Asteroid Mining 1AC

Plan: The United States federal government should fund the development of its rare earth mining capability on asteroids beyond the earth’s mesosphere.

Advantage 1 – Rare Earths

China will soon stop exporting rare earth metals – its monopoly ensures a supply chain collapse

Hsu 10 (Jeremy Hsu, Writer for PopSci, 3/17/10, “[Shortage of Rare Earth Minerals May Cripple U.S. High-Tech, Scientists Warn Congress](http://www.popsci.com/technology/article/2010-03/shortage-rare-earth-minerals-may-cripple-us-high-tech-scientists-warn-congress),” PopSci

All those hybrid and electric cars, wind turbines and similar clean tech innovations may count for nothing if the U.S. cannot secure a supply of rare earth minerals. Ditto for other advanced telecommunications or defense technologies, scientists told a U.S. House subcommittee. China has supplied 91 percent of U.S. consumption of rare earths between 2005 and 2008, and continues to represent the world's largest rare earth exporter. But the Chinese have warned that their own domestic industry appetite for rare earths may eventually force them to stop exporting -- an action that would leave the U.S. high-tech industries crippled without other readily available supplies. "The United States, not so long ago, was the world leader in producing and exporting rare earths," said Brad Miller, the Democratic Representative from North Carolina and chairman of the subcommittee. "Today, China is the world's leader." Experts testified that China's state-owned mines had set artificially low prices for the rare earth market, and that Chinese manufacturers had also forced most U.S. rare earth and permanent magnet manufacturers out of business. Rare earth magnets represent a [major component](http://www.popsci.com/cars/article/2009-09/your-prius-hogging-all-rare-metals) in Toyota's Prius hybrid and other clean tech.

Rare earth metal supply will only decrease and prices will only increase – export quotas, escalating Chinese and foreign demand, and the Chinese monopoly – cripples US

MarketResearch.com 08 (MarketResearch.com, world's largest and continuously updated collection of market research. offereing market research reports from over 700 leading global publishers, hosting Research Specialists that have in-depth knowledge of the publishers and the various types of reports in their respective industries, 10/20/08, “China Industry Research And Investment Analysis: Rare Earth Metal Smelting Industry, 2008,” MarketResearch.com – Reports from China)

China boasts the largest rare-earth reserves among all countries in the world. In the past, China sold primary products like rare earth chloride, carbonate-rich rare earths to foreign companies, which would then separate and refine these primary materials to produce rare-earth metals. As China's rare-earth smelting techniques develop and upgrade, not only the quality

of its products has been improved, but its production capacity has also expanded. Instead of selling primary products, China has begun to sell single rare-earth oxides and fluorides to foreign companies. In recent years, China's rare-earth industry has developed an enormous competitive edge due to two important factors: firstly, China's rare-earth industry has been growing by leaps and bounds, its output of rare-earth metals has multiplied, and both the industry's technological level and product quality have reached or even surpassed those of other countries; secondly, the production cost in China is very low, to the point that even the sales price of China's rare-earth products is lower than the production cost of foreign enterprises. As a result, most rare-earth producing enterprises in countries like the United States, Japan, France, Britain, Germany, Austria, India, and Russia find it very difficult to make any more profits. They began to reduce or even stop their production activities and adopted a new strategy of buying rare-earth metals and alloys from China. At present, China's share in the world rare-earth metal and alloy product market is over 80 percent. In an attempt to regulate and improve its rare-earth metal ore mining industry, which is an upstream industry to many other industries, China has resorted to policies of mining quotas and export quotas in recent years to put a control over the indiscriminate mining practices in the industry and reduce malicious price competition. A positive result of these policies is the steadily rising rare-earth metal price. In 2007, 96.77 percent of world rare-earth export came from China. The country has an absolute dominance in the world's rare-earth supply, and this position will remain so for a considerably long time to come. Due to China's rare-earth export quotas instituted in recent years, its export of rare-earth products in 2008 will decrease by about 5 percent over 2007. This, together with the fact that the world's consumption of rare-earth metals continues to grow, is expected to further aggravate other country's dependence on China for rare-earth products. In addition, China is also the biggest rare-earth consumer in the world. Its share of rare-earth consumption in the world total has been steadily increasing and now the share is about 50 percent. One of the biggest downstream industries for the industry is the electronic component and part manufacturing industry. Riding on the wave of the tremendous growth of China's electronic industry, the country's electronic component and part manufacturing industry is also booming. China has now become the world's manufacturing base for loudspeakers, electrolytic capacitors, kinescopes, printed circuit board, discrete semiconductor devices.  In the first two months of 2008, China's electronic component manufacturing industry realized a gross industrial output value of 119.699181 billion RMB, an increase of 29.68 percent over the same period in 2007; and the industry's total sales revenue in the same period was 115.11561 billion RMB, which was a 28.13 percent increase over the same period in 2007. The country's electronic device manufacturing industry also experienced tremendous growth in the first two months in 2008, achieving a gross industrial output value of 84.956401 billion RMB and total sales revenue of 79.937222 billion RMB, an increase of, respectively, 30.12 percent and 29.63 percent over the same period in 2007. As the sales of electronic products (like laptop computers) and automobiles continues to grow, worldwide demand for rare-earth metals will increase and the world's dependence on China for rare-earth supply will also increase. These two factors will combine to push up the price of rare-earth metals.

Supply disruptions are coming – countries will behave like shortages exist even if they don’t – key to economic competitiveness and growth

Parthemore 11 (Christine Parthemore, Fellow at the Center for a New American Security (CNAS), where she directs the Natural Security Program and the Natural Security Blog, prolific author, former journalist writing for The Washington Post, Roll Call, and the Atlanta Journal-Constitution, MA from Georgetown University's Security Studies Program, June 2011, “ELEMENTS OF SEUCURITY: MITIGATING THE RISKS OF U.S. DEPENDENCE ON CRITICAL MINERALS,” Center for a New American Security, <http://www.cnas.org/files/documents/publications/CNAS_Minerals_Parthemore_1.pdf>)

Assessing U.S. Vulnerability - Analysts vary widely in assessing the implications of U.S. dependence on critical minerals, despite broad acceptance of the physical reality that mineral resources are finite and the economic realities that requirements are ubiquitous and demand is growing. On one extreme, some analysts believe the 2010 incident between China and Japan suggests an approaching Hobbesian world in which resource demands outstrip supplies for minerals, nonrenewable energy sources and even food supplies. History indicates that conflict over absolute scarcities is unlikely. At the other end of the spectrum, many still believe that an open market and its invisible hand will continue to determine winners and losers with no serious repercussions for the United States given its purchasing power. In between these extremes, even staunch pragmatists will point to the 2010 China rare earths episode as proof of one basic tenet: The United States and other market-based economies no longer determine all the rules of global trade. Central to this narrative is a conundrum for policymakers. Reserve estimates show that global supplies of almost all minerals are adequate to meet expected global demands over the long term, and for decades into the future for most minerals. The U.S. Geological Survey (USGS) indicates, for example, that world supplies of rare earths will be adequate for more than 100 years.13 These estimates, however, can be meaningless in the near term if supplies are insufficient, or if suppliers reduce exports or otherwise manipulate trade. For example, most experts project that global production of rare earths will likely be insufficient to meet the world’s demand over the next two to three years. The long-term sufficiency of supplies has no practical effect because it takes years and high capital costs to start up new mining and processing businesses for rare earths. Thus, the risks of inaction are high. A range of political, economic and geographic factors can disrupt supplies and cause price spikes that can create rifts in bilateral relations, trade disputes, accusations of economic sabotage and instability in countries that possess rare reserves of prized minerals. They can also give supplier countries extraordinary leverage that can alter geopolitical calculations, especially when single countries control most world supplies. For U.S. policymakers, the risks fall into two rough categories: Disruptions, delivery lags and price spikes that affect military assets and place unanticipated strains on defense procurement budgets; and lack of affordable access to minerals and raw materials preventing important national economic growth goals. The defense industrial base in the modern era differs greatly from any previous time. Often, actual scarcity is not required for problems to arise, as concerns about future scarcities often drive countries to behave as if shortages are occurring. The National Academies recently reported, “The risk of supply interruption arguably has increased or, at the very least, has become different from the more traditional threats associated with the more familiar ideas of war and conflict.”14 During World War I and World War II, for example, governments counted on domestic steel production – and even civilian willingness to contribute scrap materials for reuse and recycling – for tanks and other equipment. In contrast, modern warfare relies on globalized and privatized supply chains rather than a primarily domestic (and often government-run) network. Vulnerability to mineral supply disruptions is likewise far broader and more complicated than it was in previous eras. Policymakers should also consider minerals that play uniquely important roles in the American economy. Rare earths, for example, are important in petroleum refining, which today enables the smooth functioning of the economy. Looking to the longer term, much concern is turning toward minerals that may see booming demand as the economy develops a greater reliance on energy efficiency and renewable energy technologies, such as the lithium used in advanced batteries and hybrid and electric vehicles. These minerals will directly affect U.S. economic competitiveness, and plans for improving economic growth and job development. Pg. 11

Scenario 1 – China

**The mere perception of a shortage triggers a US crackdown on China**

Parthemore 11 (Christine Parthemore, Fellow at the Center for a New American Security (CNAS), where she directs the Natural Security Program and the Natural Security Blog, prolific author, former journalist writing for The Washington Post, Roll Call, and the Atlanta Journal-Constitution, MA from Georgetown University's Security Studies Program, June 2011, “ELEMENTS OF SEUCURITY: MITIGATING THE RISKS OF U.S. DEPENDENCE ON CRITICAL MINERALS,” Center for a New American Security, <http://www.cnas.org/files/documents/publications/CNAS_Minerals_Parthemore_1.pdf>)

Minerals are a subject of much contention. On one hand, the United States remains less prepared for supply disruptions, price spikes and trade disagreements related to the global minerals trade than most experts realize. On the other hand, public concern over reliable access to the minerals required in key sectors of the U.S. economy, in particular those needed to produce military equipment, is growing. Too frequently, however, such concerns are based on inaccurate assumptions. A sober and informed analysis suggests there are real vulnerabilities, which place critical national security and foreign policy interests at risk. In worst-case scenarios, supplies of minerals that the United States does not produce domestically may be disrupted, creating price spikes and lags in delivery. Even short of major supply disruptions, supplier countries can exert leverage over the United States by threatening to cut off certain key mineral supplies. The United States may also lose ground strategically if it continues to lag in managing mineral issues, as countries that consider assured access to minerals as far more strategically important are increasingly setting the rules for trade in this area. China’s rising dominance is at the heart of this growing public debate. Its 2010 cutoff of rare earth elements2 – a unique set of minerals that are difficult to process yet critical to many hightech applications – attracted particular attention. After Japan detained a Chinese trawler captain over a skirmish in the East China Sea, Japanese companies reported weeks of stalled shipments of rare earths from China amid rumors of an official embargo. This may sound like a minor trade dispute, but China currently controls production of about 95 percent of the world’s rare earths, which are critical to building laser-guidance systems for weapons, refining petroleum and building wind turbines. Coinciding with possessing this incredible leverage over the rest of the world, China has also reduced its export quotas for these minerals. For its part, the Chinese government contended that it did not put any formal export embargo in place, and that its plans to reduce exports simply reflect the need to meet growing domestic demand for rare earths. Japan-China relations experienced further strain in their already tense relationship. In the United States, many reporters, policy analysts and decision makers did not foresee this challenge. Feeling blindsided, some in the United States characterized the situation in a manner that demonized China rather than using the opportunity to better understand the true nature of U.S. supply chain vulnerabilities. The 2010 rare earths case and others are increasing interest in critical minerals among U.S. policymakers. Congress held hearings on the strategic importance of minerals between 2007 and 2010, and the 2010 National Defense Authorization Act required DOD to study and report on its dependence on rare earth elements for weapons, communications and other systems.3 During a 2009 hearing on minerals and military readiness, Republican Representative Randy Forbes of Virginia called minerals, “one of those things that no one really talks about or worries about until something goes wrong. It’s at that point – the point where we don’t have the steel we need to build MRAPs [Mine Resistant Ambush Protected vehicles] or the rhenium we need to build a JSF [Joint Strike Fighter] engine that the stockpile becomes critically important.”4 In October 2010, Secretary of State Hillary Rodham Clinton stated that it would be “in our interests commercially and strategically” to find additional sources of supply for rare earth minerals, and stated that China’s recent cuts to rare earth exports “served as a wakeup call that being so dependent on only one source, disruption could occur for natural disaster reasons or other kinds of events could intervene.”5 In January 2011, Sen. Mark Begich, D-Alaska, Sen. Lisa Murkowski, R-Alaska, and Rep. Mike Coffman, R-Colo., wrote a letter to Defense Secretary Robert Gates expressing concern for minerals required for producing defense equipment such as Joint Direct Attack Munitions (JDAMs), which stated, “Clearly, rare earth supply limitations present a serious vulnerability to our national security. Yet early indications are that DOD has dismissed the severity of the situation to date.”6 Additionally, the Department of Energy (DOE) launched a multiyear effort to explore potential vulnerabilities in supply chains for minerals that will be critical to four distinct areas of energy technology innovation. While concern is growing, the media and policymakers often focus too narrowly on what may seem the most compelling indicators – usually import dependence or scarcity – in prescribing solutions to reduce U.S. vulnerabilities, in particular to supply disruptions in critical minerals such as rare earths. This focus is sparking protectionist attitudes, with some worrying that import dependence poses an inherent risk to the U.S. economy. Discussion of minerals also frequently focuses on supply scarcity and resource depletion in absolute terms. However, both the rhenium and rare earth minerals disruptions of the past five years were triggered by deliberate decisions made by political leaders to leverage their positions of strength, not by market forces, disorder or scarcities of these minerals. Countries often revert to hoarding, pressuring suppliers and otherwise behaving as if scarcities are present even when they are not, based solely on concerns that shortages are likely in the near term. In fact, neither scarcity nor import dependence alone is sufficient to signal vulnerability, and a combination of factors including concentration of suppliers is most often required for mineral issues to become security or foreign policy problems. This report, based on two years of research, site visits and discussions with stakeholders, explores how the supply, demand and use of minerals can impair U.S. foreign relations, economic interests and defense readiness. It examines cases of five individual minerals – lithium, gallium, rhenium, tantalum and niobium – and rare earth elements, such as neodymium, samarium and dysprosium, as a sixth group in order to show the complexity of addressing these concerns. Each of these minerals is critical for defense technologies and U.S. economic growth plans. They share characteristics with minerals that have caused important political or economic concerns for the United States in the past. Additionally, lithium is frequently cited in the media and in discussions of how clean energy supply chains are critical to meeting America’s future economic, energy and environmental goals. Within the past five years, two of these cases – rhenium and rare earth minerals – have involved supply disruptions or important threats of disruptions for the United States and its allies. Each of these minerals will require federal government attention in the coming years. Pg. 6-10

Shortages risk war – countries consider rare earth metals indispensible

Hinten-Nooijen 10 (Dr. Annemarie Hinten-Nooijen, Professor of Economics at Tilburg University in the Netherlands, 3/25/10, “Rare minerals – The treasures of a sustainable economy”, <http://www.tilburguniversity.edu/nl/over-tilburg-university/cultuur-en-sport/cwl/publicaties/beschouwingen/minerals/>, JPW)

Driving a hybrid car, using energy from wind turbines or solar panels. That are choices to contribute to the transition to a sustainable economy. Sustainability is the spearhead of many western policy plans. It is regarded as the solution to get out of the crisis. But ironically, the raw materials that are needed for hybrid cars and wind turbines, for our technological industry as a whole, are not that sustainable. Necessarily required minerals like neodymium and indium are rare. And they are not available in the west, China has almost all of them. And having this position of power, China wants to use it. That is about strategy. The high-tech raw materials play a central part in the highly industrialised high-wage countries to survive the global competition by technological excellence. Will future wars be about minerals instead of oil, territories or water? THE BONE MARROW OF MODERN ECONOMY Minerals are an indispensable material pillar of our current economies and societies. They are the natural product of geological processes and occur in the crust of the planet. Only a fraction of the known minerals exists in greater quantities. Some of these are mined, refined and processed; are broken up into their elemental components, which are recombined into different types of materials. These materials are used to manufacture products that form the backbone of our modern economies: from LCD displays to fighter jets, from smart phones to electric cars. Without minerals, industrial society and modern technology would be inconceivable. That seems unbelievable, because we hardly hear or read about them in the media - whereas several research reports have been published recently. But imagine that by reading this article on printed paper or at your computer screen, minerals like nickel, chromium, molybdenum, gallium, selenium, aluminium, silicon and manganese were needed! And all these elements have to be first extracted from minerals, which in turn need to be mined from the earth's crust. CHINA'S GREEN DEAL In recent years, the world economy has grown enormously, and many new high-tech applications have been made. Moreover, the demand for minerals has exploded. Mining tried to meet the demand. A global competition between countries and companies over rare mineral resources started. Prices have shot up, countries have created strategic stockpiles or imposed export restrictions in order to secure supplies of these valuable resources. Mineral scarcity concerning the industry seems to be more of an economic issue than an issue set by limited resources. Minerals are getting evermore difficult to find and costly to extract - while they are the key to advanced sustainable technologies. Talking about sustainability seems not talking about China, because China is still building many polluting coal-fired power plants, and the social circumstances there are poor. However, recent developments also show progress concerning sustainability. And in a country like China these developments go faster than in many western democracies. Where we in the west talk and dawdle, they think and act strategically. In the United States, president Obama has to explain the Americans that forms of the New Green Deal are inevitable - like the situation in the thirties of the last century, when President Roosevelt made the so-called New Deal to reform the economy. Many Americans do not want the government to influence the market. They radically believe in the free market. In China, by contrast, the ideological separation between market and government does not exist. There is no Wall Street with greedy bankers, no neoconservative Grand Old Party that dreams of the cowboy economy. Decisions are taken quickly. And besides, they have to feed one billion people and develop a country that lived in Mao-ist poverty before. The Chinese are successful, after all, also in creating a sustainable economy: China does not only build old polluting power stations but uses the latest technology, with CO2- catch and -storage. And they are working on alternatives: windmills. In the next five years, they will build 100,000 windmills in the Gobi desert. Did they hate the wind in that area before, now they consider it the new gold. In the north-west area of China, the province of Gansu, the Qilian-mountains pass into the Gobi desert. There China is building the biggest windmill and solar panel park in the world. Six windmill parks with a capacity of ten gigawatts each are built, making China the biggest market of technology of wind energy, defeating the United States. "Red China becomes green China", party officials are saying. China has to grow, and so has the contribution of wind, water and sun at the energy market. This market would be interesting for foreign investments. According to Chinese officials they are welcome and can get subsidies. But, Beijing has decided that 70 percent of the windmills have to be made and designed in China. So it can be questioned if European and American companies have a fair chance in tendering for a contract. China considers itself a developing country and thinks that the western countries should contribute money to China to reduce the CO2 discharge. While America thought that energy saving is not worthwhile, China has taken an enormous energy-technological lead. The authoritarian and undemocratic but intelligent China exposes a variant of the New Deal. THE OPEC OF THE RARE MINERALS The example of China shows us that sustainable economy has everything to do with strategy and power. In a few decades China has been flooding the market of rare metals. The legend goes that president Deng Xiaoping had already predicted this in 1992, during a tour in the south of China: "They [the Mid East] have oil, but we in China have rare minerals". Nowadays, China indeed has 95 percent of the global supply of rare minerals. How did it do that? It was a result of good strategy: in the nineties, China flooded the world market with the rare minerals, although there was not that much demand. The west thought it okay because getting the minerals was a very expensive production process and the environmental legislation was very strict. The western competitors went bankrupt and they closed their mines. China became powerful. One of the centres of the rare mineral supply is around the city Baotou, an industrial city of two million people in Inner Mongolia. Here the states concern exploits almost half of the world storage of neodymium. DISRUPTION OF THE MARKET The lack of raw materials is not particularly a result of the geological availability but of disruptions in the market, because the developments of the world wide demand for rare minerals are not recognised in time - as part of the stormy development of the Chinese economy and the expansion of technical developments - and because the minerals occur in only a few countries. Experts have predicted that in the next few decades the demand of neodymium will increase by a factor 3.8. China uses 60 percent of its exploitation for its own economy. What's more, the Chinese export quota become stricter every year. What happens? Sudden peaks in the demand can lead to speculative price movements and a disruption of the market. "2010 will be the year of the raw materials", according to Trevor Greetham, Asset Allocation Director of Fidelity. Indium, a silver-white metal, which is not found directly in nature, but is a residual product of thin and zinc, is used in LCD displays for TVs, computers, mobile phones, and for led lights and the ultrathin and flexible solar panel. The price of this mineral multiplied tenfold between 2003 and 2006 from 100 to 980 Dollars per kilogram. The price of neodymium decreased from 11.7 dollar per kilogram in 1992 to 7.4 dollar in 1996. The market volume rose. In 2006 almost all of the world production of 137,000 tons came from China. By scaling back the export, prices rose, up to 60 dollar per kilogram in 2007. Imagine that for a hybrid car, like the Toyota Prius or the Mercedes S 400, you need at least 500 grams of neodymium for the magnetic power of the engine; and for the newest generation of wind turbines, the ones that are 16 meters high, you need about 1000 kilogram. That makes 60,000 dollars - for just a little bit of metal! Big business for China. At the same time, China makes further strategic investments: it took an interest in oil and gas fields. In August 2009, PetroChina paid 41 billion dollar to gain access to an enormous field of natural gas in front of the coast of Australia. And in September that year, it obtained a stake of 60 percent in the exploitation of fields of tar sand in Alberta, which might hold one of the biggest oil reserves in the world. And because China considers titanium a growing market, it took an interest of 70 percent in a titanium mine in Kenia - not only to build the Chinese 'Jumbojet', but also to provide Boeing with 2000 tons of titanium each year. By doing so, China might beat the competition in the battle for the market in green technologies. The 'free' market can be questioned. The mineral policies of China and the US both mention the usage of administrative barriers. These nontariff barriers involve regulations that seek to protect the national mineral extraction industry. As a result, it is much harder for foreign companies, if not impossible, to invest and gain a foothold in the national mineral extraction industry in these countries. The search for rare metals has become a global race: a mine in California has also been reopened, the mine of Mountain Pass. In 2008, it was bought by a group of investors, the partnership 'Molycorp Minerals'. The process of bringing the old mines into use costs much time and money. What does this mean for us? Do we get more dependent of China? The 'Innovationplatform' in Rotterdam planned to build a unique windmill park in the sea, further from the coast and in the strongest sea wind than anywhere in the world. To build these windmills, we need rare minerals, the export of which is dominated by China. Part of the project is Darwind, which designed enormous windmills for at sea. But the umbrella company, of which Darwind is part, Econcern, was about to go bankrupt. Then, in mid-August 2009 it was saved by the, surprisingly, Chinese XEMC. THE THREAT OF GEOPOLITICAL INSTABILITY The transition to a sustainable economy involves underexposed elements like deficiency in minerals and shifting balances of power. They are the ideal receipt for geopolitical instability. The new world order will be a balance between countries that do have particular raw materials and ones that do not. The lack of indispensable minerals sharpens the relations in the world. The access to critical minerals is more and more an issue of national security, concluded the 'The Hague Centre for Strategic Studies' (HCSS) in its report about the scarcity of minerals (January 2010). The US, Japan and China are making a policy that tries to secure the supply of these raw materials. That will disturb the free market activity. HCSS thinks that large concerns will, with support of the government, compete more intensively with each other for access to these raw materials, e.g. by direct investments in areas rich in raw materials. Mineral scarcity will be an issue in the next decades, though it is uncertain when and to what extent. And we have to do something because a change in supply of rare minerals directly affects our current modern lives.

[Insert China War Impacts/General War Impacts]

Scenario 2 – Heg

Rare earths are crucial to almost every component of a functioning military – US war fighting depends on them

Hsu 10 (Jeremy Hsu, Freelance Journalist, writer for PopSci and LiveScience, 4/14/10, “US Military Supply of Rare Earth Metals Not Secure, Live Science, )

The U.S. Department of Defense did not have details on national security risks related to a possible [rare earth shortage](http://www.technewsdaily.com/shortage-of-rare-earth-elements-could-thwart-innovation-0206/) for the GAO report. But it plans to complete its assessment of dependency upon rare earths by September 2010. Military officials did stress how rare earth elements form a currently irreplaceable part of devices such as lasers, radar, missile-guidance systems, satellites and aircraft electronics. And many military systems also rely upon commercial computer hard drives that use rare earth magnets. Even more specific examples of rare earth-driven technologies include the navigation system for the M1A2 Abrams battle tank, and a new hybrid electric drive in the works for the Navy's DDG-51 destroyers. Rare earth elements might eventually become part of the U.S. National Defense Stockpile, according to the GAO report.

Rare earths are key to the US military. China could shut down the military in months.

Barry 10 (Jennifer Barry Editor at Global Asset Strategist 10/22/2010 Financial Sense “China's Rare Earth Revenge” http://www.financialsense.com/contributors/jennifer-barry/china-rare-earth-revenge)

Although the US is not a major manufacturer of high tech consumer products containing REEs, the military is dependent on (REEs) them. As modern weapons from smart bombs to tanks require these metals, the ability of America to wage war depends on a steady supply of rare earths. The US was not always dependent on the continued goodwill of foreign countries for critical materials. The National Stockpile was established after World War II to assure that essential elements would be available in case of an emergency. In the 1990s, the US Department of Defense (DOD) decided that 99% of the stockpile was “surplus” and the vast majority was sold. Although China has dominated the rare earth market since the mid-1990s, the US government was unconcerned about Chinese control of these elements for many years. Only in April 2009, did the DOD and Congress finally place a freeze on the sale of some materials, and decide to conserve a minimum of a one year supply for others. While the US House of Representatives has passed a bill to promote locating and exploiting rare earth resources, I wonder if this action is too little too late. Not only are these metals necessary for weapons, but for “green” technology that attempts to lessen dependence on foreign oil, supplied mostly by countries unfriendly to the US. While the Mountain Pass mine in California was allowed to reopen, and Congress may subsidize more rare earth resource development, it takes 7 to 15 years to move from a promising deposit to a producing ore body. With inadequate domestic stockpiles, China could shut down America’s military offensives in a matter of months.

Hard power is key to heg

Holmes ’09 (Kim, Vice President for Foreign and Defense Policy Studies and Director of the Kathryn and Shelby Cullom Davis Institute for International Studies at The Heritage Foundation and author of Liberty's Best Hope: American Leadership for the 21st Century (2008), “Sustaining American Leadership with Military Power”, http://www.heritage.org/Research/Reports/2009/06/Sustaining-American-Leadership-with-Military-Power, June 1, 2009, Accessed June 28, 2010) DM

The consequences of hard-power atrophy will be a direct deterioration of America's diplomatic clout. This is already on display in the western Pacific Ocean, where America's ability to hedge against the growing ambitions of a rising China is being called into question by some of our key Asian allies. Recently, Australia released a defense White Paper that is concerned primarily with the potential decline of U.S. military primacy and the implications that this decline would have for Australian security and stability in the Asia-Pacific. These developments are anything but reassuring. The ability of the United States to reassure friends, deter competitors, coerce belligerent states, and defeat enemies does not rest on the strength of our political leaders' commitment to diplomacy; it rests on the foundation of a powerful military. Only by retaining a "big stick" can the United States succeed in advancing its diplomatic priorities. Only by building a full-spectrum military force can America reassure its many friends and allies and count on their future support.

[Insert Heg Impacts]

Asteroid mining solves rare earth shocks and shortages

Sonter 06 (Michael Sonter, independent scientific consultant working in the Australian mining and metallurgical industries, former high school science teacher, former a University Physics lecturer in Papua New Guinea, postgraduate studies in medical physics, and 28 years in uranium mining radiation safety management, granted funds from Foundation for International Non-governmental Development of Space (FINDS) to develop concepts for mining the near-Earth asteroids, 2/9/06, “Asteroid Mining: Key to the Space Economy,” Space.com, <http://www.space.com/2032-asteroid-mining-key-space-economy.html>)

The Near Earth Asteroids offer both threat and promise. They present the threat of planetary impact with regional or global disaster. And they also offer the promise of resources to support humanity's long-term prosperity on Earth, and our movement into space and the solar system. The technologies needed to return asteroidal resources to Earth Orbit (and thus catalyze our colonization of space) will also enable the deflection of at least some of the impact-threat objects. We should develop these technologies, with all due speed! Development and operation of future in-orbit infrastructure (for example, orbital hotels, satellite solar power stations, earth-moon transport node satellites, zero-g manufacturing facilities) will require large masses of materials for construction, shielding, and ballast; and also large quantities of propellant for station-keeping and orbit-change maneuvers, and for fuelling craft departing for lunar or interplanetary destinations. Spectroscopic studies suggest, and 'ground-truth' chemical assays of meteorites confirm, that a wide range of resources are present in asteroids and comets, including nickel-iron metal, silicate minerals, semiconductor and platinum group metals, water, bituminous hydrocarbons, and trapped or frozen gases including carbon dioxide and ammonia.  As one startling pointer to the unexpected riches in asteroids, many stony and stony-iron meteorites contain Platinum Group Metals at grades of up to 100 ppm (or 100 grams per ton).  Operating open pit platinum and gold mines in South Africa and  elsewhere mine ores of grade 5 to 10 ppm, so grades of 10 to 20 times higher would be regarded as spectacular if available in quantity, on Earth. Water is an obvious first, and key, potential product from asteroid mines, as it could be used for return trip propulsion via steam rocket. About 10% of Near-Earth Asteroids are energetically more accessible (easier to get to) than the Moon  (i.e. under 6 km/s from LEO), and a substantial minority of these have return-to-Earth transfer orbit injection delta-v's of only 1 to 2 km/s. Return of resources from some of these NEAs to low or high earth orbit may therefore be competitive versus earth-sourced supplies. Our knowledge of asteroids and comets has expanded dramatically in the last ten years, with images and spectra of asteroids and comets from flybys, rendezvous, and impacts (for example asteroids Gaspra, Ida, Mathilde, the vast image collection from Eros, Itokawa, and others; comets Halley, Borrelly, Tempel-1, and Wild-2.  And radar images of asteroids Toutatis, Castalia, Geographos, Kleopatra, Golevka and other...  These images show extraordinary variations in structure, strength, porosity, surface features.  The total number of identified NEAs has increased from about 300 to more than 3,000 in the period 1995 to 2005. The most accessible group of NEAs for resource recovery is a subset of the Potentially Hazardous Asteroids (PHAs).  These are bodies (about 770 now discovered) which approach to within 7.5 million km of earth orbit.  The smaller subset of those with orbits which are earth-orbit-grazing give intermittently very low delta-v return opportunities (that is it is easy velocity wise to return to Earth). These are also the bodies which humanity should want to learn about in terms of surface properties and strength so as to plan deflection missions, in case we should ever find one on a collision course with us. Professor John Lewis has pointed out (in Mining the Sky) that the resources of the solar system (the most accessible of which being those in the NEAs) **can permanently support in first-world comfort some quadrillion people**.  In other words, the resources of the solar system are essentially infinite... And they are there for us to use, to invest consciousness into the universe, no less.  It's time for humankind to come out of its shell, and begin to grow!! So both for species protection and for the expansion of humanity into the solar system, we need to characterize these objects and learn how to mine and manage them.  Once we learn how to work on, handle, and modify the orbits of small near-earth objects, we will have achieved, as a species, both the capability to access the vast resources of the asteroids, and also the capability to protect our planet from identified collision threats. Since the competing source of raw materials is "delivery by launch from Earth," which imposes a launch cost per kilogram presently above $10,000 per kg, this same figure represents the upper bound of what recovered asteroidal material would be presently worth in low earth orbit.  Future large scale economic activity in orbit is unlikely to develop however until launch cost drops to something in the range $500 to $1,000 per kilogram to LEO.  At that point, any demand for material in orbit which can be satisfied at equal or lower cost by resources recovered from asteroids, will confer on these asteroidal resources an equivalent value *as ore* in true mining engineering terms, i.e., that which can be mined, have valuable product recovered from it, to be sold for a profit.  Now, $500,000 per ton product is extraordinarily valuable, and is certainly worth chasing! Note that the asteroidal materials we are talking about are, simply, water, nickel-iron metal, hydrocarbons, and silicate rock.  Purified, and made available in low earth orbit, they will be worth something like $500,000 per ton, by virtue of having avoided terrestrial gravity's "launch cost levy." These are values up there with optical glass, doped semiconductors, specialty isotopes for research or medicine, diamonds, some pharmaceuticals, illicit drugs.  On the mining scene, the only metal which has ever been so valuable was radium, which in the 1920's reached the fabulous value of $200,000 per gram! Platinum Group Metals (which are present in metallic and silicate asteroids, as proved by the "ground truth" of meteorite finds) have a value presently in the order of $1,000 per ounce or $30 per gram.  Vastly expanded use in catalysts and for fuel cells will enhance their value, and PGM recovery from asteroid impact sites on the Moon is the basis of Dennis Wingo's book, "Moonrush." When will we see asteroid mining start?  Well, it will only become viable once the human-presence commercial in-orbit economy takes off.  Only then will there be a market.  And that can only happen after NASA ceases acting as a near-monopolist launch provider and thwarter of competition, and reverts to being a customer instead.  A developing in-space economy will build the technical capability to access NEAs, almost automatically.  And regardless of the legal arguments about mineral claims in outer space, once the first resource recovery mission is successful, what's the bets on a surge in interest similar to the dotcom-boom and biotech-boom?  The first successful venturers will develop immense proprietary knowledge, and  make a mint.  And some as-yet unidentified (but almost certainly already discovered) NEAs will be the company-making mines of the 21st century.

Establishing a government-run rare earth stockpile solves supply shocks

Humphries 10 (Marc Humphries, energy and mineral analyst for the Library of Congress, 9/30/10, “Rare Earth Elements: The Global Supply Chain,” Congressional Research Service Report, <http://www.fas.org/sgp/crs/natsec/R41347.pdf>)

Establishing a government-run economic stockpile and/or private-sector stockpiles that would contain supplies of specific REE broadly needed for “green initiatives” and defense applications is a policy advocated by some in industry and government. This may be a prudent investment. Generally, stockpiles and stockpile releases could have an impact on prices and supply but would also ensure supplies of REE materials (oxides, metals, etc.) during times of normal supply bottlenecks. An economic stockpile could be costly and risky, as prices and technology may change the composition of REEs that are needed in the economy. According to USGS, 34 DOD along with USGS is examining which of the REEs might be necessary in the National Defense Stockpile (NDS). In the recent past, NDS materials were stored for wartime use based on a three-year war scenario. Some of the rare earth elements contained in the National Defense Stockpile were sold off by 1998. However, rare earth elements were never classified as strategic minerals. 35 DOD had stockpiled some yttrium but has since sold it off, and none of the REEs have been classified as strategic materials. A critical question for stockpile development would be: What materials along the supply chain should be stockpiled? For example, should the stockpile contain rare earth oxides or alloyed magnets which contain the REEs, or some combination of products? The National Research Council (NRC) has produced an in-depth report on minerals critical to the U.S. economy and offers its analysis as described here: “... most critical minerals are both essential in use (difficult to substitute for) and prone to supply restrictions.” 36 While the NRC report is based on several availability criteria used to rank minerals for criticality (geological, technical, environmental and social, political, and economic), REEs were determined to be critical materials assessed at a high supply risk and the possibility of severe impacts if supplies were restricted. Some of the REE applications are viewed as more important than others and some are at greater risk than others, namely the Heavy Rare Earth Elements (HREEs), as substitutes are unavailable or not as effective. 37 The federal government and private sectors are beginning to address how to secure reliable rare earth materials (raw materials through metals and alloys) from China and non-Chinese sources in the short term, and how to rebuild the U.S. supply chain for the long term.

Federal government policy action is critical to solve dependence issues

Parthemore 11 (Christine Parthemore, Fellow at the Center for a New American Security (CNAS), where she directs the Natural Security Program and the Natural Security Blog. This program explores national security and foreign policy issues related to natural resources and their consumption, including energy, minerals, land, water, climate change and biodiversity loss. She is the author or co-author of publications including: Sustaining Security: How Natural Resources Influence National Security; Broadening Horizons: Climate Change and the U.S. Armed Forces; Iran: Assessing U.S. Strategic Options; Uncharted Waters: The U.S. Navy and Navigating Climate Change; and A Strategy for American Power: Energy, Climate, and National Security. She also co-authored a chapter in the 2008 book Climatic Cataclysm: The Foreign Policy and National Security Implications of Global Climate Change, June 2011, “Elements of Security: Mitigating the Risks of US Dependence on Critical Minerals”, <http://www.cnas.org/files/documents/publications/CNAS_Minerals_Parthemore_1.pdf>, JPW)

Reliable access to critical minerals is a matter of both economic and geostrategic importance to the United States. Although concern about access to minerals waxes and wanes, it is rising now due to increasing demand, new competitors capturing large market shares and other trends that defy easy prediction. These same trends can interfere with foreign and defense policy goals and give mineral suppliers easy leverage over the United States and other countries reliant on global supply chains. Despite renewed attention to critical minerals, America’s dependence on these minerals is often misunderstood and miscast in the public debate. Recent tensions with China concerning the supply of rare earth elements, for instance, should challenge U.S. policymakers not because the United States’ import dependence is inherently problematic (which it is not) or because rare earth minerals are scarce (which they are not). Rather, rare earths deserve attention because U.S. supply options are limited: Supplies are concentrated mostly in the hands of one supplier with its own rising demand, and the United States currently has no good options for recycling rare earth minerals or substituting more easily obtained minerals. While China is nearly the sole producer and exporter of rare earths today, it does not possess a permanent “corner” on this market. Indeed, China holds only about half of known world reserves – not a terribly high concentration. 1 The loss of a single major supplier such as China may therefore increase the costs of rare earth minerals, but may not affect their long-term availability. The issue, then, is more appropriately understood in terms of managing short-term risks such as disruptions and ensuring that the U.S. government’s most important defense and energy needs can be met. To manage these risks, the U.S. government needs to alter government policy, ensure access to correct information about mineral markets and better assess which minerals are required for a small number of strategic needs, such as defense and energy. It must also use existing mechanisms, such as stockpiling and research and development funding, to help mitigate risks. The Department of Defense (DOD) can also understand its unique supply needs better by including mineral problems in relevant war games involving regions such as the South China Sea and Latin America. U.S. policy should focus on: • Preventing supplier countries and companies from wielding undue leverage over the United States. • Mitigating fiscal risk and cost overruns in an era of budgetary strain. • Reducing vulnerability to supply disruptions, especially for critical military assets. • Ensuring the ability of the United States to meet its economic growth goals in clean energy and other high-tech fields. The United States should not be complacent about its access to critical minerals. Political and economic risks to critical mineral supplies are still visible on the horizon and the stakes are high. Growing global demand coupled with the mineral requirements necessary for both managing military supply chains and transitioning to a clean energy future will require not only clearer understanding, but also pragmatic and realistic solutions.

The perception of the US moving toward asteroid mining would cause China to loosen its grip on rare earth minerals

Bova 10 (Ben Bova - President Emeritus of the National Space Society, frequent commentator on radio and television and a widely-popular lecturer, earlier, former award-winning editor and an executive in the aerospace industry, 11/28/10 “Rare earth elements are in the news,” NapleNews, <http://www.naplesnews.com/news/2010/nov/27/ben-bova-nov-28-2010-rare-earth-elements-are-news/>)

If we’re going to send astronauts to an asteroid, why not include a geologist who can bring back some samples of rare earths? Why not give the mission a purpose beyond merely exploring for the sake of scientific knowledge? Why not begin to exploit the natural resources that lie among the asteroids? Such an effort could act as an incentive for private industry to move farther into space than merely providing rockets to ferry people and cargo to the International Space Station. It could also show the world — and particularly the Chinese government — that we can move beyond our dependence on their resources (and ploys). Mining rare earths from asteroids would be enormously expensive, at first. But the effort could help to start a transition toward developing space industries. In time, we could see many industrial operations running in space, using virtually free solar energy, while our world becomes cleaner and greener: a residential zone, with industry moving off our planet. Would a move in this direction influence the Chinese government to relax its grip on rare-earth exports? There is a precedent for this sort of thing. In the 1980s, when former President Ronald Reagan proposed the Strategic Defense Initiative (aka “Star Wars”) it started a chain of events that led eventually to the fall of the Soviet Union. We didn’t go ahead with SDI — indeed, we still do not have a credible defense against ballistic missiles. But the possibility that the U.S. might develop missile defenses helped to crack the Soviet Union apart. The possibility of mining rare earths from asteroids might help influence China, too.

Beginning the mining process will alter US security calculations – The notion of shortages will become a historical footnote

Kolber 06 (Jonathan Kolber, Co-Founder and Vice President of Space Energy Access Systems, “Investing in Outer Space,” Penny Sleuth, 10/11/06,<http://pennysleuth.com/investing-in-outer-space/>//edlee)

 The mining of asteroids has been a passion of mine for over two decades. In 1983, I wrote a paper for my MBA strategy and policy class entitled, “Mining the Asteroids: A Diversification Opportunity for DeBeers.” In it, I argued that asteroid mining offered a perfect balance in that DeBeers faced, in apartheid, serious political risk with negligible technological risk, while asteroid mining was exactly the opposite. Yes, there’s gold in “them thar asteroids” — and diamonds, and every other element and mineral to be found on Earth, apparently in similar ratios. The difference is that the asteroids could be the remnants of a planet many hundreds of times bigger than Earth. Calculations have established that we could strip mine the entire Earth to a depth of ½ mile and not acquire nearly the volume of natural resources available free for the taking in asteroids. Such a resource literally dwarfs anything in human history or perspective, and when we finally do begin mining asteroids, the whole notion of resource shortages will rapidly diminish to a historical footnote.

Simply acknowledging its feasibility solves

Collins & Autino 08 (Patrick Collins, Professor at Azabu University, expert in the economics of energy supply from space, a Collaborating Researcher with the Institute for Space & Astronautical Science, co-founder of Space Future Consulting, Adriano Autino, President of the [Space Renaissance International](http://www.spacerenaissance.org/); Manager, CEO/CTO, Systems Engineering Consultant / Trainer at[Andromeda Systems Engineering LLC](http://www.andromedasystemsengineering.com/), Supplier of methodological tools and consultancy at [Intermarine S.p.A.](http://www.rodriquez.it/intermarine/home_intermarine.php), 5/25/08, “What the growth of a space tourism industry could contribute to employment, economic growth, environmental protection, education, culture and world peace,” Space Future, <http://www.spacefuture.com/archive/what_the_growth_of_a_space_tourism_industry_could_contribute_to_employment_economic_growth_environmental_protection_education_culture_and_world_peace.shtml>]

 7. World peace and preservation of human civilization - The major source of social friction, including international friction, has surely always been unequal access to resources. People - fight to control the valuable resources on and under the land, and in and under the sea. The natural resources of Earth are limited in quantity, and economically accessible resources even more so. As the population grows, and demand grows for a higher material standard of living, industrial activity grows exponentially. The threat of resources becoming scarce has led to the concept of ‘‘Resource Wars’’. Having begun long ago with wars to control the gold and diamonds of Africa and South America, and oil in the Middle East, the current phase is at centre stage of world events today [37]. A particular danger of ‘‘resource wars’’ is that, if the general public can be persuaded to support them, they may become impossible to stop as resources become increasingly scarce. Many commentators have noted the similarity of the language of US and UK government advocates of ‘‘war on terror’’ to the language of the novel ‘‘1984’’ which describes. a dystopian future of endless, fraudulent war in which citizens are reduced to slaves. 7.1. Expansion into near-Earth space is the only alternative to endless ‘‘resource wars’’ As an alternative to the ‘‘resource wars’’ already devastating many countries today, opening access to the unlimited resources of near-Earth space could clearly facilitate world peace and security. The US National Security Space Office, at the start of its report on the potential of space-based solar power (SSP) published in early 2007, stated: ‘‘Expanding human populations and declining natural resources are potential sources of local and strategic conflict in the 21st Century, and many see energy as the foremost threat to national security’’ [38]. The report ended by encouraging urgent research on the feasibility of SSP: ‘‘Considering the timescales that are involved, and the exponential growth of population and resource pressures within that same strategic period, it is imperative that this work for ‘‘drilling up’’ vs. drilling down for energy security begins immediately’’ [38]. Although the use of extra-terrestrial resources on a substantial scale may still be some decades away, it is important to recognize that simply acknowledging its feasibility using known technology is the surest way of ending the threat of resource wars .That is, if it is assumed that the resources available for human use are limited to those on Earth, then it can be argued that resource wars are inescapable [22,37]. If, by contrast, it is assumed that the resources of space are economically accessible, this not only eliminates the need for resource wars, it can also preserve the benefits of civilization which are being eroded today by‘ ‘resource war-mongers’’, most notably the governments of the ‘‘Anglo-Saxon’’ countries and their ‘‘neo-con’’ advisers. It is also worth noting that the $1trillion that these have already committed to wars in the Middle-East in the 21st century is orders of magnitude more than the public investment needed to aid companies sufficiently to start the commercial use of space resources. Industrial and financial groups which profit from monopolistic control of terrestrial supplies of various natural resources, like those which profit from wars, have an economic interest in protecting their profitable situation. However, these groups’ continuing profits are justified neither by capitalism nor by democracy: they could be preserved only by maintaining the pretence that use of space resources is not feasible, and by preventing the development of low-cost space travel. Once the feasibility of low-cost space travel is understood, ‘‘resource wars’ ’are clearly foolish as well as tragic. A visiting extra-terrestrial would be pityingly amused at the foolish antics of homo sapiens using long- range rockets to fight each other over dwindling terrestrial resources—rather than using the same rockets to travel in space and have the use of all the resources they need! Pg. 1560-156

Advantage 2 – Deflection

NASA has no technology to currently deflect an asteroid, but it could develop a nuclear missile deflection system in the future

Wagenseil 07 (Paul Wagenseil, reporter for Fox News, 8/8/07, “NASA Researchers Ponder Nuclear Asteroid Deflector,” Fox News, [http://www.foxnews.com/story/0,2933,292464,00.html](http://www.foxnews.com/story/0%2C2933%2C292464%2C00.html))

NASA scientists have proposed a spacecraft that would use atomic blasts to deflect asteroids on collision courses with Earth. Researchers from the Advanced Concepts Office at NASA's [Marshall Space Flight Center](http://www.nasa.gov/centers/marshall/home/index.html) in Huntsville, Ala., presented the idea at the 2007 [Planetary Defense Conference](http://www.aero.org/conferences/planetarydefense/), held in early March in Washington, D.C. The asteroid deflector would be launched from low Earth orbit by an Ares V rocket, NASA's next-generation heavy-cargo lifter, scheduled to go into service in 2020. As it approached the asteroid, the craft would at one-hour intervals release six missile-like interceptors, each tipped with a B83 one-megaton nuclear warhead. The warheads would detonate one by one near the surface of the asteroid, pushing it far enough off course so that it passes comfortably wide of Earth. Les Johnson, manager of interstellar propulsion research at the Marshall Center, took care to point out that the asteroid deflector is just an idea so far. "There's no blueprints. There's no funding," he said. "At this stage, it's just one of the many possible uses for the Ares V vehicle."

Nuclear missile asteroid deflection fails and risks war with China – 4 reasons

O’Neill 10 (Ian O’Neill, Space Producer for Discovery News, solar physicist, 6/28/10, “DON'T BE SUBTLE, NUKE THAT ASTEROID,” DiscoveryNews, <http://news.discovery.com/space/dont-be-subtle-nuke-that-asteroid.html>)

Personally, while I agree with Dearborn that nukes are our most powerful defense against asteroids, [there are many other factors to consider](http://news.discovery.com/space/another-good-reason-not-to-shoot-nukes-at-asteroids.html). Firstly, what if the resulting explosion rips the asteroid to shreds, but big chunks of asteroid then rain down on Earth, blanket bombing entire continents? Choosing whether to get hit by one big asteroid or a shower of smaller (but still rather big) asteroid chunks isn't a choice I'd want to make. Secondly, what if the USA fired a missile at a medium-sized asteroid, only to deflect it into China? Wars have started over much less. Thirdly, we don't have a very good understanding about the structure of asteroids. An asteroid composed of very loose rock held together under a mutual gravity (a "rubble pile") will act very differently to a solid, metallic asteroid when faced with a huge explosion. President Obama's plan to send NASA astronauts to an asteroid to study it up close suddenly seems like a good idea. Also, [a recent study](http://news.discovery.com/space/another-good-reason-not-to-shoot-nukes-at-asteroids.html) showed that a direct hit by a nuclear weapon might rip the offending asteroid apart, but it could re-form if the bomb wasn't big enough.

Nuking an asteroid will either have no effect or the asteroid will reform after the explosion – nonnuclear mechanisms are the only way to ensure deflection

O’Neill 10 (Ian O’Neill, Space Producer for Discovery News, solar physicist, 4/21/10, “ANOTHER GOOD REASON NOT TO SHOOT NUKES AT ASTEROIDS,” DiscoveryNews, <http://news.discovery.com/space/another-good-reason-not-to-shoot-nukes-at-asteroids.html>)

Unfortunately, in research presented at the [Lunar and Planetary Science Conference](http://www.lpi.usra.edu/meetings/lpsc2010/) in Texas earlier this month, this "happy ending" storyline could have a nasty twist. Scientists have found that if a nuclear weapon did blow an asteroid apart, it could reassemble itself in a very short period of time, continuing its path to death and destruction. "Um, sir, the pieces of asteroid have re-formed. We have incoming! Again!" Cut to another montage of screaming people on the streets, babies crying and the hero suggesting the cast should get hammered on a 200 year-old bottle of whisky he'd been saving for a "special occasion" (or doomsday). Reforming asteroids Don Korycansky of the University of California, Santa Cruz, and Catherine Plesko of the Los Alamos National Laboratory in New Mexico [have simulated the nuke versus asteroid scenario](http://www.newscientist.com/article/mg20527514.700-terminator-asteroids-could-reform-after-nuke.html) and demonstrated that if the explosion of an interceptor nuke was too small, the asteroid will reform under its mutual gravity much faster than expected. (This is assuming the asteroid was made of rock, acting like a "rubble pile" rather than a solid lump of iron ore. It's debatable whether any explosion could do anything about an asteroid that's mainly metal, apart from heating it up a little.) Trying to destroy asteroids with nuclear explosions is a risky business at the best of times, but this research has found that a 1 kilometer-wide asteroid could reassemble itself in a matter of hours. "The high-speed stuff goes away but the low-speed stuff reassembles [in] 2 to 18 hours," said Korycansky at the meeting. Keep Your Nukes In Their Silos But it's okay, [another study from 2009](http://www.newscientist.com/article/mg20127015.600-how-to-save-the-world-from-an-asteroid-impact.html) has set a lower limit on the size of bomb to dispense with an asteroid, preventing it from reassembling. All we'd need is a 900-kiloton weapon (50 times the size of the bomb dropped on Hiroshima in 1945) to do the job properly. I'd argue that attempting to blow up an incoming asteroid should only be considered as a last ditch attempt at neutralizing the threat. So long as we have enough lead time, [there are other (less destructive) ways of changing an asteroid trajectory](http://news.discovery.com/space/near-earth-asteroid-threat.html).

Dual-use mining equipment avoids all the problems with nuclear asteroid defense and effectively deflect asteroids

SSI No Date (Space Science Institute, established by [Professor Gerard K. O’Neill](http://en.wikipedia.org/wiki/Gerard_K._O%27Neill), American physicist, space activist, and inventor of the mass driver, vision of opening the vast wealth of space to humanity, under the direction of Prof. Freeman Dyson, is to open the energy and material resources of space for human benefit within our lifetime, first commitment is to complete the missing technological links to make possible the productive use of the abundant resources in space, No Date, “Asteroid Deflection,” Space Science Institute, <http://ssi.org/reading/papers/asteroid-deflection/>)

SSI funded studies of asteroid detection, asteroid tracking, and mining of asteroids. We also studied the concept of assembling a mass driver engine in orbit, sending it to an Earth-approaching asteroid, and then using the mass driver to modify the asteroid’s orbit. This research was conducted with the goal of guiding the asteroid into a High Earth Orbit where it could be mined for its minerals. But such a technological capability, once developed, has obvious applications should we ever need to divert an asteroid from an Earth-intercepting course. For a long while, the conventional wisdom on this issue was that one would use nuclear explosives for this purpose. But according to a paper published in the June 4th, 1998 issue of Nature, this may not be as easy as previously thought. It points out that many asteroids are multi-lobed. A nuclear detonation might be largely absorbed by one lobe, with little course deflection resulting in the whole. The paper theorizes that the average asteroid may not be so much like a solid rock as an aggregate of fragments loosely held together by fine dust. If this “flying gravel pile” theory is correct, a nuclear detonation might pulverize an approaching asteroid, converting one big problem into many little ones. A mass driver engine, by contrast, could provide the low, steady, continuous thrust needed to change an asteroid’s course gradually, using the asteroid’s own material for reaction mass. The ability to modify an asteroid’s course via mass driver certainly promises to usher in a new era where space resources are freely available for construction projects in High Earth Orbit, and holds out promise for obtaining resources in a way which is not damaging to the environment of Earth. But it is just barely conceivable that this same technology might also help to avert a catastrophe of major proportions. In any event, a major program of asteroid mining can only make the Earth safer as the centuries pass. As it happens, those asteroids which cross the orbit of the Earth (and thus pose the greatest hazard) are also the ones most economically attractive for space-resource use. It is good that humanity is becoming more aware of the threat posed by Earth-crossing asteroids. But at the same time we should also become more aware of their vast economic potential.

[Insert Asteroid Impacts]