot. Ethics as well as enlightened self-interest thus suggest that the United States should protect fully-functioning marine ecosystems wherever possible - even if a few fishers go out of business as a result.