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\*\*\*CHEMICAL\*\*\*

\*\*Perchlorate D/A

Perchlorate 1NC

Rocket fuel emits perchlorate – pollutes water, and puts babies at risk of developmental issues

Madsen and Jahagirdar 6 (Travis Madsen – Policy Analyst at Frontier Group and Sujatha Jahagirdar – Political Director at Student PIRGs, spring 2006, “The Politics of Rocket Fuel Pollution”, http://www.environmentcalifornia.org/reports/clean-water/clean-water-program-reports/the-politics-of-rocket-fuel-pollution) JPG

The main ingredient in solid rocket fuel— perchlorate—pollutes drinking water sources in more than 20 states. Tests also reveal perchlorate in grocery store food supplies and in breast milk from women across the country. A 2005 study by researchers at Texas Tech University suggests that breastfed babies ingest levels of perchlorate that exceed the ‘safe dose’ recently established by the National Academy of Science—putting children at risk for development damage. California state agencies have discovered perchlorate in more than 400 water sources since 1997, including the Colorado River and hundreds of municipal wells.

Perchlorate causes massive water shortages – contamination

Waldman 2 (Peter, reporter @ wsj, 12/27/2, http://www.kuratrading.com/HTMLArticles/perchlorate.htm) JPG

Several of the nation's fastest-growing areas -- including Las Vegas, Texas and Southern California -- could face debilitating water shortages because of groundwater contamination by perchlorate, the main ingredient of solid rocket fuel. The chemical, dumped widely during the Cold War at military bases and defense-industry sites, has seeped into water supplies in 22 states. The U.S. Environmental Protection Agency and the Department of Defense are embroiled in a bitter dispute over perchlorate's health effects, with the EPA recommending a strict drinking-water limit that the Pentagon opposes as too costly. Yet even without a national standard, state regulators and water purveyors are taking no chances: Dozens of perchlorate-tainted wells have been shuttered nationwide, casting a pall on growth plans in several parched areas. Perchlorate is what scientists call an endocrine disrupter, a chemical that can alter hormonal balances -- thyroid hormones, in this case -- and thus impede metabolism and brain development, particularly among newborns. The chemical isn't believed to enter the body through the skin, so bathing in contaminated water isn't considered dangerous. The real debate is over how much ingested perchlorate causes harm. The outcome of that argument will ultimately determine how much the Pentagon and its defense contractors will have to spend to cleanse the chemical from the nation's drinking supplies. The EPA has urged the Pentagon to undertake widespread testing for perchlorate in groundwater, but the Defense Department has resisted. Its official policy, issued last month, allows testing only where a "reasonable basis" exists to suspect perchlorate contamination is both present and "could threaten public health." One major problem is that perchlorate is turning up in many unexpected places, including at military training and test ranges where rockets and missiles -- with their large quantities of solid propellants -- aren't believed to have been used. Some scientists believe other types of munitions that used tiny amounts of perchlorate may be the culprits. Many of the ordinary military ranges with perchlorate pollution lie on the outskirts of growing cities, in places that were once distant from civilian neighborhoods but now serve as watersheds and open space for sprawling suburban communities.

Perchlorate ! – General

Perchlorate contaminates food and water – causes health risks for children and pregnant women

ENS 8 (Environmental News service, 10/6/8, http://www.ens-newswire.com/ens/oct2008/2008-10-06-01.html) JPG

Ammonium perchlorate is widely used throughout the aerospace, munitions, and pyrotechnics industries as a primary ingredient in solid rocket and missile propellants, fireworks, and explosive charges. It is a component of more than 350 types of munitions, according to the Department of Defense. The chemical has been found not only in drinking water but also in lettuce and milk. In 2004, the Food and Drug Administration reported finding perchlorate in 217 of 232 samples of milk and lettuce in 15 states. Perchlorate affects the ability of the thyroid gland to take up iodine, which is needed to make thyroid hormones that regulate many body functions. Children and pregnant women are especially susceptible. \

Perchlorate causes cancer, birth defects and other problems

Anderson 3 (Adrienne, professor of Environmental & Ethnic Studies @ Boulder U, December 2003, http://www.zcommunications.org/planetary-casualties-an-interview-with-adrienne-anderson-by-david-barsamian) JPG

A horrific wave of infant defects, cancers, and other problems followed. There are significant similar cases in California with Aerojet and other military contractors. Suburban communities are being built in these subdivisions outside of urban populations. Their water supplies are being contaminated by rocket fuel cancer-causing propellants that contaminate water supply after water supply, forcing shutdowns of well water all throughout Southern California and the Sacramento area. Lockheed Martin contaminated Burbank’s water supply. You have to wonder with all the people coming down with Parkinson’s disease and all sorts of neurological problems, what’s the association with that? Are studies being done? No, they’re not. In California, Lockheed Martin was actually paying people to eat their pollution, giving them $1,000 if they would eat perchlorates, a solid rocket fuel contaminant that was contaminating public water supplies throughout California.

Perchlorate ! – Mothers + Kids Health

Perchlorate is a health threat for expectant mothers – causes impaired development in children

Madsen and Jahagirdar 6 (Travis Madsen – Policy Analyst at Frontier Group and Sujatha Jahagirdar – Political Director at Student PIRGs, spring 2006, “The Politics of Rocket Fuel Pollution”, http://www.environmentcalifornia.org/reports/clean-water/clean-water-program-reports/the-politics-of-rocket-fuel-pollution) JPG

Perchlorate, the major component of solid rocket fuel, is a health threat for expectant mothers, developing fetuses and infant children. Exposure to perchlorate has the potential to interfere with brain development, leading to a variety of learning and behavior problems. Perchlorate affects the thyroid hormone system at very low levels of exposure. It acts by preventing uptake of iodine into the thyroid gland, reducing the gland’s ability to produce enough hormone.15 Low iodine or thyroid hormone levels can lead to developmental problems, including lower IQ, impaired learning, hyperactive behavior, delayed growth, mental retardation, or other serious problems.16 Evidence exists that changes in thyroid hormone levels may be part of the cause of attention deficit and hyperactivity disorder (ADHD), a serious and growing problem in California.17 Newborns in particular are likely to be much more vulnerable to perchlorate than adults. They have no thyroid hormone stored in their glands, they have very low body weight, and thyroid hormone in their blood recycles more quickly than in adults.18 According to a study of rocket fuel levels in human breast milk, breast-fed babies ingest more than twice as much perchlorate on average than the National Academy of Sciences’ recommended “safe dose.”19 Infants exposed to the highest levels of contamination receive a dose comparable to levels that cause changes in brain structure and behavior in infant rats.20

Perchlorate causes health issues in mothers and newborns – it multiplies the effects of other harmful chemicals
Szabo 11 (Liz, writer @ USA TODAY, 1/17/11, http://www.usatoday.com/yourlife/parenting-family/pregnancy/2011-01-14-chemicals14\_st\_N.htm) JPG

In spite of these efforts, a new study shows the typical pregnant woman has dozens of potentially toxic or even cancer-causing chemicals in her body — including ingredients found in flame retardants and rocket fuel. Almost all 268 women studied had detectable levels of eight types of chemicals in their blood or urine, finds the study, published in today's Environmental Health Perspectives. It analyzed data from the Centers for Disease Control and Prevention (CDC). These chemicals include certain pesticides, flame retardants, PFCs used in non-stick cookware, phthalates (in many fragrances and plastics), pollution from car exhaust, perchlorate (in rocket fuel) and PCBs, toxic industrial chemicals banned in 1979 that persist in the environment. Many of these chemicals pass through the placenta and can concentrate in the fetus, says lead author Tracey Woodruff, director of the University of California-San Francisco Program on Reproductive Health and Environment. Other researchers have discovered some of these chemicals in babies' umbilical cords, Woodruff says. Some of the chemicals detected in the study have been linked to health problems in other studies. For example, the Food and Drug Administration has expressed "some concern" that BPA — an estrogen-like ingredient in plastic found in 96% of pregnant women — affects the development of the brain, prostate and behavior in children exposed both before and after birth. Lead and mercury are known to cause brain damage. The study tested for 163 chemicals. So, as disturbing as the findings are, the study may actually underestimate the number of chemicals circulating through women's bodies, says Sarah Janssen, a senior scientist with the Natural Resources Defense Council, an advocacy group. She's concerned that some of these chemicals may act together to cause more damage than they would alone.

Perchlorate ! – Water/Cancer

Perchlorate contaminates water supplies – causes cancer

Madsen and Jahagirdar 6 (Travis Madsen – Policy Analyst at Frontier Group and Sujatha Jahagirdar – Political Director at Student PIRGs, spring 2006, “The Politics of Rocket Fuel Pollution”, http://www.environmentcalifornia.org/reports/clean-water/clean-water-program-reports/the-politics-of-rocket-fuel-pollution) JPG

Lockheed Martin, the world’s largest defense contractor, polluted water supplies in the Redlands area of San Bernardino County, California, near where it made missiles from 1961 to 1974.42 Officials discovered trichloroethylene, an industrial solvent, in water wells near the former Lockheed site in 1980. The chemical was gradually polluting Redland’s water supply. The pollution plume—one of the largest in California—spanned more than 14 miles.43 In 1997, officials discovered widespread perchlorate contamination in the same area.44 Contamination from the Lockheed facility created a perchlorate plume measuring approximately seven square miles. Forty-seven drinking water wells have been affected to date, and concentrations as high as 70 ppb have led to the shutdown of five wells.45 Analysis showed that 63 percent of water delivered to residents in Loma Linda and 18 percent of the water supply in Redlands came from perchlorate-tainted wells.46 A group of nearly 800 people filed lawsuits against Lockheed Martin, seeking damages for health problems that could have been caused by exposure to pollution from the site, including cancer.47 Since 1998, Lockheed has spent $80 million cleaning and replacing contaminated municipal water systems around Redlands and Riverside, California. The company expects to pay $180 million more over the next 20 years cleaning up perchlorate and other chemicals that seeped into underground water supplies near this facility.48 Regulatory standards for cleanup of perchlorate contamination will affect the amount of liability Lockheed will face for cleanup and affect any pending legal cases. Regarding these standards, Lockheed spokeswoman Gail Rymer said, “Those levels determine how much treatment is necessary. It’s a cost issue.”49

Perchlorate ! – Water – Timeframe Helper

Perchlorate spreads quickly through water supplies

Newman 7 (Penny, Exec director @ Center for Community Action and Environmental Justice, 4/10/7, naturalresources.house.gov/uploadedfiles/newmantestimony04.10.07.pdf) JPG

Perchlorate travels easily in water, allowing spills to rapidly enter water supplies, and persists for many decades underground. Through careless handling, use, storage and disposal of perchlorate over the last six decades, the military and its contractors have extensively polluted California’s drinking water sources. State agencies have discovered perchlorate pollution in more than 350 California water sources, including the Colorado River and hundreds of municipal wells. Perchlorate contaminates the drinking water supply of 16 million Californians. The contamination extends into more than 10 counties, San Bernardino, Sacramento, Los Angeles, Riverside, Ventura, Tulare, Orange, Santa Clara, Sonoma and San Diego (Exhibit 3). According to the U.S. Environmental Protection Agency, Office of Research and Development the vast majority of perchlorate in the United States is synthetic associated with use in rocket propellants, explosives, road flares, air bags, electronic tubes lubricating oils, leather tanning, fabrics, electroplating, aluminum refining, rubber manufacture, and the production of paints. As a consequence of their widespread use and water solubility, huge amounts of perchlorate have leached into surface and groundwater used as drinking water source.

Perchlorate ! – Food

Perchlorate kills food supplies, unproportionally affects the Latino population

Newman 7 (Penny, Exec director @ Center for Community Action and Environmental Justice, 4/10/7, naturalresources.house.gov/uploadedfiles/newmantestimony04.10.07.pdf) JPG

The impact of perchlorate is not limited to drinking water. Perchlorate also concentrates in leafy vegetables like lettuce, which creates a concern for consumers of Imperial Valley crops irrigated with Colorado River water. Tests by scientists and advocacy organizations like the Environmental Working Group have confirmed that plants, especially broad-leaf varieties, concentrate perchlorate from the environment. Scientists have found perchlorate in plant tissues at levels up to 100 times higher than in nearby water sources. In 2004, The Food and Drug Administration released a study finding perchlorate in 90 percent of 128 lettuce samples and in all but three of the 104 milk samples, with average levels ranging from six parts per billion in milk to 12 parts per billion in Romaine lettuce. These results raise the possibility that perchlorate contamination is much more widespread than regulators currently know, and that exposure is wide spread across the country. Perchlorate is highly mobile in water and can persist for decades under typical ground and surface water conditions. Research has also shown that perchlorate can concentrate in crops such as wheat, lettuce, alfalfa, and cucumbers thereby resulting in much greater exposures than might be predicted by water or fertilizer concentrations. Newer data have shown perchlorate contamination to be widespread in store-bought fruit, vegetables, cow’s milk, beer and wine. Perchlorate has been found in human breast milk at levels up to 92 ppb, and was found in every one of 2820 urine samples the Centers for Disease Control recently tested for perchlorate. Nopales, a staple in the Latino communities, has similar characteristics of those vegetables found to uptake perchlorate easily such as lettuce. A concern for low income Latino communities that rely on the tasty succulent as a major food source is that perchlorate levels will be high in this crop as well.

Perchlorate ! – Enviro Justice

Perchlorate pollution inproportionately affects minority and poor communities – it’s a matter of environmental racism

Davis 7 (Debbie, Legislative Analyst, Environmental Justice Coalition for Water, 3/20/7, http://www.swrcb.ca.gov/public\_notices/petitions/water\_quality/docs/a1824rialto/policy\_statements/ejcw2.pdf) JPG

Only six miles separate Redlands from Colton and Rialto, yet the cleanup of the drinking water supply has been handled in two drastically different ways. In Redlands, cleanup and abatement orders were issued to the corporate polluter, Lockheed Martin, in the same yes: the Perchlorate was discovered. On the other hand, the three most responsible corporate polluters in Rialto and Cotton--Goodrich Corp-., Black 8; Decker, and PyroSpectacular—have not had any cleanup and abatement order enforced in the ten years since the discovery of Perchlorate in Rialto and Colton’s drinking water supply. The lack of rocket fuel cleanup in Rialto and Colton is indisputably an issue of environmental racism. To Redlands, 56% of the household incomes ranges from $50,000-$200,000. In contrast, 28% of the households in Rialto have an income of $25,000 or less—Red1ands is 17%. Redlands population is 73% white, while in Colton, Latino people make up 61% of the population. The Rlalto Latino Community makes up 65% of the city’s population and African Americans contribute 17% to Ria1to’s population. (US Census 2000) President Bush didn't tolerate the presence of Perchlorate from the McGregor Naval Weapons Station south of Waco in the water supply at the Presidential Ranch at Crawford. Congress appropriated money so that Bush‘s water for his animals would be safe to drink, so what about the rest of us? The California Water Code provides the State Water Resources Control Board (Board) with the authority to require the cleanup and abatement of Perchlorate contamination throughout the state. In order to fully exercise their authority and restore aquifers throughout the state to health. I urge the -‘State Water Resources hoard to adopt cleanup and abatement orders for Perchlorate cleanup that require the following: 1) Cleanup of Perchlorate pollution to the ﬁxliest extent that is technically feasible and uses best available technology; 2) Provision Of safe, alternative water supplies until full cleanup is complete; 3} Full reimbursement by responsible dischargcrs to community members and public utilities that have paid for stopgap cleanup measures; 4) Implementation of strict enforcement measures in the event of a failure to meet cleanup requirernents and timelines. Perchlorate does not belong in Califomia’s drinking water supplies. By including the measures outlined above in cleanup and abatement orders, the State Water Resources Control Board will take the 516115 necessary to restore vital groundwater resources across the state to health.

Rocket fuel disproportionately affects minority populations – specifically women

EWG 9 (Environmental Working Group, EWG research team: Senior researchers Anila Jacob, MD, MPH; Sonya Lunder, MPH, May 2009, http://www.ewg.org/report/Pollution-in-5-Extraordinary-Women) JPG

An unprecedented two-year study commissioned by the Environmental Working Group and conducted by four independent research laboratories in the United States, Canada and the Netherlands has documented up to 481 toxic chemicals in the blood of five minority women leaders in the environmental justice movement. The women leaders, from New Orleans, Green Bay, Corpus Christi and Oakland, have spent years deeply engaged in battles to rid their communities of air and water pollution from local manufacturing plants, hazardous waste dumps, oil refineries and conventional agriculture. 75 chemicals tested The study, sponsored by EWG in conjunction with Rachel's Network, a nationwide organization of women environmental leaders, tested the five women last year for 75 chemical contaminants. Testing was targeted toward compounds that are heavily used in everyday consumer products but that have escaped effective regulation under the antiquated Toxic Substances Control Act (TSCA). The results underscore the widespread and systemic failure of current law to protect the public from chemicals, many of which persist in the environment for decades or far longer, that are associated in animal studies with cancer, reproductive problems and behavioral effects. All of the women were contaminated with flame retardants, Teflon chemicals, synthetic fragrances, the plastics ingredient bisphenol A and the rocket fuel component perchlorate. Conclusion Though they live thousands of miles apart, come from distinctive cultural traditions and confront different environmental hazards outside their homes, the women's differences are only skin deep. Their body burdens of environmental pollutants, a mix of industrial chemicals, synthetic cosmetics ingredients and chemicals used to treat consumer products, are strikingly similar - and roughly equivalent to the body burdens of other Americans surveyed by governmental and independent research organizations. Every woman: Tested positive for 35 to 60 percent of the 75 chemicals on the search list. Had a high body burden of at least one controversial chemical whose lack of regulation and widespread presence in American life is fueling debate over reform of the nation's toxic chemical policies. The laboratory analyses, which offer a snapshot of the toxic body burdens of women on the front lines of the environmental health and environmental justice movements, set the stage for larger, population-scale research projects that could determine how exposure to chemicals in water, food and consumer products may vary across minority populations; what other industrial compounds may also be present in Americans' bodies; and any health risks those pollutants may pose, alone or in combination.

Perchlorate ! – Enviro Justice – Impact

Environmental injustice is a continuation of the legacy of slavery, and entrenches racism

Bullard 2 (Joseph, Director of the Environmental Justice Resource Center at Clark Atlanta University, http://209.85.173.104/search?q=cache:S0SkCJTUZKoJ:www.ejrc.cau.edu/PovpolEj.html+environmental+racism+impact&hl=en&ct=clnk&cd=1&gl=us)

People of color around the world must contend with dirty air and drinking water, and the location of noxious facilities such as municipal landfills, incinerators, hazardous waste treatment, storage, and disposal facilities owned by private industry, government, and even the military.[[3](http://www.ejrc.cau.edu/PovpolEj.html#3end)] These environmental problems are exacerbated by racism. Environmental racism refers to environmental policy, practice, or directive that differentially affects or disadvantages (whether intended or unintended) individuals, groups, or communities based on race or color. Environmental racism is reinforced by government, legal, economic, political, and military institutions. Environmental racism combines with public policies and industry practices to provide benefits for the countries in the North while shifting costs to countries in the South. [[4](http://www.ejrc.cau.edu/PovpolEj.html#4end)] Environmental racism is a form of institutionalized discrimination. Institutional discrimination is defined as "actions or practices carried out by members of dominant (racial or ethnic) groups that have differential and negative impact on members of subordinate (racial and ethnic) groups." [[5](http://www.ejrc.cau.edu/PovpolEj.html#5end)] The United States is grounded in white racism. The nation was founded on the principles of "free land" (stolen from Native Americans and Mexicans), "free labor" (African slaves brought to this land in chains), and "free men" (only white men with property had the right to vote). From the outset, racism shaped the economic, political and ecological landscape of this new nation.  Environmental racism buttressed the exploitation of land, people, and the natural environment. It operates as an intra-nation power arrangement--especially where ethnic or racial groups form a political and or numerical minority. For example, blacks in the U.S. form both a political and numerical racial minority. On the other hand, blacks in South Africa, under apartheid, constituted a political minority and numerical majority. American and South African apartheid had devastating environmental impacts on blacks.

Racism must be rejected

Barndt, Pastor and Co-director of Crossroads 91 –– Ministry working to dismantle racism (Joseph, Dismantling Racism: The Continuing Challenge to White America 155-6,)

To study racism is to study walls. We have looked at barriers and fences, restraints and limitations, ghettos and prisons. The prison of racism confines us all, people of color and white people alike. It shackles the victimizer as well as the victim. The walls forcibly keep people of color and white people separate from each other; in our separate prisons we are all prevented from achieving the human potential that God intends for us. The limitations im­posed on people of color by poverty, subservience, and power­lessness are cruel, inhuman, and unjust; the effects of uncontrolled power, privilege, and greed, which are the marks of our white prison, will inevitably destroy us as well.     But we have also seen that the walls of racism can be dis­mantled. We are not condemned to an inexorable fate, but are of­fered the vision and the possibility of freedom . Brick by brick, stone by stone, the prison of individual, institutional, and cul­tural racism can be destroyed. You and I are urgently called to join the efforts of those who know it is time to tear down, once and for all, the walls of racism.     The danger point of self-destruction seems to be drawing ever more near . The results of centuries of national and worldwide conquest and colonialism, of military buildups and violent aggres­sion, of overconsumption and environmental destruction may be reaching a point of no return . A small and predominantly white mi­nority of the global population derives its power and privilege from the sufferings of the vast majority of peoples of color. For the sake of the world and ourselves, we dare not allow it to continue.

Perchlorate !/A2 – Cleanup

Perchlorate contamination is immoral and causes health issues – nothings being done to stop it

ENS 8 (Environmental News service, 10/6/8, http://www.ens-newswire.com/ens/oct2008/2008-10-06-01.html) JPG

"Perchlorate contamination endangers the health of our families, especially pregnant women and children," she said, "and to simply allow it to remain in our drinking water is immoral." Perchlorate is found in the drinking water supplies of up to 16.6 million Americans, according to EPA. But Boxer cites the estimates of independent researchers that 20 million or more Americans are exposed to the toxin. In July, the Senate Environment and Public Works Committee passed two measures to protect the public from exposure to perchlorate. One requires the EPA to resume testing of drinking water for perchlorate and disclose the results of those tests to the public. The other requires the EPA to promptly set a standard for perchlorate in drinking water that protects pregnant women and children. Neither of these measures has become law. Perchlorate has been found at 46 Superfund sites out of 1,557 current and deleted sites, EPA's Assistant Administrator for Water Benjamin Grumbles told a House of Representatives hearing in 2007. Of these 46 sites, he said, 12 are private sites and 34 are federal facilities. At approximately 28 sites, perchlorate concentrations in ground water or drinking water exceed 24.5 parts per billion, which is the Defense Department's level of concern for managing perchlorate in ground water. Perchlorate has been discovered in over 350 of 6,400 public water supply wells tested in California, the EPA says on its website. "Contamination of groundwater and of the Colorado River affects important drinking water and irrigation water supplies. There may be over 30 sites with perchlorate in California alone. Thirteen of these are EPA Superfund sites and the state of California leads cleanup efforts at 12 other sites." In Massachusetts, the chemical has been found in groundwater plumes issuing from the Massachusetts Military Reservation on Cape Cod.

A2 – “EPA Solves Perchlorate”

EPA isn’t doing anything

ENS 8 (Environmental News service, 10/6/8, http://www.ens-newswire.com/ens/oct2008/2008-10-06-01.html) JPG

Perchlorate, a toxic component of rocket fuel that contaminates drinking water at sites in at least 35 states, will not be regulated at the national level the U.S. Environmental Protection Agency has decided.

A2 – “NASA Has Changed”

NASA is using the same type of rockets and fuel as 30 years ago

Matthews 6/17 (Mark, writer @ Orlando sentinel, 2011, http://articles.orlandosentinel.com/2011-06-17/news/os-nasa-rocket-competition-20110616\_1\_constellation-moon-program-new-rocket-big-rocket) JPG

As soon as next week, NASA will announce the design for its next big rocket, and anyone who has seen the space shuttle should recognize the key pieces — as the vehicle includes much of the same 30-year-old technology. Like the shuttle, the new rocket will use a giant fuel tank and a pair of booster rockets. The major difference is that the airplane-like orbiter is gone, replaced by a new Apollo-like crew capsule atop the fuel tank, according to industry sources and internal NASA documents. That NASA selected this model is not a complete surprise: a 2010 law all but requires agency engineers to reuse shuttle parts or remnants from the now-defunct Constellation moon program, and the design does that. But it also commits the agency's future to hardware — like the main engines taken from the space shuttle — that was designed in the 1970s.

A2 – Perchlorate ≠ Bad – Bad Studies

Studies downplaying the effects of perchlorate are biased – funded by the ones emitting it

Madsen and Jahagirdar 6 (Travis Madsen – Policy Analyst at Frontier Group and Sujatha Jahagirdar – Political Director at Student PIRGs, spring 2006, “The Politics of Rocket Fuel Pollution”, http://www.environmentcalifornia.org/reports/clean-water/clean-water-program-reports/the-politics-of-rocket-fuel-pollution) JPG

The Perchlorate Study Group hired a public relations firm, which then downplayed concerns about rocket fuel spills. This same firm once performed a similar service for tobacco giant Philip Morris. The PSG supports an organization called the Council on Water Quality, including a prominent spokesperson (former California EPA director James Strock). The Council has consistently and publicly downplayed concerns about rocket fuel exposure. Deeper investigation reveals that: • The Council on Water Quality is actually a project of the public relations firm APCO Worldwide; • In 2004, the PSG paid APCO $770,000 to run this effort (See “Perchlorate Study Group Budget, 2004” on page 4); and • On behalf of Philip Morris, APCO has used similar front groups to challenge the use of science in policy-making and make it harder for citizens to sue corporations. The Perchlorate Study Group funded scientific research that was then used to argue that rocket fuel exposure was not a big concern. • New analysis by Environment California Research & Policy Center shows that the PSG or its members funded more than half of all studies directly addressing the health effects of perchlorate exposure that were published between 1996 and January 2005 when the National Academy of Sciences issued a report on perchlorate. Independent sources like the National Institutes of Health funded less than 10 percent of the research. • In some cases, PSG research appears to have deliberately employed an experimental approach that was inappropriate for the task. • The Council on Water Quality concludes that perchlorate is not a health threat at low levels using only PSG-funded research. The Council Website omits concerns raised by independent scientists who believe that perchlorate in drinking water at even a few parts per billion, or ppb, could constitute a significant health threat. The Perchlorate Study Group worked to influence the conclusions of a National Academy of Sciences panel charged with evaluating perchlorate for the U.S. government. • The PSG paid a consultant to present PSG- funded research at meetings of the American Thyroid Association, where members of the National Academy of Sciences (NAS) panel were present and while the panel was active. – Dr. Steven Lamm, the director of a firm called Consultants in Epidemiology and Occupational Health, requested $25,000 from the PSG to attend the American Thyroid Association annual meeting in 2004. He justified this request by noting that National Academy panelists would be in attendance. He wrote: “The session is chaired and hosted by a member of the NAS committee and this will probably be the last opportunity before the finalization of the NAS report for a PSG presentation to be observed by the many NAS panel members who are part of that panel.” – While acting as a consultant for the PSG, Dr. Lamm became a member of the Public Health Committee at the American Thyroid Society. During his tenure, the Thyroid Society issued two formal statements favorable to industry.

\*\*Aff – Perchlorate D/A

Aff – A2 – Water Contamination

Water is plentiful

Radford 8 (Benjamin, writer @ LiveScience, 6/23/8, http://www.livescience.com/2639-water-shortage-myth.html) JPG

No, there is plenty of water. The problem is that the vast majority of Earth's water is contained in the oceans as saltwater, and must be desalinated before it can be used for drinking or farming. Large-scale desalination can be done, but it is expensive. But nor is the world running out of freshwater, either. There's plenty of freshwater on our blue globe; it is not raining any less these days than it did millennia ago. As with any other resource, there are of course regional shortages, and they are getting worse. But the real problems are availability and transport; moving the freshwater from where it is plentiful (such as Canada, South America, and Russia) to where it is scarce (such as the Middle East, India, and Africa). Water is heavy and costly to transport, and those who can afford it will always have water.

Aff – Alt Causes/Regs Solve

Alt causes – fireworks, explosives, chemical plants – AND EPA regulations solve contamination

Cappiello 11 (Dina, writer @ HuffPost, 2/2/11, http://www.huffingtonpost.com/2011/02/02/perchlorate-rocket-fuel\_n\_817370.html) JPG

The Environmental Protection Agency is setting the first federal drinking water standard for a toxic rocket fuel ingredient linked to thyroid problems in pregnant women and young children, the Obama administration announced on Wednesday. Environmental Protection Agency administrator Lisa Jackson said that setting the standard will protect public health and spark new technologies to clean up drinking water. Based on monitoring conducted from 2001 to 2005, 153 drinking water sources in 26 states contain perchlorate. The standard could take up to two years to develop, the EPA said. Perchlorate is also used in fireworks and explosives. In most cases, water contamination has been caused by improper disposal at rocket testing sites, military bases and chemical plants. "As improved standards are developed and put in place . clean water technology innovators have an opportunity to create cutting edge solutions that will strengthen health protections and spark economic growth," Jackson said in a statement.

Aff – No Brink/Alt Cause

No brink – perchlorate doesn’t have effects at low levels and there are multiple alt causes

Rimer 4 (Andrea, Number 3, Volume 18, Winter 2004, Natural Resources & Environment, pp. 72-73,

http://marketing.troutmansanders.com/files/upload/RimerPoliticsArticle.pdf) JPG

Perchlorate (ClO4-), a naturally occurring and man-made inorganic salt, is the main component of solid rocket fuel, and has been widely used in rocket and munitions manufacturing and testing for more than forty years. In addition, perchlorate is used in the manufacture of such products as fireworks, matches, flares, air bag inflators, and leather-tanning solutions. Perchlorate has also been detected near grain silos in Iowa, indicating that certain grain fumigants may have also contained perchlorate. At high concentrations, perchlorate is known to affect thyroid function by blocking the uptake of iodide, and has been used clinically for years in the treatment of thyroid disorders such as Graves’ disease. Studies have failed to definitively establish, however, a threshold exposure level at which perchlorate would likely become toxic to adults, children and pregnant women, and its effect on human health at lower levels is currently unclear.

Aff – A2 – Health !

Their impacts are exaggerated – Perchlorate has minimal effects on health

Holt 11 (Jim, senior writer @ The Signal, 4/5/11, http://www.the-signal.com/section/36/article/42903/) JPG

“There were fundamental flaws we found in the scientific conclusions that were reached,” said Bill Romanelli, spokesman for the corporate interests. The group — calling itself the Perchlorate Study Group and representing a handful of aerospace and chemical corporations that make or use perchlorate — want the state study withdrawn and re-evaluated to focus on what it considers “reliable and widely accepted scientific information.” The statement came in reaction to a study released in January by the Office of Environmental Health Hazard Assessment. The study recommends that California re-set the limit for perchlorate in drinking water to 1 part per billion. The current health safety limit — called a public health goal — calls for no more than 6 parts per billion of perchlorate in drinking water, which is six micrograms in a liter. The state study is separate from yet another study, released by the Boston University School of Medicine in February, that found extremely low levels of perchlorate won’t adversely effect pregnant women or their unborn children.

Aff – A2 – Health !

Perchlorate doesn’t affect health – overwhelming scientific consensus

Weaver 4/11 (Lindsay, writer @ Morgan Hill Times, 2011, http://www.morganhilltimes.com/printer/article.asp?c=274593) JPG

The reliable and widely accepted science already exists, the Perchlorate Information Bureau insists, and it's past due that California recognizes at low levels the natural toxin isn't hazardous to your health. The residents affected by San Martin's distressful rocket fuel groundwater contamination of 2003 are still seeing the remnants of the spill by Olin Corp.'s shuttered road flare factory on Tennant Avenue - fewer than 20 wells are still closely monitored and millions of dollars have been spent by local government agencies to clean and monitor South County's drinking water. A few residents are even still dependent on bottled water. But, according to a new study by Boston University School of Medicine's scientist Dr. Elizabeth Pearce, perchlorate isn't harmful to thyroid function even in pregnant women in their first trimester. The findings depict what the National Academy of Sciences has said for 50 years, the Perchlorate Information Bureau's spokesman Bill Romanelli said; "It doesn't come as a surprise. It's the same as the bulk of overwhelmingly scientific conclusions that say it simply doesn't impact human health," he said Monday. The Perchlorate Information Bureau represents the interests of the aerospace industry that uses and produces rocket fuel, but Romanelli said the science speaks for itself.

\*\*Acid Rain/NOx D/A

Rocket Fuel Bad – Acid Rain/Health/Bio-D

Burning rocket fuel causes acid rain – causes health risks and kills biodiversity in surrounding areas

Mother Jones 90 (Lenny siegel, writer for mother jones, pp. 24-25, sept.-Oct. ed. 1990, google books) JPG

Making acid rain The residue from ground testing of solid rockets and waste burning of their fuel reacts with water to form acid rain and acid fog. In the dry foothills above San Jose, California, the Chemical Systems Division of United Technologies Corporation (UTQ) burns toxic solid rocket fuel in open pits, while citizens living nearby arc not allowed to bum household garbage or even yard cuttings. The Bay Area Air Quality Board, as well as agencies permitting solid-rocker-fuel burning in other parts of California, Colorado, Utah, and Mississippi, allows the practice because there is no proven, safe alternative. Rocket-fuel pollution is footloose: when activists and officials stopped some UTC fuel burning in San Jose, the company started burning it openly at the Sierra Army Depot, in Herlong, California, north of Lake Tahoe. Even if production of new rockets and fuel stops, the cold-war missile buildup may come back to haunt, and poison. The INF treaty with the Soviet Union actually specified that the United States destroy Pershing II solid rocket motors through open burning or explosive demobrion, which was carried out in the Pueblo Army Depot in Colorado and the Longhorn Army Ammunition Plant in Texas. The army's Redstone Arsenal, in Huntsville, Alabama, has developed an experimental method to recycle rather than burn off toxic elements of rocket fuel, but to make it practical would require a good deal more support from army and government hinders. Meanwhile, along the wetlands of the Mississippi Gulf Coast, a group called Citizens for a Healthy Environment is distributing skull-and-crossbones bumper stickers as part of its campaign to block NASA's Advanced Solid Rocket Motor program. NASA plans lo test the new rockets at the Stennis Space Center, near Bay St. Louis. Stennis has conducted tests of liquid-fueled rockets since the mid-1960s, but the higher levels of pollution from solid rockets have people worried about health risks as well as damage to the wetlands. NASA initially plans four 2.25-minute tests of the new motors each year, which are expected to release about 1.7 million pounds of aluminum oxide, 123,000 pounds of chlorine, and more than a million pounds of hydrogen chloride at the site annually. When the hydrogen chloride mixes with water, it will form up to 3.2 million pounds of hydrochloric acid each year. NASA proposes to protect the environment by deflecting the exhaust plume upward to dilute its impact, and by testing only under optimum weather conditions.

Rocket Fuel Bad – NOx Module – Acid Rain/GHGs/Health

Rocket fuel contains nitric acid – causes acid rain, emits ghgs and causes various health problems

Science ray 11 (5/19/11, http://scienceray.com/biology/ecology/about-nitric-acid/#ixzz1QJmsahzP) JPG

Nitric acid is a naturally occur chemical that is left after the breakdown of animal and human waste.This chemical breakdown occur in the ocean and it causes the marine toxicity and the death of many sea animals. Nitric acid is used for rocket fuel, Chemical Reagent and woodwork. Nitric acid is used in different form of oxides in liquid-fueled rockets in Rocket. These forms included red fume, white fumes and mixtures of sulfuric acid. The red fume nitric acid is used in BOMARC missile. Nitric acid is also used to artificially age pine trees and maple trees. The acid makes the wood looked like a furnished wood. Nitric acid causes 7 percent of all greenhouses gases. The person who produces the acid are industrial workers or lab workers and sell them all over the world. The workers creating the acid are the ones who are suffering because they might pour it all over their hand and eat the flesh and you can say goodbye hand! This acid can harm the person directly. The symptoms of this acid are: burns all over body tissue, Inhalation can cause lung and tooth damage, burn the eye causing permanent eye damage, ingestion of the acid can cause burns of the mouth, throat, esophagus and gastrointestinal tract. The acid can affect the marine life and affects the environment next to industrial plant. These affections are harmful to the environment. It affect the marine life by leading algae blooms in a particular area absorbing all the oxygen and leading to the death of all life. It also affects the environment on land by creating acid rains. The chemical used to make this acid rain is NOx. NOx is the acronym for Nitrogen Oxide. It is form when nitrogen from the vehicles, Industrial plant mix with the oxygen in our air and making a smog and combining with other smogs to create an acid cloud. The acid rain would destroy many building, statue that are easily dissolved in acid and life killing them with the high pH water.

NOx Link – Soyuz

Soyuz uses NOx fuel

NASA 10 (10/22/10 http://www.nasa.gov/mission\_pages/station/structure/elements/soyuz/spacecraft\_detail.html) JPG

The propulsion compartment contains the primary thermal control system and the Soyuz radiator, which has a cooling area of 86 square feet. The propulsion system, batteries, solar arrays, radiator and structural connection to the Soyuz launch rocket are located in this compartment. The propulsion compartment contains the system that is used to perform any maneuvers while in orbit, including rendezvous and docking with the Space Station and the deorbit burns necessary to return to Earth. The propellants are nitrogen tetroxide and unsymmetric-dimethylhydrazine. The main propulsion system and the smaller reaction control system, used for attitude changes while in space, share the same propellant tanks.

NOx ! – Warming

Nutrous oxide causes warming – creates a feedback loop

Upham 10 (Ben, writer @ New York Times, 4/8/10, http://www.enn.com/sci-tech/article/41195) JPG

Nitrous oxide, also known as "laughing gas," is ranked third behind carbon dioxide and methane in contributing to global warming, and is regulated under the Kyoto Protocols. According to the EPA, the gas is 310 times more effective in trapping heat than carbon dioxide. Sixty percent of the nitrous in the atmosphere is produced naturally. Global warming "wild card" Twenty-five percent of the land surface in the Northern Hemisphere is underlain by permafrost, and as it thaws it could create a feedback loop that accelerates global warming, because it releases greenhouse gases, like methane and carbon dioxide, which in turn increase warming, spurring more thawing. Scientists had thought only a little nitrous oxide was released during this process, but the journal study suggests otherwise.

Acid Rain ! – Ecosystems

Acid rain destroys ecosystems

Spash 2 (Clive Spash, prof. Enc. And Rural Economics at Aberdeen and pres. European

Society for Ecological Economics, 2002 “Greenhouse Economics”)

One result of the new power stations was to inject sulphur dioxide and nitrous oxides high into the atmosphere, where they were out of sight and out of mind. That was until the 1970s when Scandinavian scientists began to publicise the link between the changes in their forests and water ecosystems due to acidic deposition. A decade of dispute and research led to the more general acceptance that the long-range transportation of air pollutants form the UK and Germany to Scandinavia was possible, but there was no action by the major emitters. Emissions were given more serious attention by the German government as their own forests began to die and environmentalists began to successfully move into mainstream politics. The main impact on emissions in the UK was due to the changing political and economic fortunes of the coal industry with Conservative administrations determined to break the power of the mining unions. The availability of cheaper natural gas and a move away from heavy industry aided this political agenda. Thus, political and structural change was affecting emissions rather than any concern for environmental damagers inflicted on others. Acidic deposition remains a serious problem which has destroyed and is destroying ecosystems across Europe. In the late 1990s the Scandinavians were forced to issue health warnings against pregnant women eating fish due to the heavy metals released into the water by acidic deposition, which then accumulates in the body of the fish. The developing human foetus is particularly vulnerable to the toxic effects of these heavy metals. Of course decades of acidic deposition have also contaminated water supplies, in a similar fashion, and Scandinavian household in remote areas dependent upon ground water are at risk. The Norwegian and Swedish programmes for liming vast areas on a regular basis merely maintain a life line for ecosystems (similar to the geo-engineering options offered to counter climate change), which can only stand a change of recovery if acidic deposition from burning fossil fuels in the United Kingdom and Germany are strictly curtailed. In the meantime ecosystems are degraded. Biodiversity lost and once vibrant communities disappear as fish die and ecosystems degrade. However, attention has moved away form that ongoing environmental disaster and many seem to believe the problem has gone away because the media rarely seems to report on it anymore.

Impact is extinction

Santo 99 (Miguel Santo, professor of Ecology and Environmental Science at Baruch College, 1999, “Environmental Crisis,” p. 35-36)

In addition, natural forests provide recreation and unique scientific beauty while at the same time serving as the basis for natural communities that provide life support to organisms (including people). As mentioned, one vital by-product of plant photosynthetic activity is oxygen, which is essential to human existence. In addition, forests remove pollutants and odors from the atmosphere. The wilderness is highly effective in metabolizing many toxic substances. The atmospheric concentration of pollutants over the forest, such as particulates and sulfur dioxide, are measurably below that of adjacent areas (see Figure 2.3). In view of their ecological role in ecosystems, the impact of species extinction may be devastating. The rich diversity of species and the ecosystems that support them are intimately connected to the long-term survival of humankind. As the historic conservationist Aldo Leopold stated in 1949, “The outstanding scientific discovery of the twentieth century is not television or radio, but the complexity of the land organisms. . . To keep every cog and wheel is the first precaution of indifferent tinkering.” An endangered species may have a significant role in its community. Such an organism may control the structure and functioning of the community through its activities. The sea otter, for example, in relation to its size, is perhaps the most voracious of all marine mammals. The otter feeds on sea mollusks, sea urchins, crabs, and fish. It needs to eat more than 20 percent of its weight every day to provide the necessary energy to maintain its body temperature in a cold marine habitat. The extinction of such keystone or controller species from the ecosystem would cause great damage. Its extinction could have cascading effects on many species even causing secondary extinction. Traditionally, species have always evolved along with their changing environment. As disease organisms evolve, other organisms may evolve chemical defense mechanisms that confer disease resistance. As the weather becomes drier, for example, plants may develop smaller, thicker leaves, which lose water slowly. The environment, however, is now developing and changing rapidly but evolution is slow, requiring hundreds of thousands of years. If species are allowed to become extinct the total biological diversity on Earth will be greatly reduced: therefore, the potential for natural adaptation and change also will be re4yce&shus endangering the diversity of future human life-support systems.

Acid Rain ! – Brink

Keeping acid rain out is key to ecosystem recovery – its happening now

Willyard 10 (Cassandra, writer @ Smithsonian.com, 4/19/10, http://www.smithsonianmag.com/specialsections/ecocenter/air/EcoCenter-Air-Acid-Rain-and-Our-Ecosystem.html?c=y&page=1) JPG

Some researchers have tried adding calcium back into the forests to speed recovery. April is currently involved in one such experiment in the Adirondacks. Over the past four and a half years, the calcium has penetrated only the top 15 centimeters of forest soil. “It takes a really long time for [the calcium] to get back down into the soil,” April says, so it won’t be a quick fix. April would like to see sulfur dioxide and other emissions curtailed even further. “We still have acid rain coming in,” he says. “Some lakes look like they might be ready to come back, and if we cut the emissions more they would.” Princeton University’s Michael Oppenheimer, who was a key player in the acid wars as chief scientist for the conservation group Environmental Defense Fund, agrees. “I think sulfur dioxide and nitrogen oxide need to be effectively eliminated,” he says. “We ought to head towards zero and see how close we can get.” Although some effects of acid rain are lingering, most scientists consider it an environmental success story. “Science identified the problem. Science provided the guidelines for how to try to resolve the problem,” Likens says. “The success is that we have taken action as a society to try to deal with the problem.”

Acid Rain ! – Oceans

Acid rain kills Ocean ecosystems

Kintisch 7 (Eli, writer @ Science magazine, 12/21/7, http://discovermagazine.com/2008/jan/acid-rain-intensifies-threat-to-marine-life) JPG

Human-generated carbon dioxide in the atmosphere is slowly acidifying the ocean, threatening a catastrophic impact on marine life. And just as scientists are starting to grasp the magnitude of the problem, researchers have delivered more bad news: Acid rain is making things worse. Scientists estimate that one-third of the world’s acid rain falls near the coasts, carrying some 100 million tons of nitrogen oxide, ammonia, and sulfur dioxide into the ocean each year. Using direct measurements and computer models, oceanographer Scott Doney of Woods Hole Oceanographic Institution and his colleagues calculated that acid rain causes as much as 50 percent of the acidification of coastal waters, where the pH can be as low as 7.6. (The open ocean’s pH is 8.1.) The findings increase the urgency of confronting the crisis of ocean acidity, says Richard Feely, a collaborator at the National Oceanic and Atmospheric Administration. In the laboratory, researchers have seen some effect on just about every ocean creature that forms a calcium carbonate shell, says Feely, including algae—the tiny creatures at the crucial bottom of the deepwater food chain—and coral, whose skeletons grow more slowly in water with a pH even slightly lower than normal. Soon-to-be-released field experiment findings “seem to be showing the same kind of thing,” Feely says. That’s bad news, he adds, since a third of the world’s fish species depend in part on coral reefs for their ecosystems.

Loss of ocean ecosystems collapses the economy and causes extinction

Heinberg 8 (Richard, Senior Fellow-in-Residence @ Post Carbon Institute, 11/25/8, http://www.postcarbon.org/top\_food\_chain) JPG

Today comes the [startling news](http://www.earthportal.org/news/?p=1385) of a British government report showing a drop in oceanic zooplankton of 73 percent since 1960. For many people, this may seem relatively inconsequential as compared to daily cataclysmic revelations about the state of the national and global economy. This reaction is understandable: we care first and foremost about our own immediate survival prospects, and a new and greater Depression will mean millions losing their homes, millions more their jobs. It's nothing to look forward to. It takes some scientific literacy to appreciate the implications of the catastrophic loss of microscopic sea animals. We need to understand that these are food for crustaceans and fish, which are food for sea birds and mammals. We need to appreciate the importance of the oceanic food web in the planetary biosphere. At the top of the global food chain sits a species that we really do care about—Homo sapiens. The ongoing disappearance of zooplankton, amphibians, butterflies, and bees is tied directly or indirectly to the continuing growth of our own species—both in population (there are nearly seven billion of us large-bodied omnivores, more than any other mammal) and in consumptive voracity (water, food, minerals, energy, forests—you name it). It's at this point in the discussion that some of us start feeling guilty for being human, and others of us tune the conversation out because there's apparently not much we can do to fundamentally change the demographic and economic growth trends our species has been pursuing for hundreds, if not thousands of years. But the current economic Armageddon (that we care about) is related to human-induced biodiversity loss (that many of us don't notice) in systemic ways. Both result from pyramid schemes: borrowing and leveraging money on one hand; on the other, using temporary fossil energy to capture ever more biosphere services so as to grow human population and consumption to unsustainable levels. Our economic pyramid is built out of great hewn blocks of renewable and non-renewable resources that are being made unavailable to other organisms as well as to future generations of humans. The financial meltdown tells us these trends can't go on forever. How the mighty have fallen!—Masters of the Universe reduced to begging for billion-dollar handouts in front of a television audience. Next will come a human demographic collapse (resulting from the economic crisis, with poor folks unable to afford food or shelter), as mortality begins to exceed fertility. In all of this it's important to remember that the species on the lower levels of the biodiversity pyramid have been paying the price for our exuberance all along. The pyramid appears to collapse from the top, while in fact its base has been crumbling for some time.

Acid Rain ! – Coral Reefs Module (1/2)

Acid rain kills Coral Reefs

Thompson 7 (Andrea, writer @ LiveScience, 12/13/7, http://www.livescience.com/2135-increasing-acid-kill-coral-2050.html) JPG

The world’s coral reefs face almost certain death as increasing amounts of carbon dioxide in the atmosphere are absorbed by the oceans, acidifying the water in which corals live, a new [study](http://www.livescience.com/2135-increasing-acid-kill-coral-2050.html) warns. In the past few decades, corals have come under increasing pressure from warming ocean waters, overfishing and disease. A recent study found corals in Pacific ocean were disappearing faster than previously thought. The new study, to be presented tomorrow at a meeting here of the American Geophysical Union, points to yet another factor plaguing these underwater bastions of biodiversity: carbon dioxide. As carbon dioxide is emitted through the burning of fossil fuels, some of it is absorbed by the world’s oceans. “About a third of the carbon dioxide put into the atmosphere is absorbed by the oceans,” said study team member Ken Caldeira of the Carnegie Institution of Washington, “which helps slow greenhouse warming, but is a major pollutant of the oceans.” When the carbon dioxide is absorbed in the water, it produces carbonic acid, the same acid that gives soft drinks their fizz. This acid also makes certain minerals dissolve more readily in seawater, particularly aragonite, the mineral used by corals and many other marine organisms to grow their skeletons. Caldeira and his colleagues ran [computer](http://www.livescience.com/2135-increasing-acid-kill-coral-2050.html) simulations of ocean chemistry based on a range of atmospheric carbon dioxide levels, from 280 parts per million (ppm) (pre-industrial levels) to 5,000 parts per million. (Present levels are 380 ppm and rising.) Their findings, detailed in the Dec. 14 issue of the journal Science, show that if current emission trends continue, 98 percent of present-day reef habitats will be too acidic by mid-century for reef growth. “Before the industrial revolution, over 98 percent of warm water coral reefs were bathed with open ocean waters 3.5 times supersaturated with aragonite, meaning that corals could easily extract it to build reefs,” said study co-author Long Cao, also of the Carnegie Institution. “But if atmospheric CO2 stabilizes at 550 ppm—and even that would take concerted international efforts to achieve—no existing coral reef will remain in such an environment.” At greatest risk of these changes are Australia’s iconic Great Barrier Reef, the world's largest living structure, and the reefs of the Caribbean Sea. To slow ocean acidification, Caldeira and Cao warn, will likely take more stringent and immediate reductions in carbon dioxide than would be needed to reduce the other effects of global warming. “The science speaks for itself. We have created conditions on Earth unlike anything most species alive today have experienced in their evolutionary history,” said co-author Bob Steneck of the University of Maine. “Corals are feeling the effects of our actions, and it is now or never if we want to safeguard these marine creatures and the livelihoods that depend on them.”

Acid Rain ! – Coral Reefs Module (2/2)

Coral reef extinction kills millions, destroys ocean ecosystems, crushes the economy, causes political instability, and prevents solutions to diseases – preventing acidification is the key internal link

Skoloff 10 (Brian, correspondent @ associated press, 3/25/10, http://www.huffingtonpost.com/2010/03/26/coral-reef-extinction-cou\_n\_514742.html) JPG

Coral reefs are dying, and scientists and governments around the world are contemplating what will happen if they disappear altogether. The idea positively scares them. Coral reefs are part of the foundation of the ocean food chain. Nearly half the fish the world eats make their homes around them. Hundreds of millions of people worldwide – by some estimates, 1 billion across Asia alone – depend on them for their food and their livelihoods. If the reefs vanished, experts say, hunger, poverty and political instability could ensue. "Whole nations will be threatened in terms of their existence," said Carl Gustaf Lundin of the International Union for the Conservation of Nature. Numerous studies predict coral reefs are headed for extinction worldwide, largely because of global warming, pollution and coastal development, but also because of damage from bottom-dragging fishing boats and the international trade in jewelry and souvenirs made of coral. At least 19 percent of the world's coral reefs are already gone, including some 50 percent of those in the Caribbean. An additional 15 percent could be dead within 20 years, according to the National Oceanic and Atmospheric Administration. Old Dominion University professor Kent Carpenter, director of a worldwide census of marine species, warned that if global warming continues unchecked, all corals could be extinct within 100 years. "You could argue that a complete collapse of the marine ecosystem would be one of the consequences of losing corals," Carpenter said. "You're going to have a tremendous cascade effect for all life in the oceans." Exotic and colorful, coral reefs aren't lifeless rocks; they are made up of living creatures that excrete a hard calcium carbonate exoskeleton. Once the animals die, the rocky structures erode, depriving fish of vital spawning and feeding grounds. Experts say cutting back on carbon emissions to arrest rising sea temperatures and acidification of the water, declaring some reefs off limits to fishing and diving, and controlling coastal development and pollution could help reverse, or at least stall, the tide. Florida, for instance, has the largest unbroken "no-take" zone in the continental U.S. – about 140 square miles off limits to fishing in and around Dry Tortugas National Park, a cluster of islands and reefs teeming with marine life about 70 miles off Key West. Many fishermen oppose such restrictions. And other environmental measures have run into resistance at the state, local, national and international level. On Sunday, during a gathering of the Convention on the International Trade in Endangered Species of Wild Fauna and Flora, restrictions proposed by the U.S. and Sweden on the trade of some coral species were rejected. If reefs were to disappear, commonly consumed species of grouper and snapper could become just memories. Oysters, clams and other creatures that are vital to many people's diets would also suffer. And experts say commercial fisheries would fail miserably at meeting demand for seafood. "Fish will become a luxury good," said Cassandra deYoung of the U.N. Food and Agriculture Organization. "You already have a billion people who are facing hunger, and this is just going to aggravate the situation," she added. "We will not be able to maintain food security around the world." The economic damage could be enormous. Ocean fisheries provide direct employment to at least 38 million people worldwide, with an additional 162 million people indirectly involved in the industry, according to the U.N. Coral reefs draw scuba divers, snorkelers and other tourists to seaside resorts in Florida, Hawaii, Southeast Asia and the Caribbean and help maintain some of the world's finest sandy beaches by absorbing energy from waves. Without the reefs, hotels, restaurants and other businesses that cater to tourists could suffer financially. Many Caribbean countries get nearly half their gross national product from visitors seeking tropical underwater experiences. People all over the world could pay the price if reefs were to disappear, since some types of coral and marine species that rely on reefs are being used by the pharmaceutical industry to develop possible cures for cancer, arthritis and viruses. "A world without coral reefs is unimaginable," said Jane Lubchenco, a marine biologist who heads NOAA. "Reefs are precious sources of food, medicine and livelihoods for hundreds of thousands around the world. They are also special places of renewal and recreation for thousands more. Their exotic beauty and diverse bounty are global treasures."

Aff – Acid Rain ! Turn – Warming

Acid rain prevents methane emission – solves warming

New Scientist 4 (Proceedings of the National Academy of Sciences, 8/3/4, http://www.newscientist.com/article/dn6231-acid-rain-limits-global-warming.html) JPG

Acid rain restricts global warming by reducing methane emissions from natural wetland areas, suggests a global climate study. Acid rain is the result of industrial pollution, which causes rainwater to carry small quantities of acidic compounds such as sulphuric and nitric acid. Contaminated rainwater can upset the chemical balance rivers and lakes, killing fish and other organisms and also damage plants, trees and buildings. But the new study shows that sulphur in acid rain may have benefits, limiting global warming by counteracting the natural production of methane gases by microbes in wetland areas. Methane is thought to account for 22 percent of the human-enhanced greenhouse effect. And microbes in wetland areas are its biggest producers. They feed off substrates such as hydrogen and acetate in peat and emit methane into the atmosphere. Global warming itself will only fuel the production of methane as heating up the microbes causes them to produce even more methane. But the new model suggests that sulphur pollution from industry mitigates this. This is because sulphur-eating bacteria also found in wetland regions outcompete the methane-emitting microbes for substrates. Experiments have shown that sulphur deposits can reduce methane production in small regions by up to 30 per cent by activating the sulphur-eating bacteria.

Warming creates a feedback loop with methane microbes – causes the impacts faster

New Scientist 4 (Proceedings of the National Academy of Sciences, 8/3/4, http://www.newscientist.com/article/dn6231-acid-rain-limits-global-warming.html) JPG

Furthermore, the model suggests that sulphur pollution will continue to suppress methane emissions despite the feedback effect that global warming has on the process. While sulphur emissions reduce methane emissions by about eight per cent currently, the figure should rise to 15 per cent by about 2030, predicts the model. "All our projections show that, if you don't include acid rain, methane pollution is going to increase," Gauci adds. Sulphur pollution is already estimated to have cut methane emissions from wetlands from about 175 to 160 million tonnes per year in 2004. By 2030, this is predicted to fall to 155 million tonnes per year with the help of sulphur-eating bacteria.

Aff – A2 – NOx – Alt Cause

Impossible to eliminate emissions – human emissions, soil microbes, fertilizer

Harris 9 (Richard, science writer @ NPR, 8/28/9, http://www.npr.org/templates/story/story.php?storyId=112288478) JPG

The bad news is that it isn't easy to reduce human production of nitrous oxide. Cindy Nevison of the University of Colorado says controlling chlorofluorocarbons and other synthetic chemicals that destroy ozone was relatively easy, since just a few factories produced them. "Whereas nitrous oxide is produced by microbes in the soil, and humans have greatly increased the amount of nitrogen available to these microbes," Nevison says. When we spread nitrogen fertilizer on the soil, we also feed those bacteria. And they produce more nitrous oxide. Bacteria in seawater also produce nitrous oxide when the fertilizer runs down the rivers and out to sea. Nevison says factories and automobile tailpipes produce some nitrous oxide, but not all that much. "I think that limiting nitrous oxide is going to be more difficult than, for example, limiting carbon dioxide emissions. And we know how difficult that is," she says. That's because we need nitrogen — it's an essential part of protein. Carbon dioxide comes mostly from smokestacks and tailpipes. "You can get your energy from other sources than carbon, but you really can't get your food from sources other than nitrogen." We can't phase out nitrogen fertilizers, Nevison says. And studies show we could make only a modest difference if we used them more carefully.

\*\*Cape Canaveral D/A

Cape Canaveral = Normal Means

Cape Canaveral is normal means for launches – closest to the equator and its on the east coast

Primer 9 (Magazine, 11/17/9, http://www.primermagazine.com/2009/field-manual/know-it-all-why-does-nasa-launch-their-shuttles-from-florida) JPG

It seems like before every space shuttle launch from Cape Canaveral, NASA encounters some delay by way of weather, leading most people to wonder “why have it in a state that frequently deals with rainy weather?” Blast off. There are three simple reasons why NASA doesn’t mind the finicky weather of the Sunshine State and will not move their base of operations to a weather utopia like southern California anytime soon: 1. Florida is closer to the Equator than any other part of the contiguous 48 United States. The Earth’s linear velocity is fastest at the Equator (translation: the Earth spins “fastest” at its center) and any launch made close to the Equator can better take advantage of the Earth’s natural rotational speed, thus saving on fuel, rocket power, etc. For comparison, the European Space Agency uses a launch site in French Guiana (5 degrees above the Equator). 2. Florida is on the East Coast. To travel with the Earth’s rotation as mentioned above, a launch from any place in America must travel east. Therefore, if a shuttle lifted off from a place like Los Angeles, it would have to fly over America as it gained altitude and though shuttle debris/disasters are rare, if something were to go wrong after take-off, NASA felt it was better for that to potentially happen over the ocean. 3. When the Space Center was erected, the area around Cape Canaveral was basically a very rural beach within decent driving distance of both a Navy and Army base. Despite the low population density, there was infrastructure in the area for transportation, allotting the Space Agency a fair amount of privacy and reasonable isolation (not the case with more southern American locations like Hawaii or Puerto Rico).

More ev – alternatives provide logistical problems

Coffey 10 (Jerry, writer @ universetoday.com, 9/29/10, http://www.universetoday.com/74655/cape-canaveral/) JPG

Cape Canaveral was chosen for rocket launches because the linear velocity of the Earth’s surface is greatest towards the equator. The location of the cape allows rockets to take advantage of this by being launched eastward to match the Earth’s rotation. Also, since it is best to launch a rocket downrange towards an unpopulated area, the ocean is a great area to launch towards. Although the United States has sites closer to the equator with expanses of ocean to the east of them. There are better sites in the United Sates(Hawaii for instance), but they present significant logistical obstacles.

Cape Canaveral Bad – Florida Scrub Jay Mod. (1/2)

Cape Canaveral is home to the Florida Scrub Jay – expanded launches kill its habitat

George 11 (Donald, staff sergeant U.S. Air Force, Spring, Endangered Species Bulletin, http://findarticles.com/p/articles/mi\_m0ASV/is\_1\_36/ai\_n57586307/) JPG

Cape Canaveral Air Force Station is the only U.S. space launch site capable of placing satellites into geosynchronous orbit (an orbit that places a satellite stationary over a given spot). Both government and commercial space operations rely heavily on Cape Canaveral's launch capability. However, because Cape Canaveral AFS is a critical conservation area for the threatened Florida scrub-jay (Aphelocoma coerulescens), current launch programs are confined to their existing footprints to prevent loss of scrub habitat. The only available land for any new "heavy" launch vehicle or processing facilities is mostly scrub jay habitat, and all activities that impact scrub habitat on the base incur a 4:1 mitigation requirement to offset the habitat loss.

Florida scrub jays are a keystone species – protecting their habitat is key to preserve the Florida ecosystem – every animal counts for biodiversity

SUSF 2009 (State Univeristy System of Florida, Publication of Archival Library & Museum Materials, http://palmm.fcla.edu/lfnh/currmat/Biodiversityinfo.shtml) JPG

Most efforts to restore endangered species populations are targeted at this level.  The Florida panther, manatee, red-cockaded woodpecker, and Florida scrub jay are all species that represent important biodiversity in Florida .  Often, by protecting their habitats, we also protect an ecosystem. Ecosystem level: This level is the variety of different kinds of ecosystems within a region that enable the regions to cope with changes or disturbances. For example, migrating birds need two different kinds of ecosystems in two different parts of the world as well as in healthy ecosystem rest stops along their route. As we lose many different types of ecosystems to development and consumption of natural resources, this level of global diversity decreases.  For example, filling in mangrove swamps to build high-rise hotels on the coast or cutting down rain forests for grazing land and the sale of prized natural resources such as mahogany and rubber is dramatically decreasing the resiliency of ecosystem diversity. Ecosystem, Species, and Genetic Resiliency All three levels of diversity are essential to maintain life on earth as we know it today.  Each level must be protected because they all depend on one another and must be resilient in order to survive.  It is the variety of genes, species, or ecosystems that makes all three levels resilient. The Importance of Biodiversity Here is an analogy to help you understand what biodiversity does: Let's pretend I'm giving you a free ticket for a flight to Hawaii. You'll take it, right? You might ask, "What's the catch?" Well, the catch is that the plane...is losing rivets...not too many....just a few every hour. You might want to know a few things about rivets and airplanes; like...how many rivets does a plane have? How many does a plane need to fly? Are some more critical than others? Can rivets function alone - or do they only work in sets? That's a lot like our ecosystems and species diversity. We know plants and animals help our ecosystems provide ecological services - like the photosynthetic plants that give you food energy, and the decomposers that enrich your soil so trees are able to grow in order to provide shade you. Suppose we asked these questions:  "How many species do we have on this eco-ship?" "How many do we need?" "Are some more important than others?" "What is the minimum number we need to function?"  We don't know the answers.  Now think about it, wouldn't you like to keep as many of these rivets as possible? How Biodiversity Benefits Humans So, when we lose biodiversity, we lose access to many different plants and animals that we might need. Here are some specific ways that biodiversity helps us: Scientists use the genetic diversity in our food crops so we can continue to grow plants that are resistant to pests and disease. Many of our prescription drugs were first made from plants and animals. If we continue to lose species, especially those not well researched such as those in tropical forests, will lose out on potentially valuable medicinal cures. Biodiversity stabilizes the ecosystem.  It keeps our options open for the future. There may be resources out there that we don't yet understand their potentials, and we don't want to destroy them before we even know about them. Biodiversity also increases the beauty of the planet. What would Florida be without herons, eagles, or zebra long-wing butterflies?

Cape Canaveral Bad – Florida Scrub Jay Mod. (2/2)

Florida is key to global biodiversity

Whitney, Means and Rudloe 2004 (Eleanor Noss Whitney – Ph.D. in Bio @ Washington U, D. Bruce Means – President and Executive Director of the Coastal Plains Institute and Land Conservancy & starred in 8 documentary films, Anne Rudloe – PhD in biology @ Florida State U, “Priceless Florida: natural ecosystems and native species”, pp. 97, google books) JPG

The single 35-mile stretch of ravines on the east side of the Apalachicola River in Florida harbors more total plant and animal species, and more endemic species in particular, than any other area of the same size on the southeastern Coastal Plain. The ravines are home to more than 100 rare and endangered species. Despite their fame, however, the Apalachicola Bluffs and Ravines have never been exhaustively surveyed; they have many more secrets to reveal in times to come. The Florida Biodiversity Task Force has ranked the Apalachicola River basin, together with the central Florida ridge, as a "hot spot" of endemic species, a site of great value to global biodiversity. The Nature Conservancy has purchased the bluffs and ravines for ongoing preservation and now a large percentage is owned by the state and managed as Torreya State Park.4

Loss of biodiversity leads to extinction

Diner, Major, 94 (Major David N.; Instructor, Administrative and Civil Law Division, The Judge Advocate General's School, United States Army) "The Army and the Endangered Species Act: Who's Endangering Whom?" 143 Mil. L. Rev. 161l/n WBW

Biologically diverse ecosystems are characterized by a large number of specialist species, filling narrow ecological niches. These ecosystems inherently are more stable than less diverse systems. "The more complex the ecosystem, the more successfully it can resist a stress. . . . [l]ike a net, in which each knot is connected to others by several strands, such a fabric can resist collapse better than a simple, unbranched circle of threads -- which if cut anywhere breaks down as a whole." 79 By causing widespread extinctions, humans have artificially simplified many ecosystems. As biologic simplicity increases, so does the risk of ecosystem failure. The spreading Sahara Desert in Africa, and the dustbowl conditions of the 1930s in the United States are relatively mild examples of what might be expected if this trend continues. Theoretically, each new animal or plant extinction, with all its dimly perceived and intertwined affects, could cause total ecosystem collapse and human extinction. Each new extinction increases the risk of disaster. Like a mechanic removing, one by one, the rivets from an aircraft's wings, 80 mankind may be edging closer to the abyss.

Aff – A2 – Cape Canaveral Scrub Jay

Protection and preservation projects have preserved biodiversity at Cape Canaveral

George 11 (Donald, staff sergeant U.S. Air Force, Spring, Endangered Species Bulletin, http://findarticles.com/p/articles/mi\_m0ASV/is\_1\_36/ai\_n57586307/) JPG

One of the core purposes of the U.S. Department of Defense's (DoD) Readiness and Environmental Protection Initiative (REPI) projects is to conserve such environmental assets as wildlife in a manner that supports military mission readiness and national security. These projects also demonstrate a commitment to landscape-level planning, which helps preserve biodiversity, allows for species migration, and provides greater opportunities for adapting to, and mitigating, the effects of climate change. When threatened and endangered species are present on installation habitat, training can be severely restricted. To alleviate this problem, installations are working with an off-post local conservation entity to promote the recovery of listed species and conserve their habitat on lands off the military base. Installations can accrue credits and alleviate restrictions by contributing to a species' recovery on these non-DoD lands. Similarly, installations can receive credits for protecting off-post habitat, which can be applied to mitigate construction or other on-post habitat uses. While a number of REPI projects have preserved valuable habitats and allowed DoD missions to continue, the project at Cape Canaveral Air Force Station in Florida illustrates the mutually beneficial relationship between species conservation and DoD's readiness efforts.

Alternate causes and preservation solves the impact

Baker 10 (Richard, president of Pelican Island Autobon Society, 12/18/10, http://www.pelicanislandaudubon.org/hootnovember06.htm) JPG

Florida scrub-jays, the only bird species unique to Florida and keystone species of fire-dependent xeric oak scrub, have been in a steady decline; 90% of the original populations are gone due to the loss of habitat for agriculture and urban development and also due to degrading of habitat from the suppression of natural fires. Like our bald eagle, scrub-jays are listed as a threatened species by both federal and state agencies. To rectify this decline, some scrub habitats have been preserved and managed (although not enough) to protect this species and the other species found only in scrub. Large areas are needed as each scrub-jay family group, two breeders and up to six helpers, defends approximately 13-25 acres of land.

\*\*Ozone D/A

Ozone 1NC

Current launch rates wont affect the ozone – the plan pushes emissions
over the brink and kills the ozone

Ross et. al. 9 (Martin – environmental Systems Directorate @ Aerospace, Ph.D. @ UCLA in Earth and planetary sciences, Darin Toohey, Manfred Peinemann and Patrick Ross, Volume 7, Issue 1 January 2009 , pages 50 – 82, informaworld) JPG

Combustion emissions from rocket launches change the composition of the atmosphere. The changes can be divided into transient changes near the launch site that affect air quality in the lowermost troposphere and long-term global changes in the composition of the stratosphere. In this paper, we are concerned with the long-term impact of rocket emissions on the global ozone layer. Ozone depletion has been a critical concern of nations across the globe for many decades, and large-scale industrial processes that alter stratospheric composition are assessed with respect to the amount of ozone depletion they would cause. When an assessment suggests unacceptably large ozone loss for a particular process, regulatory actions to limit or modify that process might be enacted to protect the ozone layer.[1](http://www.informaworld.com/smpp/section?content=a909005018&fulltext=713240928#EN0001) In this paper, we consider rocket combustion emissions in the context of ozone layer protection over the next several decades. Our calculations are not a formal assessment, but are a preliminary evaluation to identify the main areas of concern for the space industry. These concerns include risks associated with overly conservative regulation and a suggestion for new research in order to reduce the likelihood of such regulation. Cicerone and Stedman[2](http://www.informaworld.com/smpp/section?content=a909005018&fulltext=713240928#EN0002) first considered rocket emissions as a source of ozone depletion. Subsequent studies have shown consistently that at current launch rates, ozone depletion from rocket exhaust is insignificant compared to other sources of ozone loss.[3](http://www.informaworld.com/smpp/section?content=a909005018&fulltext=713240928#EN0003) If launch rates and ozone depletion from other sources remain at current levels, this assessment will not change. The potential exists that the demand for launch services could increase significantly in the future.[4](http://www.informaworld.com/smpp/section?content=a909005018&fulltext=713240928#EN0004) Large (factors of ten or more) increases in launch demand could come about for a variety of reasons, including national decisions regarding security, enhanced space exploration, market forces associated with significant reductions in launch costs, or the emergence of new markets such as space tourism, manufacturing, or solar power. Analysts generally assume that if the cost of access to orbit is reduced sufficiently, then large, new markets will emerge for space industry and the launch market. This development would be considered revolutionary, and it is not clear when or if, this might occur. Nevertheless, if space transport follows the “normal” development path of transportation technology enters a period of continual expansion, it would be necessary to reconsider the environmental consequences of large rockets, launched often. In this paper, we consider the implication of such significant increase in demand for orbital launches on the global ozone layer. We do not consider greenhouse gas emissions from rockets. Climate change is to some extent a separable problem from ozone depletion. While rocket engines emit gases identified as contributing to climate change, the amount emitted globally is trivial compared to other sources and is likely to remain so. Annual CO2 emissions from rockets, for example, are about several kilotons (kt) compared to emissions of several hundred kt from aircraft which, in turn, is only a few percent from all CO2 sources.[5](http://www.informaworld.com/smpp/section?content=a909005018&fulltext=713240928#EN0005) Space launch emissions, even for the large growth scenarios discussed here, will not likely be significant in future greenhouse gas regulatory schemes. As a cautionary tale, we point out that even though aircraft are responsible for a few percent of all CO2 emissions, the airline industry must contend with considerable attention and likely regulation or carbon taxation.[6](http://www.informaworld.com/smpp/section?content=a909005018&fulltext=713240928#EN0006) The message to the space industry should be clear: policy and media attention on high visibility propulsion emissions are often framed in ways that overemphasize the relative contribution.[7](http://www.informaworld.com/smpp/section?content=a909005018&fulltext=713240928#EN0007) If rockets are a minuscule contributor to the problem of climate change, they do have a significant potential to become a significant contributor to the problem of stratospheric ozone depletion. This follows from three unique characteristics of rocket emissions: Rocket combustion products are the only human-produced source of ozone-destroying compounds injected directly into the middle and upper stratosphere. The stratosphere is relatively isolated from the troposphere so that emissions from individual launches accumulate in the stratosphere.[8](http://www.informaworld.com/smpp/section?content=a909005018&fulltext=713240928#EN0008) Ozone loss caused by rockets should be considered as the cumulative effect of several years of all launches, from all space organizations across the planet. Stratospheric ozone levels are controlled by catalytic chemical reactions driven by only trace amounts of reactive gases and particles.[9](http://www.informaworld.com/smpp/section?content=a909005018&fulltext=713240928#EN0009) Stratospheric concentrations of these reactive compounds are typically about one-thousandth that of ozone. Deposition of relatively small absolute amounts of these reactive compounds can significantly modify ozone levels. Rocket engines are known to emit many of the reactive gases and particles that drive ozone destroying catalytic reactions.[10](http://www.informaworld.com/smpp/section?content=a909005018&fulltext=713240928#EN0010) This is true for all propellant types. Even water vapor emissions, widely considered inert, contribute to ozone depletion. Rocket engines cause more or less ozone loss according to propellant type, but every type of rocket engine causes some loss; no rocket engine is perfectly “green” in this sense.

Ozone depletion means extinction

Festive Earth Society, 8 (February 26, “The Ozone Layer,” http://festiveearth.com/content/view/96/54/index.html, JM)

The ozone layer is essential for human life.  It is able to absorb much harmful ultraviolet radiation, preventing penetration to the earths surface.  Ultraviolet radiation (UV) is defined as radiation with wavelengths between 290-320 nanometers, which are harmful to life because this radiation can enter cells and destroy the deoxyribonucleic acid (DNA) of many life forms on planet earth.  In a sense, the ozone layer can be thought of as a UV filter or our planets built in sunscreen (Geocities.com, 1998).  Without the ozone layer, UV radiation would not be filtered as it reached the surface of the earth.  If this happened, cancer would break out and all of the living civilizations, and all species on earth would be in jeopardy (Geocities.com, 1998).  Thus, the ozone layer essentially allows life, as we know it, to exist.

Ozone Uq I/L

Increased rocket launches crush the ozone – the status quo is sustainable

Ross et. al. 9 (Martin – environmental Systems Directorate @ Aerospace, Ph.D. @ UCLA in Earth and planetary sciences, Darin Toohey, Manfred Peinemann and Patrick Ross, January, http://www.makealeap.org/node/41204) JPG

The global market for rocket launches may require more stringent regulation in order to prevent significant damage to Earth’s stratospheric ozone layer in the decades to come, [according](http://www.colorado.edu/news/r/13dcef625a8a43e2e6d4d0e06e10ac8f.html) to a new study by researchers in California and Colorado. Future ozone losses from unregulated rocket launches will eventually exceed ozone losses due to chlorofluorocarbons, or CFCs, which stimulated the 1987 Montreal Protocol banning ozone-depleting chemicals, said Martin Ross, chief study author from [The Aerospace Corporation](http://www.aero.org/) in Los Angeles. The study, which includes the University of Colorado at Boulder and Embry-Riddle Aeronautical University, provides a market analysis for estimating future ozone layer depletion based on the expected growth of the space industry and known impacts of rocket launches. The paper by Ross, Manfred Peinemann of The Aerospace Corporation, CU-Boulder’s Darin Toohey and Embry-Riddle Aeronautical University’s Patrick Ross appeared online in March in the journal Astropolitics. “If left unregulated, rocket launches by the year 2050 could result in more ozone destruction than was ever realized by CFCs.”—Darin Toohey Solid rocket motors (SRMs) and liquid rocket engines (LREs) deplete the global ozone layer in various capacities. Highly reactive trace-gas molecules known as radicals dominate stratospheric ozone destruction, and a single radical in the stratosphere can destroy up to 10,000 ozone molecules before being deactivated and removed from the stratosphere. Microscopic particles, including soot and aluminum oxide particles emitted by rocket engines, provide chemically active surface areas that increase the rate such radicals leak from their reservoirs and contribute to ozone destruction. In addition, every type of rocket engine causes some ozone loss, and rocket combustion products are the only human sources of ozone-destroying compounds injected directly into the middle and upper stratosphere where the ozone layer resides. The authors estimated global ozone depletion from rockets as a function of payload launch rate and relative mix of SRM and LRE rocket emissions. Currently, global rocket launches deplete the ozone layer ~0.03%, an insignificant fraction of the depletion caused by other ozone depletion substances (ODSs). However, they note, as the space industry grows and ODSs fade from the stratosphere, ozone depletion from rockets could become significant.

Ozone Link – Solid and Liquid Propellant

Rocket emissions crush the ozone in short and long term

Ross and Zittel 2k (Martin N. Ross – environmental Systems Directorate @ Aerospace, Ph.D. @ UCLA in Earth and planetary sciences and Paul F. Zittel – Ph.D. in physical chemistry @ Berkeley, summer 2000, Aerospace mag, http://www.aero.org/publications/crosslink/summer2000/01.html) JPG

Both solid and liquid rocket-propulsion systems emit a variety of gases and particles directly into the stratosphere. A large percentage of these emissions are inert chemicals such as carbon dioxide that do not directly affect ozone levels. Emissions of other gases, such as hydrogen chloride and water vapor, though not highly reactive, indirectly affect ozone levels by participating in chemical reactions that determine the concentrations of the ozone-destroying radicals in the global stratosphere. A small percentage of rocket- engine emissions, however, are highly reactive radical compounds that immediately attack and deplete ozone in the plume wake following launch. Aerosol emissions, such as alumina particles, carbon (soot) particles, and water droplets, can also act as reactive compounds when heterogeneous chemical reactions take place on the surface of these particles. Rocket emissions have two distinct effects on ozone: short-term and long-term. Following launch, rapid chemical reactions between plume gases and particles and ambient air that has been drawn into the plume wake cause immediate changes in the composition of the local atmosphere. During this phase, which lasts for several hours, the concentrations of radicals in the plume can be thousands of times greater than the concentrations found in the undisturbed stratosphere, and the ozone loss is dramatic. Long-term effects occur as gas and particulate emissions from individual launches become dispersed throughout the global stratosphere and accumulate over time. The concentrations of emitted compounds reach an approximate global steady state as exhaust from recent launches replaces exhaust removed from the stratosphere by natural atmospheric circulation.

Ozone Link – Rockets\*

Expanding chemical rocket use causes catastrophic damage to ozone

Asian News International 9 (“Rocket launches may need regulation to prevent ozone depletion, “ April 1, http://www.thefreelibrary.com/Rocket+launches+may+need+regulation+to+prevent+ozone+depletion-a0199260862, JM)

A new study by researchers in California and Colorado has suggested that the global market for rocket launches may require more stringent regulation in order to prevent significant damage to Earth's [stratospheric](http://www.thefreedictionary.com/Stratospheric) (strat·o·spher·ic   adj. 1. Of, relating to, or characteristic of the stratosphere. 2. Extremely or unreasonably high: "money borrowed at today's stratospheric rates of interest")  [ozone layer](http://encyclopedia2.thefreedictionary.com/ozone%2Blayer) (ozone layer or ozonosphere, region of the stratosphere containing relatively high concentrations of ozone, located at altitudes of 12–30 mi (19–48 km) above the earth's surface.)  in the decades to come. The study, which includes the [University of Colorado](http://encyclopedia.thefreedictionary.com/University%2Bof%2BColorado) (University of Colorado may refer to: University of Colorado at Boulder (flagship campus) University of Colorado at Colorado Springs University of Colorado at Denver and Health Sciences Center University of Colorado at Boulder and [Embry-Riddle Aeronautical University](http://encyclopedia.thefreedictionary.com/Embry-Riddle%2BAeronautical%2BUniversity) Embry-Riddle Aeronautical University (ERAU) is a not-for-profit, non-sectarian, coeducational private university with a history dating back to the early days of aviation. , provides a market analysis for estimating future ozone layer depletion based on the expected growth of the space industry and known impacts of rocket launches. Future ozone losses from unregulated rocket launches will eventually exceed ozone losses due to [chlorofluorocarbons](http://encyclopedia2.thefreedictionary.com/chlorofluorocarbons) (CFCs), organic compounds that contain carbon, chlorine, and fluorine atoms. , or CFCs, which stimulated the 1987 Montreal Protocol banning ozone-depleting chemicals, according to Martin Ross, chief study author from The Aerospace Corporation in Los Angeles. "As the rocket launch market grows, so will ozone-destroying rocket emissions," said Professor Darin Toohey of CU-Boulder's atmospheric and oceanic sciences department. "If left unregulated, rocket launches by the year 2050 could result in more ozone destruction than was ever realized by CFCs," he added. Since some proposed space efforts would require frequent launches of large rockets over extended periods, the new study was designed to bring attention to the issue in hopes of sparking additional research, explained Ross. "In the policy world, uncertainty often leads to unnecessary regulation," he said. "We are suggesting this could be avoided with a more robust understanding of how rockets affect the ozone layer," he added. According to Toohey, current global rocket launches [deplete](http://medical-dictionary.thefreedictionary.com/deplete) (de·plete v. 1. To use up something, such as a nutrient. 2. To empty something out, as the body of electrolytes.)  the ozone layer by no more than a few hundredths of 1 percent annually. But, as the space industry grows and other ozone-depleting chemicals decline in the Earth's stratosphere, the issue of ozone depletion from rocket launches is expected to move to the forefront. Highly reactive trace-gas molecules known as radicals dominate stratospheric ozone destruction, and a single radical in the stratosphere can destroy up to 10,000 ozone molecules before being deactivated and removed from the stratosphere. "Microscopic particles, including soot and [aluminum oxide](http://encyclopedia2.thefreedictionary.com/aluminum%2Boxide) aluminum oxide: see alumina.  particles emitted by rocket engines, provide chemically active surface areas that increase the rate such radicals "leak" from their reservoirs and contribute to ozone destruction," said Toohey. "Today, just a handful of [NASA](http://encyclopedia2.thefreedictionary.com/NASA) (NASA: see National Aeronautics and Space Administration. NASA  in full National Aeronautics and Space Administration) Independent U.S.  space shuttle launches release more ozone-depleting substances in the stratosphere than the entire annual use of CFC-based medical inhalers used to treat asthma and other diseases in the United States and which are now banned," said Toohey. "The Montreal Protocol has left out the space industry, which could have been included," he added. (ANI)

Ozone Link – Rockets

Chemical launch destroys ozone

Minard 9 (Annie, Contributor, National Geographic News, “Rocket Launches Damage Ozone Layer, Study Says,” April 14, http://news.nationalgeographic.com/news/2009/04/090414-rockets-ozone.html, JM)

Plumes from rocket launches could be the world's next worrisome emissions, according to a new study that says solid-fuel rockets damage the ozone layer, allowing more harmful solar rays to reach Earth. Thanks to international laws, ozone-depleting chemicals such as chlorofluorocarbons (CFCs) and methyl bromide have been slowly fading from the atmosphere. Increased international space launches and the potential commercial space travel boom could mean that rockets will soon emerge as the worst offenders in terms of ozone depletion, according to the study, published in the March issue of the journal Astropolitics. If the space tourism industry alone follows market projections, rocket launches are "going to run up against Montreal Protocol," said study co-author Darin Toohey of the University of Colorado at Boulder. The Montreal Protocol on Substances that Deplete the Ozone Layer, an international treaty, prescribes measures intended to hasten the recovery of Earth's depleted ozone layer. "This isn't urgent," Toohey said. "But if we wait 30 years, it will be."

Ozone Link – Chemical Propulsion

Chemical propulsion is one of the main threats to ozone

Shapiro 95 (Lynn Anne, Contributor, *Southern California Interdisciplinary Law Journal* 1994-1995*,* p. 748, JM)

In order to put the above numbers in perspective, it is useful to look at the effluent contributions by United States rockets in comparison with other factors contributing to ozone depletion. For example, during each launch, the Space Shuttle will emit sixty-eight tons of highly destructive chlorine (CI) into the stratosphere, and a Titan IV booster rocket will emit thirty-two tons.60 At a projected rate of nine Shuttle and six Titan launches per year, the chlorine contribution from these two vehicles will be 800 tons compared to 300,000 tons from worldwide industrial sources.6' While this may appear to be a relatively inconsequential amount, the amount of chlorine injected into the stratosphere by each Shuttle launch is more damaging to the ozone supply than the aggregate annual chlorofluorocarbon emissions of most of the world's factories. This occurs, in part, because the chlorine (Cl) is injected directly into the stratosphere and immediately begins participating in ozone destruction.62 Rocket propellant effluents also have a uniquely dangerous depleting effect on the ozone layer in that the depletion is highly concentrated. Measurements of ozone loss in the launch trail of a Titan II booster rocket thirteen minutes after launch, at an altitude of eighteen kilometers, have shown that ozone is reduced by more than forty percent within the trail63 Other studies have shown that within one kilometer of the exhaust trail of the Space Shuttle and Energia vehicles ozone may be reduced up to eighty percent between one and three hours after launch.64

Ozone Link – Combustion

Chemical propulsion uniquely damages key ozone areas.

Alexeyev et al 2 (Yu, speaker @ The Second World Space Congress, “The Impact of the chemical propulsion on the ozone layer,” October, http://adsabs.harvard.edu/abs/2002iaf..confE.102A, JM)

The space activity is considered in the investigation real trend changes of total column ozone amounts (TCO). In combustion gas of all propulsion systems, especially solid ones, there are main ozone destroyers - Cl, NOx, OH, condensed particles Al2O3 etc. During every launch several tons such substances are practically immediately going into the atmosphere on 20-30 km altitude (i.e. layer with maximum ozone concentration) inaccessible for other ozone destroyers. The determination real consequences interaction between combustion gas and stratospheric ozone is the urgent problem of the practical astronautics. The analytical estimates for atmospheric ozone destroyed in a rocket plume are made more then 20 years. The results very differ even for the same rocket types and prognoses vary from extremely pessimistic to restrained optimistic ones. Such divergence is a result, first of all, high chemical kinetics calculations sensitivity to the rate constants values varying more then several times for the numerous reactions taking into account, initial data for a rocket plume, initial data for the atmosphere performance etc. The wide known comparisons the calculated results with the real TCO change above the space-vehicle launching sites are absent till now despite the regular TCO space monitoring is conducted since 1978 year. In the article the analyses of the spline-interpolation total ozone mapping spectrometer (TOMS) measurements [1,2] is presented. We have examined 773 launches space rockets ARIAN, CZ, DELTA, PROTON, SHUTTLE, TITAN, ZENIT families was made for period since 1978 until 2001 year. For every launch the ozone level maps for regions corresponding to 10o latitude on 20o longitude during 7 days elapsed time have been built. For ~30% launches we have exposed the areas with TCO decreased on 15-20 Dobson units. The areas have shape either "spots" with 200-300km diameter or "stripes" 200-300km width parallel to plume. Such local ozone "holes" appear in 1-2 days after launch and disappear in 5-7 days as rule. For comparison, we also made the ozone level maps for regions similar to launching sites latitude. So far as the probability (frequency) of appearance of natural ozone "holes" with same dimension and shape above the launching sites is less then exposed ones, with good reason it may be assumed that in some cases the "holes" are the result of stratospheric ozone depletion by propulsion gas components. The space rockets families we compared from point of frequency appearance the ozone "holes". The worse result gave us the SHUTTLE family (~50%). With aid of the results it is offered to make the prognosis for every launch of "dirty" rockets and choose the most convenient launching time for stratospheric ozone depletion minimization.

Ozone Link – Solid-Chemical Propellant

Solid chemical propellant kills ozone at its most plentiful point.

Shapiro 95 (Lynn Anne, Contributor, *Southern California Interdisciplinary Law Journal* 1994-1995*,* p. 745, JM)

The principal components of solid propellant are ammonium per-chlorate oxidizer (NH4CIO4) and a polymer to bind the fuel consisting of powdered aluminum.42 The major effluents from solid propellants consist of hydrogen chloride (HC1), aluminum oxide (Al2Oj), water (H20), hydrogen (H2), carbon monoxide (CO), and carbon dioxide (C02).43 Trace amounts of halogens (acids), nitrogen (N2), metal par­ticles, and organics also are found in the exhaust.44 Solid propellants present an acute environmental danger to the ozone since their effluents are disseminated below fifty kilometers, directly into the area of highest ozone concentration.45 Solid propel­lants are also very dangerous, as compared to liquid propellants, since HC1 is a by-product of the combustion and the chlorine atom is known to deplete the ozone.46

Ozone Link – Liquid-Chemical Propellant

Liquid chemical propellants deplete ozone.

Shapiro 95 (Lynn Anne, Contributor, *Southern California Interdisciplinary Law Journal* 1994-1995*,* p. 746, JM)

Liquid propellants usually consist of one of three combinations: (1) liquid oxygen and hydrocarbon; (2) nitrogen tetroxide used with a mixture of asymmetrical dimethylhydrazine and hydrazine; or (3) liq­uid oxygen and liquid hydrogen.49 Countries just starting develop­ment of space launch vehicles often use a combination of kerosene and liquid oxygen.50 Major exhaust components of liquid rocket fuels include carbon monoxide (CO), carbon dioxide (C02), hydrogen (H), molecular hydrogen (H2), water (H20), hydroxyl (OH), nitrogen oxide (NOx) and molecular nitrogen (N2).51 Liquid propellants may also release soot and ice particles and organics.52 Liquid propellant emissions are primarily found above 50 kilome­ters.53 Therefore, unlike solid propellants, their effluents are not directly infused into the ozone. Despite this fact, however, liquid pro­pellants do pose a significant threat to the ozone layer. Liquid propel­lants produce potential ozone depleting catalysts including hydrogen (H), hydroxyl (OH), nitrogen oxide (NO,), and soot and ice parti­cles.54 In addition, liquid rockets require static ground testing, which may be as long in duration as an actual mission burn, during which ozone depleting exhaust products are emitted that will eventually find their way into the stratosphere.55

Ozone Link/!

Expansion of chemical propellant use causes extinction – ozone.

Johnson 9 (John, Staff, *Los Angeles Times*¸ April 4, http://www.greenchange.org/article.php?id=4228, JM)

Some atmospheric researchers are suggesting that rocket launches may ultimately have to be restricted in number to avoid serious damage to the Earth's protective ozone layer. Future ozone losses from the increasing number of rocket launches could eventually exceed the damage caused by chlorofluorocarbons, or CFCs, the chemical compounds banned from use in aerosols, freezers and air conditioners, they conclude in a new study. "As the rocket launch market grows, so will ozone-destroying rocket emissions," said Darin Toohey, a professor in the atmospheric and oceanic sciences department at the University of Colorado at Boulder. "If left unregulated, rocket launches by the year 2050 could result in more ozone destruction than was ever realized by CFCs." Toohey's research, based on measurements of pollutants emitted by current rocket launches and projections of future launches, in conjunction with authors from the Aerospace Corp. and Embry-Riddle Aeronautical University, appeared online in March in the journal Astropolitics. Without Earth's ozone layer, exposure from the sun's harmful radiation would make life on the planet's surface impossible. Several decades ago, scientists began to notice the ozone layer was being eaten away, most famously over Antarctica, due to chemical reactions eventually traced to chlorofluorocarbons. In 1987, CFCs were banned from industrial uses, leading to predictions that the ozone layer would recover by 2040. Global rocket launches, currently at more than 100 per year, deplete the ozone layer by less than 1% annually, Toohey said. But as the number of launches increases with plans by some nations, including the U.S., to colonize the moon and venture to Mars, the problem could become serious, he said. Rockets use a variety of propellants -- solids, liquids and hybrids. Little is known about how each affects the ozone layer. "I am optimistic that we are going to solve this problem, but we are not going to solve it by doing nothing," Toohey said.

Ozone ! – Econ/Disease/Species

Ozone loss hurts the economy, causes disease, and disrupts wildlife.

Shapiro 95 (Lynn Anne, Contributor, *Southern California Interdisciplinary Law Journal* 1994-1995*,* p. 744, JM)

Some of the predicted effects of a thinning ozone layer include: (1) for every 1% drop in the amount of ozone (a) a 2% to 5% increase in squamous cell skin cancer, (b) a 1% to 3% increase in basal cell skin cancer, (c) a 1% to 2% increase in the incidence of and a 0.8% to 1.5% increase in mortality from melanoma skin cancer, and (d) a 0.3% to 0.6% increase in cataracts; (2) suppression of the human immune system resulting in an increase in the numbers and severity of various diseases; (3) changes in the delicate competitive balance among plant species, with a resulting reduction in crop yields, often on a one-to-one ratio to the percentage drop in ozone levels; (4) changes in marine ecosystems with resulting, potentially devastating, effects on aquatic food chains; (5) degradation of certain polymer compounds used by industry with costly economic consequences from necessary countermeasures; (6) potential for increased acid rain; and (7) contri­butions to the so called "greenhouse effect" and global warming, due to an increase in atmospheric carbon dioxide levels resulting from the depletion of the ozone layer.33

Ozone ! – Cancer

Ozone depletion causes disproportionate increases in cancer rates

Martens 98 (WJM, Mathematics Department @ Maastricht University, Environmental Health Perspectives 106, 1, February, JM)

Analysis of what happens with the tumor incidences in the course of time after the ozone layer changes is more complex than the previous example, due in particular to the relatively long incubation time between initial UV exposure and the first appearance of cancer. Although there is a large body of data, both experimental and epidemiologic, that confirms a causal relationship between accumulated UV dose and squamous cell carcinoma (33,34), the UV dose dependencies of basal cell carcinoma and melanoma skin cancer (MSC) (except for lentigo maligna melanoma) are less certain. Earlier skin cancer assessments were based on comparison of two stationary situations (35) and did not include the delay between exposure and tumor development (36). The assessment model used here integrates dynamic aspects of the full source-risk chain: from production and emission of ozone-depleting substances, global stratospheric chlorine concentrations, local depletions of stratospheric ozone, resulting increases in UV-B levels, and finally, the effects on skin cancer rates (37-39). Figure 5 clearly shows the delay mechanisms in the effect of ozone depletion on skin cancer rates. Full compliance with the Copenhagen Amendments to the Montreal Protocol would lead to a peak in the atmospheric chlorine concentration around 1995, a peak in stratospheric chlorine concentration and ozone depletion around 2000, and a peak in skin cancer by about 2050 (50 years after the peak in ozone depletion). The latter delay is mainly due to the fact that skin cancer incidences depend on cumulative UV-B exposure. An important aspect in this modeling experiment is that skin cancer rates are very sensitive with respect to lifestyle (i.e., sun exposure habits). Changing lifestyles such as the trend toward sun worshipping during the last half century contribute greatly to the increases in the incidence of skin cancer. This has been identified as a serious public health problem in several western countries, and campaigns have been launched to curb excessive exposure to the sun. An increase in UV exposure of 50% would increase the excess number of skin cancer cases to 135% (Figure 6). Another factor contributing to a steady increase in the number of skin cancers is the aging of the population. Because older people build up a high cumulative UV dose during their lives, skin cancer occurs more frequently among the elderly. Figure 6 also shows that if a population is aging, the same level of UV exposure would lead to higher incidences of skin cancer than in a younger population, perhaps a 50 to 60% increase in the overall incidence. So it appears that in view of the several delay mechanisms involved in cancer onset and, additionally, the aging of the population, increases in incidences of skin cancer are likely to occur.

Ozone ! – Climate Change

Ozone depletion causes climate change

ERW 6-13 (Environmental Research Web, “Ozone hole has affected whole Southern Hemisphere,” http://environmentalresearchweb.org/cws/article/news/46255, JM)

While previous work has shown that the ozone hole is changing atmospheric flow at high latitudes, a Science paper by researchers from Columbia University, US, demonstrates that the ozone hole is able to influence tropical circulation and increase rainfall at low latitudes in the entire Southern Hemisphere. This is the first time that ozone depletion – an upper atmospheric phenomenon confined to the polar regions – has been linked to climate change from the Pole to the equator. "The ozone hole is not even mentioned in the summary for policymakers issued with the last IPCC report," says Lorenzo Polvani, co-author of the paper. "We show in this study that it has large and far-reaching impacts. The ozone hole is a big player in the climate system." Lead author Sarah Kang says: "It's really amazing that the ozone hole, located so high up in the atmosphere over Antarctica, can have an impact all the way to the tropics and affect rainfall there – it's just like a domino effect." The ozone hole is now widely believed to have been the dominant agent of atmospheric circulation changes in the Southern Hemisphere in the last half century. This means, according to Polvani and Kang, that international agreements about mitigating climate change cannot be confined to dealing with carbon alone – ozone needs to be considered, too. "This could be a real game-changer," says Polvani. Over the past decade ozone depletion has largely halted. Scientists now expect it to fully reverse, with the ozone hole closing by mid-century. "While the ozone hole has been considered as a solved problem, we're now finding it has caused a great deal of the climate change that's been observed," says Polvani. Together with colleagues at the Canadian Centre for Climate Modelling and Analysis, Kang and Polvani used two different state-of-the-art climate models to show the ozone hole effect. They first calculated the atmospheric changes in the models produced by creating an ozone hole. They then compared these changes with the ones that have been observed in the last few decades: the close agreement between the models and the observations shows that ozone is likely to have been responsible for the observed changes in the Southern Hemisphere. Kang and Polvani plan next to study extreme precipitation events, which are associated with major floods, mudslides, etc. "We really want to know," says Kang, "if and how the closing of the ozone hole will affect these."

Ozone ! – Disease/Food/Environment

Ozone depletion causes disease, crop failure, and ecosystem disruption

Mishra 10 (M. P., Chief Editor of ECOSOC, international environmental newsletter, “Ozone Layer: Its depletion, consequences, and protection,” September 12, http://www.ecosensorium.org/2010/09/ozone-layer-its-depletion-consequences.html, JM)

Ozone absorbs ultraviolet radiations so that much of it is never allowed to reach to the earth surface. The protective umbrella of ozone layer in the stratosphere protects the earth from harmful ultraviolet radiations. Ozone plays an important role in the biology and climatology on the earth’s environment. It filters out all the radiations that remain below 3000Å. Radiations below this wavelength are biologically harmful. Hence any depletion of ozone layer is sure to exert catastrophic impacts on life in the biosphere. The Ultraviolet radiation is one of the most harmful radiations contained in the sunlight. Ozone layer in the stratosphere absorbs these radiations and does not allow it to reach to the earth. The depletion of Ozone layer may lead to UV exposures that may cause a number of biological consequences like Skin Cancer, damages to vegetation, and even the reduction of the population of planktons (in the oceanic Photic zone). Some of the remarkable effects of the UV radiations or the effects of depletion of the Ozone Layer are mentioned below. (1) UV radiation causes sun- eye- diseases (cataract), skin diseases, skin cancer and damage to immune systems in our body. (2) It damages plants and causes reduction in crop productivity. (3) It damages embryos of fish, shrimps, crabs and amphibians. The population of salamanders is reducing due to UV-radiations reaching to the earth. (4) UV- radiations damage fabrics, pipes, paints, and other non-living materials on this earth. (5) It contributes in the Global Warming. If the ozone depletion continues, the temperature around the world may rise even up to 5.5 Celsius degrees. II.Specific Effects The specific effects of depletion of Ozone Layer have been observed on Human Society, Agriculture, Plants and Animals etc. These effects have been summarized as below- A. Effects of Ozone Depletion on Human Society (i).The flux of ultra violet radiation in the biosphere is increased due to ozone depletion. It has seriously harmful effects on human societies like formation of patches on skin and weakening of the human immune system. (ii). It may cause three types of skin cancer like basal cell carcinoma, squamous cell carcinoma and melanoma. A 10 per cent decrease in stratospheric ozone has been reported to cause 20 to 30 per cent increase in cancer in human society. Each year, about 7000 people die of such diseases each year in USA. About 10 percent increase in skin cancer has been reported in Australia and New Zealand. (iii).Exposure to UV radiations damages skin of the sun-bathing people by damaging melanocyte-cells or by causing sun-burns due to faster flow of blood in the capillaries of exposed areas. (iv).Exposure to UV radiations due to ozone depletion may cause leukemia and breast cancer. (iv).Exposure of UV radiation to human eye damages cornea and lens leading to Photo keratitis, cataract and even blindness. (v).The Ambient Ozone Exposure may cause Emphysema, bronchitis, asthma and even obstruction of lungs in human beings. (vi).Exposure to radiations due to ozone depletion has been reported to cause DNA breakage, inhibition and alteration of DNA replication and premature ageing in human beings. B. Effect of Ozone Depletion on Agriculture (i). Radiations reaching to the earth due to ozone depletion cause severe damage to plants including crops. As per reports, ultra violet radiations reaching to the earth cause losses up to 50 per cent in European countries. (ii).The radiation reaching to the earth due to the depletion of the ozone layer cause visible damages in plants. They adversely affect the rate of photosynthesis that finally results into decrease in the agricultural production. (iv).The UV radiation enhances the rate of evaporation through stomata and decreases the moisture content of the soil. This condition adversely affects the growth and development of crop plants and reduces the crop yield. (v). The ozone reduction adversely affects the weather pattern which in turn affects the crop production by encouraging plant injuries and disease development. (vi). The UV radiation reaching to the earth surface alters the global balance between radiation and energy. This condition of imbalance causes seasonal variations that further reduce the crop production. (vii). A number of economically important plant species such as rice, depend on cyanobacteria residing in their roots for the retention of nitrogen. These bacteria are sensitive to UV light and they are hence, are killed instantly. C. Effects of Ozone Depletion on other Plants and Animals (i).The ozone layer depletion causes climatic alterations that cause physiological changes in plants and animals. The change in the energy balance and radiation may affect the survival and stability of living organisms. (ii).The depletion of ozone layer may cause changes in thermal conditions of the biosphere. It may affect type, density and stability of vegetation which in turn may affect different bio-geo-chemical cycles operating in nature. Interruption in these cycles damages important process of ecosystem leading to dangerous conditions for plants and animals. (iii).The depletion of ozone layer causes death of plankton- populations in fresh as well as marine waters .This condition seriously affects the transfer of materials in ecosystems. The recent researches gave analyzed a widespread extinction of planktons 2 million years ago that coincided with the nearby supernova. Planktons are particularly susceptible to effects of UV light and are vitally important to the marine food webs.

Ozone ! – Warming/Cancer

Ozone depletion causes warming and skin cancer, and disrupts ecosystems

EPA 1-13 (“Health and Environmental Effects of Ozone Layer Depletion,” http://www.epa.gov/ozone/science/effects/index.html, JM)

Reductions in stratospheric ozone levels will lead to higher levels of UVB reaching the Earth's surface. The sun's output of UVB does not change; rather, less ozone means less protection, and hence more UVB reaches the Earth. Studies have shown that in the Antarctic, the amount of UVB measured at the surface can double during the annual ozone hole. Another study confirmed the relationship between reduced ozone and increased UVB levels in Canada during the past several years. Effects on Human Health Laboratory and epidemiological studies demonstrate that UVB causes nonmelanoma skin cancer and plays a major role in malignant melanoma development. In addition, UVB has been linked to cataracts -- a clouding of the eye’s lens. All sunlight contains some UVB, even with normal stratospheric ozone levels. It is always important to protect your skin and eyes from the sun. Ozone layer depletion increases the amount of UVB and the risk of health effects. EPA uses the Atmospheric and Health Effects Framework (AHEF) model, developed in the mid 1980s, to estimate the health benefits of stronger ozone layer protection policies under the Montreal Protocol. EPA estimates avoided skin cancer cases, skin cancer deaths, and cataract cases in the United States. Effects on Plants Physiological and developmental processes of plants are affected by UVB radiation, even by the amount of UVB in present-day sunlight. Despite mechanisms to reduce or repair these effects and a limited ability to adapt to increased levels of UVB, plant growth can be directly affected by UVB radiation. Indirect changes caused by UVB (such as changes in plant form, how nutrients are distributed within the plant, timing of developmental phases and secondary metabolism) may be equally, or sometimes more, important than damaging effects of UVB. These changes can have important implications for plant competitive balance, herbivory, plant diseases, and biogeochemical cycles. Effects on Marine Ecosystems Phytoplankton form the foundation of aquatic food webs. Phytoplankton productivity is limited to the euphotic zone, the upper layer of the water column in which there is sufficient sunlight to support net productivity. The position of the organisms in the euphotic zone is influenced by the action of wind and waves. In addition, many phytoplankton are capable of active movements that enhance their productivity and, therefore, their survival. Exposure to solar UVB radiation has been shown to affect both orientation mechanisms and motility in phytoplankton, resulting in reduced survival rates for these organisms. Scientists have demonstrated a direct reduction in phytoplankton production due to ozone depletion-related increases in UVB. One study has indicated a 6-12% reduction in the marginal ice zone. Solar UVB radiation has been found to cause damage to early developmental stages of fish, shrimp, crab, amphibians and other animals. The most severe effects are decreased reproductive capacity and impaired larval development. Even at current levels, solar UVB radiation is a limiting factor, and small increases in UVB exposure could result in significant reduction in the size of the population of animals that eat these smaller creatures. Effects on Biogeochemical Cycles Increases in solar UV radiation could affect terrestrial and aquatic biogeochemical cycles, thus altering both sources and sinks of greenhouse and chemically-important trace gases e.g., carbon dioxide (CO2), carbon monoxide (CO), carbonyl sulfide (COS) and possibly other gases, including ozone. These potential changes would contribute to biosphere-atmosphere feedbacks that attenuate or reinforce the atmospheric buildup of these gases. Effects on Materials Synthetic polymers, naturally occurring biopolymers, as well as some other materials of commercial interest are adversely affected by solar UV radiation. Today's materials are somewhat protected from UVB by special additives. Therefore, any increase in solar UVB levels will therefore accelerate their breakdown, limiting the length of time for which they are useful outdoors.

\*\*AFF

Aff- Environment Friendly Propulsion Coming

Better forms of chemical propulsion developing now

Ward 2k (Dennis, Science Educator @ University Corporation for Atmospheric Research, “Advanced Chemical Propulsion,” http://eo.ucar.edu/staff/dward/sao/fit/advanced.htm, JM)

The most common monopropellant in use is hydrazine. It is passes through a catalyst bed, where it decomposes into nitrogen and ammonia and delivers a specific impulse of about 230 lbf-s/lbm. Propulsion systems of this sort are well suited to pulsed operations of short duration, such as small spacecraft attitude control. (Adams, 1994) NASA is also developing new monopropellant systems to replace the current hydrazine monopropellant systems. The monopropellants under consideration are environmentally friendly, have a higher density, and have better thermal characteristics than hydrazine. The near-term goal is to improve mission performance and greatly reduce ground operations costs. For the far-term, a very high performance (high specific impulse) system is being sought. The key to this goal is the development of a high-temperature catalyst; research in this area is underway. (Schneider, 1997) For small spacecraft, several chemical propulsion technologies are being explored. Examples include: 1. A warm gas propulsion system that uses a mixture of hydrogen, oxygen, and an inert gas (nitrogen or helium) and that offers a high specific impulse alternative to cold gas systems with a minimal increase in complexity 2. Exothermic decomposing solid and hybrid systems, which offer the high density and simplicity of solid propellants for low-thrust, quick-response applications 3. A water electrolysis concept that can provide dual use as a combined propulsion/power system 4. A "microturbomachinery"-based bipropellant system for very high-performance applications which uses microelectronic mechanical system (MEMS) fabrication technology to provide propulsion systems "on-a-chip" similar to computer chips. (Schneider, 1997)

Aff – A2 – Ozone !

Ozone “depletion” isn’t caused by humans

Maduro 2 (Rogielo, Co-author, *The Holes in the Ozone Scare*, January, http://www.mitosyfraudes.org/Ingles/Crista.html, JM)

They discovered that changes in the ozone layer were directly caused by the horizontal and vertical movement of air masses (that is, wind dynamics). A close analysis of the data also demonstrated that chemistry played no role in the thickness of the ozone layer over these stations. The authors discuss the implications of their work in detail: Intensive investigations on irregular variations of the total ozone during the last years point out many phenomena as possible sources. Influences related to homogeneous and heterogeneous chemistry, volcanic activity, solar proton events, and other forms of solar activity are documented ... The main cause, however, may be influences from meteorological conditions, and these relations have got much less attention. The role of horizontal advection and vertical motion as a significant source for ozone column variations has been studied more than 40 years ... Recently Rabbe and Larsen [(3)](http://www.mitosyfraudes.org/Ingles/Crista.html#8link) have indicated dynamic processes in the atmosphere as a main reason of ozone variations and ozone "miniholes." They show that ascending motion of the air is accompanied by dilution of the ozone layer, and vice versa, descending motion of the air causes enhanced density of the ozone layer. The causes of ascending and descending motions are often winds blowing across mountain ranges. Such vertical air movements will cause adiabatic expansion and compression with cooling and warming in time scales down to a few hours. Chemical processes can also contribute to ozone variations, but here the time scales are days. On the other hand, ozone variations with periods in the order of 10 days, and seasonal variations as well can also be explained by dynamic meteorological reasoning. After a detailed analysis of the Russian data, Henriksen and Roldugin conclude with a sharp reminder to the promoters of the ozone depletion fraud that they cannot arbitrarily exclude factors other than chemistry from their models: The question of so-called "ozone depletion" has to be investigated from the point of view of long-term variation of general circulation in the atmosphere. Models of "the depletion," as summarized in [the World Meteorological Organization's] WMO Report, must realize that the meteorological conditions have significant effects on the ozone layer, being the main cause of seasonal as well as most of the shorter and apparently arbitrary density and thermal variations.

Chemical rockets pose a minimal threat to ozone

Ross and Zittel 2k (Martin N. and Paul F., PhD in Earth & Planetary Sciences, UCLA, PhD in Physical Chemistry, UCBerkeley, *Aerospace* 1, 2, Summer, JM)

Space transportation, once dominated by government, has become an important part of our commercial economy, and the business of launching payloads into orbit is expected to nearly double in the next decade. Each time a rocket is launched, combustion products are emitted into the stratosphere. CFCs and other chemicals banned by international agreement are thought to have reduced the total amount of stratospheric ozone by about 4 percent. In comparison, recent predictions about the effect on the ozone layer of solid rocket motor (SRM) emissions suggest that they reduce the total amount of stratospheric ozone by only about 0.04 percent. Even though emissions from liquid-fueled rocket engines were not included in these predictions, it is likely that rockets do not constitute a serious threat to global stratospheric ozone at the present time. Even so, further research and testing needs to be done on emissions from rockets of all sizes and fuel system combinations to more completely understand how space transportation activities are affecting the ozone layer today and to predict how they will affect it in the future.

Aff – A2 – UV Radiation !

UV radiation is harmless, unrelated to ozone, and not increasing – no impact.

Maduro 2 (Rogielo, Co-author, *The Holes in the Ozone Scare*, January, http://www.mitosyfraudes.org/Ingles/Crista.html, JM)

How has such a technical matter as stratospheric chemistry come to dominate headlines around the world and mobilize politicians to impose a ban that will cost their nations over $5 trillion over the next few years? The answer is fear of increased numbers of deaths from skin cancer as more ultravioiet radiation hits the Earth, supposedly the result of ozone depletion. If it were not for the mass hysteria that has been created over the alleged dangers of an increase in skin cancer rates, there would be no ban on CFCs today, and newspapers would not even bother to cover the issue. For example, during the same four- to six-week period that the so-called ozone hole appears over Antarctica, a nitrogen oxide (NOx) hole also develops over the same area. Both the so-called ozone hole and nitrogen oxide hole are created in Antarctica by the same natural phenomena, but mentioning this and other unusual phenomena over Antarctica would raise too many questions in people's minds about the extraordinary chemistry that takes place at the end of the polar winter in Antarctica, and would lead people to question the ozone scare. So, the NOx hole is never mentioned. Let's look at the UV/cancer theory. First, the scare stories about UV and ozone depletion are based on increases in UV that are minuscule, compared with the natural variations in UV-B that are determined by one's altitude and distance from the Equator. Second, there is no evidence that levels of UV-B have increased at the surface of the Earth, despite the claims of worldwide ozone depletion. And third, biological research now indicates that it is not UV-B that causes the malignant types of skin cancer, but UV-A, which is not screened out by the ozone layer. The ozone depletion theory predicts that there will be a 10 to 20 percent increase in the level of UV-B radiation at the surface as a result of ozone depletion. This might seem like a large increase, unless one knows something about the geometry of the Sun and the Earth. UV-B varies by 5,000 percent from the Equator to the Poles. It also varies with altitude. This is the result of simple geometry: There is more sunlight exposure at the Equator and the atmosphere is thinner in the mountains, so more UV-B gets through. In midlatitudes such as that of the United States, a 1 percent increase in UV-B is the equivalent of moving 6 miles south (closer to the Equator). Thus, the alleged increase in UV radiation, according to the theory, would be the equivalent of what a person would receive if he were to move 60 to 120 miles south – the equivalent of moving from New York City to Philadelphia. Actual instrumental measurements of ultraviolet radiation at the surface show that there has been no increase in UV levels, despite widespread claims of ozone depletion in northern latitudes. Just as with the ozone layer, the levels of UV radiation go through tremendous seasonal fluctuations. The amount of incoming UV radiation is modulated by several factors, including the angle of the Sun at that particular time of the year (lowest in winter), incoming solar radiation, sun spots, thickness of the ozone layer, meteorological conditions (cloud cover, and so on) and pollution. Accurately determining the amount of UV radiation requires long-term readings over an extensive network. Curiously enough, while tens of billions of dollars have been spent on "ozone research" almost no money has been spent on UV readings at the surface. The most extensive study to date of UV-B radiation at the surface is that conducted by Joseph Scotto and his collaborators at the National Cancer Institute. The study, published in the Feb. 12, 1988, issue of Science,[(6)](http://www.mitosyfraudes.org/Ingles/Crista.html#11link) presented evidence that the amount of UV-B reaching ground level stations across the United States had not increased, but in fact, had decreased between 1974 and 1985. Instead of rejoicing at the results, the promoters of the ozone depletion scare saw to it that the network of observing stations was shut down, by cutting its funding (less than $500,000 out of more than $1.75 billion in research funds to study "climate change"). One of the recent attempts to contradict the Scotto study was an article by J.B. Kerr and C.T. McElroy, published in Science magazine in 1993, claiming an upward trend in UV radiation over Toronto. [(7)](http://www.mitosyfraudes.org/Ingles/Crista.html#12link) The results were front-page news internationally, but when it was soon demonstrated by other scientists that the so-called trend was based on faulty statistical manipulation [(8)](http://www.mitosyfraudes.org/Ingles/Crista.html#13link) this reverse got little publicity. The entire "rise" in UV was based on readings taken during the last 3 days of five years of measurements! A correct statistical analysis showed that the trend in UV was zero (that is to say, the amount of UV had neither increased nor decreased over the five-year period). Interestingly enough, the Canadian study had been rejected for publication by Nature. At the time the Canadian paper was submitted to Science, F. Sherwood Rowland was the president of the American Association for the Advancement of Science, publisher of Science. According to knowledgeable sources, Rowland rammed through the publication of the paper despite its obvious errors.

Aff – CFCs Good

Restriction of chlorofluorocarbons causes starvation and disease

Maduro 2 (Rogielo, Co-author, *The Holes in the Ozone Scare*, January, http://www.mitosyfraudes.org/Ingles/Crista.html, JM)

The latest atmospheric data, presented here, confirm that the ozone depletion theory is a scientific fraud. In fact, the Montreal Protocol banning CFCs was signed in 1987, despite the fact that there was no scientific evidence to support such a ban, and that the people who organized the treaty knew that there was no such evidence. Richard Elliot Benedick, the U.S. State Department official responsible for negotiating the Montreal Protocol, says so plainly in his book Ozone Diplomacy. [(12)](http://www.mitosyfraudes.org/Ingles/Crista.html#17link) "The Montreal Protocol on Substances that Deplete the Ozone Layer mandated significant reductions in the use of several extremely useful chemicals.... By their action, the signatory countries sounded the death knell for an important part of the international chemical industry, with implications for billions of dollars of investments and hundreds of jobs in related sectors. The protocol did not simply prescribe limits on these chemicals based on "best available technology," which had been a traditional way of reconciling environmental goals with economic interests. Rather, the negotiators established target dates for replacing products that had become synonymous with modern standards of living, even though the requisite technologies did not yet exist. At the time of the negotiations and signing, no measurable evidence of damage existed. Thus, unlike environmental agreements of the past, the treaty was not a response to harmful developments or events, but rather a preventive action on a global scale". What Benedick knew, but did not say, is that the ban on CFCs would directly and indirectly cause millions of deaths per year, and that he supports this mass murder. Seven years after the Montreal Protocol banning CFCs, the "evidencé of damage" still does not exist, and the Montreal Protocol has served as the shining example for new international environmental treaties. The Climate Treaty, the Biodiversity Treaty, and others, have been signed despite the lack of scientific evidence, the argument being that the delegates are just following the example of the Montreal Protocol. The ban on the production of CFCs took effect on Jan. 1, 1996, in the United States. This event, which most people may not even notice until their car air conditioners break down, is earth-shaking. The production of one of the most useful chemicals invented by man – literally, the life-blood of the world.'s food refrigeration system – is ending. By preserving the food supply and keeping it wholesome, refrigeration is one ot the major factors in the dramatic increase in human life expectancy in the past half-century. By removing these inexpensive, benign, and efficient coolants, the Montreal Protocol measures put at risk the poorest populations in the world, those for whom the more expensive refrigerant replacements will make the cost of refrigeration prohibitive. The entire worldwide food chain depends on CFCs. CFCs are used in refrigeration systems at the time crops are harvested and during transportation, storage, and distribution. This refrigeration "cold chain" depends on a steady supply of CFCs and HCFCs. [(13)](http://www.mitosyfraudes.org/Ingles/Crista.html#18link) There are no drop-in substitutes for CFCs and HCFCs for most refrigerators, freezers, and refrigerated transports, which means that as supplies disappear, existing equipment shuts down or is scrapped. Most nations of the world cannot afford to replace this equipment. As a result of the ban on CFCs, the cold chain is already collapsing in the poorer areas of the world, particularly Africa and Eastern Europe. Public health also suffers from this cold chain collapse, because most vaccines and many medicines need to be refrigerated. In addition, a ban on the agricultural pesticide and fumigant methyl bromide, for which there is no available chemical substitute, means that many countries will lose the ability to export their crops, and that dangerous pests will spread to other areas of the world to destroy crops and attack people. Methyl bromide is crucial to preserve food in storage, particularly grains. More than one third of the world's grain supply will be lost if methyl bromide is banned. In 1992, international refrigeration experts estimated that the ban on CFCs was going to kill between 20 to 40 million people every year by the end of the decade, through hunger, starvation, and foodborne diseases. This is now an underestimate, given the addition of methyl bromide to the list of chemicals to be banned, and given the emergence of new and old diseases.

Aff – A2 – Ozone 🡪 Climate Change

Ozone depletion has a minimal relation to climate change

ESRL 10 (Earth System Research Laboratory, “Implications of Ozone Depletion and the Montreal Protocol,” http://www.esrl.noaa.gov/csd/assessments/ozone/2010/twentyquestions/Q18.pdf, JM)

Stratospheric and tropospheric ozone both absorb infrared radiation emitted by Earth’s surface, trapping heat in the atmosphere. Stratospheric ozone also significantly absorbs solar radiation. As a result, increases or decreases in stratospheric or tropospheric ozone induce a climate forcing and, therefore, represent direct links between ozone and climate. In recent decades, global stratospheric ozone has decreased due to rising reactive chlorine and bromine amounts in the atmosphere, while global tropospheric ozone in the Industrial Era has increased due to pollution from human activities (see Q3). Stratospheric ozone depletion has caused a small negative radiative forcing since preindustrial times, while increases in tropospheric ozone have caused a positive radiative forcing (see Figure Q18- 1). Summing the positive forcing due to tropospheric ozone increases with the smaller negative forcing from stratospheric ozone depletion yields a net positive radiative forcing. The large uncertainty in tropospheric ozone forcing reflects the difficulty in quantifying tropospheric ozone trends and in modeling the complex production and loss processes that control its abundance. The negative radiative forcing from stratospheric ozone depletion will diminish in the coming decades as ODSs are gradually removed from the atmosphere. Stratospheric ozone depletion cannot be a principal cause of present-day global climate change for two reasons: first, the climate forcing from ozone depletion is negative, which leads to surface cooling. Second, the total forcing from other longlived and short-lived gases in Figure Q18-1 is positive and far larger. The total forcing from these other gases is the principal cause of observed and projected climate change.

Aff – Alt Cause CFCs

Plan is a drop in the bucket – CFCs are 80 percent of ozone depletion and last for 120 years

Coffey 10 (Jerry, writer @ Universe Today, 1/20/2010, http://www.universetoday.com/51375/causes-of-ozone-depletion/) JPG

Chloroflourocarbons(CFC) are the ”big dog” as far as causes of ozone depletion are concerned. CFC’s are man made chemicals that are very stable in the atmosphere. They take from 20 to 120 years to break down. All the while they are destroying ozone molecules. This is what happens: CFCs do not fall back to Earth with rain, nor are they destroyed by other chemicals. Because of their relative stability, CFCs rise into the stratosphere where they are eventually broken down by ultraviolet (UV) rays from the Sun. This causes them to release free chlorine. The chlorine reacts with oxygen which leads to the chemical process of destroying ozone molecules. The net result is that two molecules of ozone are replaced by three of molecular oxygen leaving. The chlorine then reacts again with the oxygen molecules to destroy the ozone and the process repeats 100,000 times per molecule. While naturally occurring chlorine has the same effect on the ozone layer, it has a shorter life span in the atmosphere. Of all of the causes of ozone depletion, the release of CFCs is thought to have accounted for 80% of all stratospheric ozone depletion. With great forethought, the developed world has phased out the use of CFCs in response to international agreements, like the Montreal Protocol, to protect the ozone layer. On the downside though, because CFCs remain in the atmosphere so long, the ozone layer will not fully repair itself until at least the middle of the 21st century.

Alt causes outweigh the internal link

O’Neill 9 (Ian, writer @ AstroEngine, 1/13/9, http://www.astroengine.com/2009/01/oh-no-rocket-launches-are-bad-for-the-environment-wed-better-stay-at-home-then/) JPG

Of course, there are other space agencies, and now we have a growing number of private rocket companies, but compared with the daily carbon emissions we individuals and industry are responsible for, rocket launches aren’t exactly the Spawn of Satin.

Aff – SPS Link Turn

SPS is key to innovation – solves problems including pollution

O’Neill 9 (Ian, writer @ AstroEngine, 1/13/9, http://www.astroengine.com/2009/01/oh-no-rocket-launches-are-bad-for-the-environment-wed-better-stay-at-home-then/) JPG

Space-based solar power could be THE revolution for the future of mankind. We have a long way to go, but if we are looking for an endless energy resource, we might be on the verge of becoming a viable space-borne civilization. All going well, this will help the world on a vast scale. Unfortunately, wars, famine and human/ecological suffering will still continue, but it can, perhaps, be alleviated by having an extroverted view on human evolution. Introverted attitudes stifle growth (economic, evolutionary, technological), therefore making the world a very bleak place.

Aff – Link Turn

Innovation has minimized pollution – space exploration is the only way to solve climate problems

O’Neill 9 (Ian, writer @ AstroEngine, 1/13/9, http://www.astroengine.com/2009/01/oh-no-rocket-launches-are-bad-for-the-environment-wed-better-stay-at-home-then/) JPG

For every article written about the amazing advances in space vehicle technology, there are two negative comments about the pointlessness of space exploration. “What’s the point?“, “We have war, famine, poverty and human suffering around the world, why invest billions on space?“, “What’s space exploration ever done for me?“. However, today, after I wrote a pretty innocuous article about the awesome SpaceX Falcon 9 rocket being hoisted vertically on the launchpad at Cape Canaveral, I get a comment (anonymous, naturally) starting off with, “This launch and others like it should be halted indefinitely until it’s carbon footprint and environmental impact can be accounted for.” The commenter then goes into something about making an environmental assessment, levying SpaceX’s taxes and setting up a board of environmental scientists. Oh please. On the one hand, I’m impressed by this person’s spirited stand against environmental damage, carbon emissions and global warming, but on the other, this is probably one of the most misplaced environmentalism attacks I have seen to date. There are extremists on both sides of the “green” debate, but the last thing we need is an attack against the only answer we have to fight climate change. And that answer comes in the form of a cigar shaped polluter, blasting into Earth orbit; whether you like it or not, it is a necessary (yet small) evil…Some of the comments I get on the Universe Today are hilarious. Admittedly, they can be pretty nasty too (2012 anyone?), and others are outright rude (edit»delete). It’s not that I mind, but there seems to be this online attitude that you can say what you like to whom you like without consequence. Fortunately, on the Universe Today and Astroengine, we both exercise the right to ban, so be nice. To be honest, this doesn’t happen too often (apart from if I mention the LHC, Mayans or Planet X; they are the keywords for anger, and cursing, plus personal attacks), and I totally embrace any alternative theories and opinions. I actually really, really appreciate a good debate in the comment boxes, and I make a point of participating when I can. So today, I get this comment that started a good meaty debate under my SpaceX article, so I felt compelled to get involved. The best reply to the above comment was left by a regular reader, Maxwell, saying, “Spaceflight is too important an endeavor to dick around with red tape.” And I agree. As I spent 15 minutes writing my reply, I thought I’d base an Astroengine post around it, so here’s my response to the whole “rockets are bad” argument: I write an article about one of the biggest advances in commercial spaceflight history and we wind up talking about how bad rockets are for the environment! I’m pretty sure the effects of rocket emissions on the atmosphere are minimal compared with the routine daily emissions we all generate. Also, from articles I’ve previously written, companies such as SpaceX are acutely aware of pollution and have taken measures to supplement launches with enrolment in carbon-offset projects. Also, their engines are generally very efficient, minimising pollution. The argument against advancing our spacefaring ability because “there are more problems on Earth that need fixing first” simply does not hold water. Science endeavour in general enhances our lives in ways I doubt we’ll ever fully comprehend. For now, rocket launches are the best way to get us into space, and until another alternative comes along (that I’m sure a commercial entity such as SpaceX will be the first to design), the small amount of ecosystem damage caused by a few launches might be a necessary evil (although I’d debate it is not a huge contributing atmospheric impact).

\*\*Chemical Propulsion Good/Bad\*\*

Soyuz Bad

Soyuz fails – its unsafe and explodes upon reentry

Messier 8 (Doug, editor @ Parabolic Arc, co-owner of spacejobs.com, Intl space U, 9/21/8, http://www.parabolicarc.com/2008/09/21/is-soyuz-unsafe/) JPG

The Rocketsandsuch blog has an interesting post about what might be causing re-entry problems with Soyuz spacecraft returning from the International Space Station. The last two missions to return from orbit experienced rough, ballistic re-entries because the pyrotechnic charges designed to separate the crew return module from the rest of the ship failed to fire properly. “The space station has grown in size considerably since those first early long duration flights that the Soyuz so flawlessly serviced. It is a bit larger now with all the new modules the Emperor has sent aloft for our friends. As such it makes quite a target for training gangly military officers on ground-based radars around the world. It has also become quite a source of electromagnetic energy itself, with all the radios and such from all the international partners blasting their messages back to the homelands,” the blogger writes. “Did you hear the recent news about cell phones in your pocket causing your little reproductive agents to slow down or become ineffective? The same thing may be at work when the cacophony of EMI on the space station envelops the Soyuz separation pyros and causes them to become inert.” If this report is true, then the space station program is in serious trouble. The current crew could be at risk if their Soyuz is similarly affected; the last crew to return were lucky to escape with their lives, according to some reports. Their Soyuz vehicle began to re-enter the atmosphere backwards until it broke away from the orbital module and righted itself. This problem also raises questions about NASA’s plan to rely on the Soyuz as the primary transportation vehicle after the agency retires the space shuttle in 2010. NASA’s successor vehicle, Orion, might not be ready to fly crews to the ISS until 2015. “Soyuz is unsafe and we are subjecting our astronauts to an unnecessary risk by putting them in vehicles that have been on orbit for more than a couple of weeks,” Rocketsandsuch concludes.

Soyuz Launch D/A Link

Soyuz rockets are outdated, unsafe, and burn solid fuel

Popular Science 3 (Magazine, May 2003, pp. 104, google books) JPG

Like so many other questions one could ask about space travel, the answer is not yet, but soon. All current military, commercial and scientific launches use decades old rocket technology. The most popular is a solid rocket booster, so called because its oxidizer and fuel—a blend of volatile and hazardous chemicals—are pre-mixed inside the rocket, where they cure into a solid. Once fired, these rockets cannot be shut off or even throttled down. At its core, launching a manned capsule or satellite on a solid rocket booster is the space travel equivalent of tying a green plastic Army man to a bottle rocket and hoping it doesn't blow up. The main exception in the U.S. space program is the troubled shuttle, which uses liquid hydrogen and oxygen in addition to solid fuels (see story, page 76). Soyuz rockets burn liquid oxygen and kerosene fuel.

Soyuz Bad – $

Soyuz costs 63 million dollars a seat

Dillow 3/15 (Clay, writer @ popular science, 3/15/11, http://www.popsci.com/technology/article/2011-03/hitchhiking-iss-soyuz-gets-more-expensive-nasa-signs-new-deal-russia) JPG

The Russians are teaching the Americans an important lesson in capitalism: where there’s high demand for a scarce commodity, costs will rise. NASA and its Russian counterpart inked a new $753 million modification to its current International Space Station transportation deal Monday, securing seats on the Russian Soyuz spacecraft from 2014 to 2016 at a price of almost $63 million per seat. The old contract, which runs until 2014, reserves seats on the Soyuz for just $56 million. The new deal is a bridge between the end of the old contract in 2014 and the expected emergence of a homegrown commercial manned space transportation system sometime in the middle of the decade. It secures a place for six crew members for launch in 2014 and six more the following year along with the return of both crews, with the second crew returning in 2016 after a six-month stint on the ISS. With NASA’s retiring of the space shuttle fleet later this year, the Russian Soyuz has the market cornered as far as manned transportation between the Earth and the ISS is concerned. Whether or not that has anything to do with the uptick in per-seat price is pure speculation, but NASA chief Charles Bolden took the opportunity Monday to remind Americans and American companies of the importance of developing a space transit option that’s made in the U.S.A.

Soyuz Good

Soyuz is safe

Halvorson and Karash 8 (Todd Halvorson and Yuri Karash, writers @ Florida today, 6/30/8, http://www.space.com/5574-rides-soyuz-spacecraft-rocky-risky.html) JPG

The crew of the International Space Station will get a go-ahead next week to perform spacewalking inspections as part of a probe into back-to-back ballistic re-entries by Russian Soyuz spacecraft. Two veteran cosmonauts, meanwhile, say the type of steep trajectories flown by consecutive Soyuz crews are safe-but-rocky rides back to Earth. "Imagine you drive a luxury car with fine shock absorbers, not feeling the road at all," said Pavel Vinogradov, who served on Russia's Mir space station and commanded an expedition to the new outpost. "And then suddenly, one of the shock absorbers breaks and you start feeling all the dents and unevenness of the road," he said. "It doesn't mean that your life is in danger. You can still safely drive the car."

SpaceX Bad – Falcon 9

Falcon 9 is a failure – launches have had to be aborted

Atkinson 10 (Nancy, writer @ universe today, 3/9/10, http://www.universetoday.com/59298/spacex-falcon-9-test-fire-ends-with-abort/) JPG

SpaceX just released the official word on what happened with Tuesday’s 3.5 second test-fire of the Falcon 9 rocket. The test aborted immediately after it started, and a a spin start system failure forced the early shutdown. The Falcon 9 sits on Launch Complex 40 at Cape Canaveral Air Force Station, and from the Kennedy Space Center press site, (about 4 miles away) a muffled bang was heard at the time of ignition, 1:41 pm EST. “Today SpaceX performed our first Static Fire for the Falcon 9 launch vehicle,” said Emily Shankin from SpaceX in a press release. “We counted down to an T-2 seconds and aborted on Spin Start. Given that this was our first abort event on this pad, we decided to scrub for the day to get a good look at the rocket before trying again. Everything looks great at first glance.” An online webcam on Spaceflightnow.com showed a brief flash and a small cloud of smoke, and then nothing. Other observers at the site said it appeared as if flight computers detected a problem and automatically shut down the engines before the test was completed. The test-firing is considered a major objective towards the first launch of the Falcon 9, now tentatively scheduled for March 22, but SpaceX officials say launch is more likely to occur in April.

SpaceX Bad – Falcon 9 – Engine

The Falcon 9 uses the same engine as the Falcon 1

Spacex no date (http://www.spacex.com/falcon9.php) JPG

Like Falcon 1, Falcon 9 is a two stage, liquid oxygen and rocket grade kerosene (RP-1) powered launch vehicle. It uses the same engines, structural architecture (with a wider diameter), avionics and launch system.

The engine causes launch failures

Spencer 8 (Henry, computer programmer & spacecraft engineer, 8/7/8, http://www.newscientist.com/blog/space/2008/08/spacex-rocket-failure-due-to-new-engine.html) JPG

SpaceX has now announced what caused the failure of its Falcon 1 rocket last weekend: a new engine on its first stage. As I wrote in my previous post, the new engine's walls were cooled by the incoming fuel rather than just having a thick layer of expendable insulation. That left more fuel inside the engine at cut-off time, so its thrust died out slowly as the extra fuel escaped out the nozzle. This "residual" thrust pushed the first stage forward gently, enough that it caught up with the second stage before the second stage had moved far enough away. That caused the first stage to collide with the second just after the two separated at an altitude of 217 kilometres.

It was three for three on launch failures

Musil 8 (Steven, editor at CNET, 8/3/8, http://news.cnet.com/8301-11386\_3-10005481-76.html) JPG

A privately funded rocket suffered a launch failure Saturday night, the third launch failure in as many attempts for an Internet entrepreneur who is hoping to develop private space delivery and transportation. The failure occurred about two minutes after the launch of the two-stage Falcon 1 rocket, which was manufactured by Space Exploration Technologies, also known as SpaceX. A failure prevented the two stages from separating after the launch from a central Pacific atoll, SpaceX CEO [Elon Musk](http://news.cnet.com/Elon-Musk-on-rockets%2C-sports-cars%2C-and-solar-power/2008-11389_3-6230661.html) said in a [company blog](http://spacex.com/updates.php). The rocket was carrying three satellites for NASA and the Department of Defense. Musk said an investigation into the cause of the failure is under way, but he called the launch itself "picture perfect."

The engine catches on fire – causes mission failure

Bergin 6 (Chris, writer @ nasaspaceflight.com, 3/26/6, http://www.nasaspaceflight.com/2006/03/spacex-come-hell-or-high-water/) JPG

SpaceX’s initial analysis indicates that there was a fuel leak just above the main engine, which caused a highly visible fire. The fire cut into the first stage helium pneumatic system, causing a decrease of pneumatic pressure at T+25s. ‘Once the pneumatic pressure decreased below a critical value, the spring return safety function of the pre-valves forced them to close, shutting down the the main engine at T+29s,’ Elon Musk stated in a statement about the incident.

SpaceX Bad – Falcon 9 – Fragola

Falcon 9 experienced double-engine failure – Fragola statement

Teglet 11 (Traian, writer @ Softpedia, 6/22/11,
http://news.softpedia.com/news/SpaceX-Sues-Company-Over-Defamatory-Allegations-207587.shtml) JPG

Valador Inc.'s Joe Fragola said in his email to the NASA official that he heard about a rumor concerning a possible failure that affected the SpaceX rocket during its second flight, which the latter company deemed a success. “I have just heard a rumor, and I am trying now to check its veracity, that the Falcon 9 experienced a double engine failure in the first stage and that the entire stage blew up just after the first stage separated,” he wrote in the email, Space reports. “I also heard that this information was being held from NASA until SpaceX can 'verify' it,” he added in the letter. SpaceX considered these to be defamatory allegations, and brought the other company to court in the Fairfax County Circuit Court of Virginia on June 14.

Fragola is extremely qualified

Valador No Date (http://www.valador.com/joe\_fragola\_profile) JPG

Joe Fragola has over 35 years of experience working in reliability and risk technology in both the aerospace and nuclear industries. He is a Professional Engineer and received his B.S. and M.S. degrees in Physics from the Polytechnic Institute of New York. In the past he has worked for Grumman Aerospace Corporation, and IEEE at their Headquarters in New York. He was recently a Principal Scientist at SAIC and continues to be a visiting professor at the University of Strathclyde in Glasgow, Scotland. He has published almost 50 papers and two books. He has been awarded the P.K. McElroy RAMS best paper award in 1993 and the Alan Plait Award for the Best Tutorial in 2004, the IEEE Region I award, and has been named an IEEE Fellow for his contributions to the theory and practice of risk, safety, and reliability. He was awarded the 1995 SAIC Publication Prize in Engineering and Applied Mathematics.

More ev

Teglet 11 (Traian, writer @ Softpedia, 6/22/11,
http://news.softpedia.com/news/SpaceX-Sues-Company-Over-Defamatory-Allegations-207587.shtml) JPG

Fragola is regarded as an expert in human spaceflight safety. He is a member of the NASA Exploration Systems Architecture Study team, and was directly involved in selecting the ARES I and V delivery systems for construction under Project Constellation back in 2005.

SpaceX Bad – Falcon 9

Falcon 9 isnt successful – both test flights had massive problems

Thompson 11 (Loren, Chief Operating Officer @ Lexington Inst. & CEO of Source Associates, 5/31/11,

http://blogs.forbes.com/beltway/2011/05/31/the-case-against-spacex-part-ii/) JPG

SpaceX supporters contend this is an unfair comparison, because all of the company’s launch failures occurred with the Falcon 1 vehicle that the company no longer offers. Both launches of the much bigger Falcon 9 vehicle last year were successful, they point out — which is crucially important, since that is the rocket that SpaceX plans to use for supplying the space station. However, two launches isn’t much of a track record, and those launches were far from flawless. For instance, the trade press reported after the initial Falcon 9 launch in June of last year that “roll torque” from the first stage engines had produced a “twisting motion” on lift-off, that an overheated actuator had caused “dramatic spin” in the second stage, and that restart of the second-stage engines did not occur as planned. That’s a lot of problems for a single launch, and concerns are hardly alleviated by Mr. Musk’s description of the second-stage roll as a “non-fatal situation” (Musk admitted at the time he was “not happy” with the restart attempt on the second-stage engine). A series of tweaks presumably resolved these issues, because six months later the company conducted a second launch of the Falcon 9 vehicle that resulted in SpaceX becoming the first private company to ever launch a capsule into space, return it to earth and then recover it. But that launch too was less than perfect, with technicians during the final days before liftoff deciding to trim off four feet of rocket-motor nozzle extensions with metal shears to address an unexpected problem with cracking. Aviation Week described this unorthodox move in the headline of its story on the second Falcon 9 launch as “shear magic.”

SpaceX Bad – Falcon 9 – Mission Failure

Falcon 9 causes significant delays that result in mission failures

Thompson 11 (Loren, Chief Operating Officer @ Lexington Inst. & CEO of Source Associates, 5/23/11

http://blogs.forbes.com/beltway/2011/05/23/what-nasa-risks-by-betting-on-elon-musks-spacex/) JPG

Mr. Musk recently responded to a question from *Space News* reporter Amy Svitak about the two-year delay in accomplishing that second Falcon 9 launch by observing, “In the space business that’s on time.” Perhaps he was irritated by the reporter’s implied criticism, but it goes without saying that if astronauts on board the space station are awaiting supplies, a prolonged launch delay could spell big trouble. It also could signal trouble for a business plan that assumes few mis-steps in performance — the kind of mis-steps that might unravel a company’s pricing model. When launches are delayed, production inputs are used less efficiently and impatient customers need to be compensated. If the delays are really egregious, customers could turn to other providers, reducing the potential for high launch rates essential to achieving economies of scale. Musk noted in the same interview with *Space News* that SpaceX finances are heavily dependent on “milestone payments” from NASA that accelerate as rockets approach their launch dates.

SpaceX Bad – General

SpaceX will fail – it has an unsustainable business model and its rockets are inconsistent

Thompson 11 (Loren, Chief Operating Officer @ Lexington Inst. & CEO of Source Associates, 5/23/11

http://blogs.forbes.com/beltway/2011/05/23/what-nasa-risks-by-betting-on-elon-musks-spacex/) JPG

You don’t have to be a believer in conspiracy theories to wonder why senior government officials are so committed to going the commercial route in space. Even a cursory review of SpaceX programs and plans reveals reasons for doubt. The questions begin with a business strategy that isn’t just disruptive, but downright incredible. Mr. Musk says that he can offer launch prices far below those quoted by any traditional provider — including the Chinese — by running a lean, vertically integrated enterprise with minimal government oversight that achieves sizable economies of scale. The economies of scale are possible, he contends, because there is huge pent-up demand for space travel in the marketplace that cannot be met within the prevailing pricing structure. By dropping prices substantially, this latent demand can then be unlocked, greatly increasing the rate of rocket production and launches. When combined with other features of the SpaceX business model, the increased pace of production and launches results in revolutionary price reductions. There isn’t much serious research to demonstrate that the pent-up demand Musk postulates really exists, nor that the price reductions he foresees are feasible. He has suggested in some interviews that launch costs could decline to a small fraction of current levels if all the assumptions in his business plan come true, and he has posted a commentary on his web-site explaining how SpaceX is already able to offer the lowest prices in the business. It’s hard to look inside the operations of a private company, but SpaceX does seem to be doing all the things necessary to minimize costs such as using proven technology, building as many items as possible in-house, and hiring a young workforce willing to work long hours. And to his credit, Musk has committed over $100 million of his own money to the venture. However, his rockets have major performance limitations compared with other launch vehicles in the market, and they are not yet rated as safe for carrying people. Becoming “man-rated” will necessarily increase the role of federal officials in monitoring SpaceX operations, which is not good news for a business model grounded in minimal government oversight (traditional launch providers say government regulations and overhead charges are a key driver in their own pricing policies).

SpaceX Bad – General

SpaceX has a poor track record – launch failures, delays, and cost hikes

Thompson 11 (Loren, Chief Operating Officer @ Lexington Inst. & CEO of Source Associates, 5/23/11

http://blogs.forbes.com/beltway/2011/05/23/what-nasa-risks-by-betting-on-elon-musks-spacex/) JPG

It’s easy to pick apart business plans, though, and every successful entrepreneur has to deal with doubters. The real test is how plans play out in the marketplace. So far, SpaceX’s track record is decidedly mixed, with three launch failures in seven attempts, sizable schedule delays, and some fairly substantial price increases above what were originally proposed. With regard to launch failures, the company did not succeed in launching its initial Falcon 1 vehicle until the fourth try, about five years after it originally proposed to demonstrate the system. It then shelved the Falcon 1 to focus on a larger launch vehicle designated Falcon 9 that was delayed three years before lofting its first payload into orbit, on June 4, 2010. The only other launch of Falcon 9 occurred six months later, when it enabled SpaceX to become the first private company in history to place a space capsule into orbit and then return it to earth. The latter launch was part of a NASA program to develop new vehicles for supplying the space station — a program that is currently being restructured in part because of cost increases and delays associated with the Falcon 9 program.

SpaceX Bad – General – Launch Costs

Poor business model causes SpaceX to increase launch costs

Thompson 11 (Loren, Chief Operating Officer @ Lexington Inst. & CEO of Source Associates, 5/23/11

http://blogs.forbes.com/beltway/2011/05/23/what-nasa-risks-by-betting-on-elon-musks-spacex/) JPG

The easiest ways to track prices in the launch services market are to follow cost per launch and cost per pound lifted into orbit — metrics that may diverge considerably depending on the intended payload size and orbital plane. Measured either way, SpaceX tends to over-promise when it announces a new vehicle and then raise prices later. For example, the price of a Falcon 1 launch was initially stated at about $6 million in 2003-2004, but then gradually rose to about $11 million in 2010-2011. The price of a Falcon 9 launch rose from $35 million prior to 2008 to $60 million today. The lower prices were quoted before the two vehicles had actually been launched, so the later prices presumably reflect complications encountered in development — a key problem when implementing any new business strategy. Similarly, the per-pound cost of launching payloads into orbit on either vehicle has risen over 100 percent since initial estimates were made by the company. Other items in the SpaceX business plan have also seen significant price increases over time. For instance, the cost of certifying the Falcon 9 launcher and Dragon space capsule for use by astronauts has risen from an initial estimate of about $300 million in 2006 to a billion dollars today. The cost of developing a new Merlin 2 engine to power launch vehicles has reflected a similar pattern. Such increases suggest that SpaceX is following the same trajectory as traditional launch providers in projecting development costs too optimistically, and then having to backtrack. The space industry has a long history of over-estimating demand, under-estimating technical challenges, and then experiencing cost increases and schedule delays leading to recriminations. The same pattern prevails in the weapons industry, which probably means that companies selling to the government operate within a structure of incentives that rewards such behavior.

SpaceX Bad – General – $

SpaceX business model isn’t sustainable – launch rates, bureaucracy, outsourcing – causes massive delays and price incrwases

Thompson 11 (Loren, Chief Operating Officer @ Lexington Inst. & CEO of Source Associates, 5/31/11,

http://blogs.forbes.com/beltway/2011/05/31/the-case-against-spacex-part-ii/) JPG

There are three basic problems with this strategy. First of all, the elasticity of demand in response to price decreases is speculative, both with regard to how far prices can be cut and how prospective customers might react. That is especially true of potential private passengers on commercial space flights, a category of demand that space enthusiasts frequently highlight. A study conducted earlier this year by the prestigious Aerospace Corporation — a federally funded think tank — stated that “no one knows” how price cuts might affect demand for private space travel, but cast doubt on the financial feasibility of any enterprise keyed to that market. Other categories of demand are likely to be more robust. However, federal agencies utilizing launch services are notorious for shifting plans unexpectedly and a single mishap can lead to prolonged groundings. So sustaining a rate of launches not seen since the early days of the space race seems improbable, even if demand does surge. In addition, SpaceX is assuming it will save money by achieving high reuse rates for its boosters when it has yet to recover, much less reuse, boosters from Falcon 9 launches. A second potential defect in the SpaceX business strategy is reliance on vertical integration — pulling parts and component production in-house — to control costs. Elon Musk states in a May 4 posting on the SpaceX web-site that, “because SpaceX is so vertically integrated, we know and can control the overwhelming majority of our costs.” Actually, that’s only half true. If launch rates and production levels are high, performing most manufacturing in-house can help control costs, but if rates are low then SpaceX ends up saddled with unnecessary fixed costs that could have been avoided by outsourcing. SpaceX competitors typically focus their in-house activities on areas where they have core competencies or a competitive advantage, purchasing other items from subcontractors who may have pricing advantages due to greater experience or economical production rates enabled by numerous customers. The notion that vertical integration saves money flies in the face of prevailing business practices, and probably will hinder SpaceX in meeting its pricing objectives. A third big question mark in the SpaceX strategy is whether the company can continue to avoid unnecessary costs by minimizing “bureaucracy,” which in this case means various forms of government oversight and regulation. A key reason why the cost structure in SpaceX contracts is so different from that of traditional launch providers is that it is allowed to escape a raft of federal acquisition practices that range from administrative charges to accounting requirements to workplace standards to small-business set-asides. For instance, NASA imposes heavy overhead charges on its traditional contractors to cover the cost of various agency functions that drive up the price of each space launch. SpaceX thus far has managed to escape most such costs by presenting itself as a non-traditional, “commercial” launch provider. But will it be able to continue avoiding the costs other companies must carry even as it competes against them for the same work? Probably not.

SpaceX Bad – Comparative

Comparatively SpaceX makes the least reliable reliable rockets

Thompson 11 (Loren, Chief Operating Officer @ Lexington Inst. & CEO of Source Associates, 5/31/11,

http://blogs.forbes.com/beltway/2011/05/31/the-case-against-spacex-part-ii/) JPG

Musk’s enthusiasm is infectious and inspiring, but SpaceX’s performance to date doesn’t measure up to the rhetoric. SpaceX has only mounted seven launches since its inception, three of which were catastrophic failures. By way of comparison. Lockheed Martin’s family of Atlas boosters has seen 97 consecutive launches without a single failure. The United Launch Alliance in which traditional providers Lockheed Martin and Boeing are partnered to offer both Atlas and Delta launch vehicles has had 50 successful launches in a row.

SpaceX Good – Falcon 9

Falcon 9 is successful – key to public and private launches

Kaufman 10 (Marc, writer @ Washington Post, 6/5/10, http://www.washingtonpost.com/wp-dyn/content/article/2010/06/04/AR2010060403360.html) JPG

The Falcon 9, the first of a new generation of private rockets that could one day make space travel commonplace, successfully launched from Cape Canaveral on Friday. The 180-foot rocket put a model of its Dragon capsule into orbit about 160 miles up, setting the stage for possible flights to the international space station early next year. The flight came after an initial abort right at ignition. The launch gives a major boost to the rocket's builder, SpaceX, and its Internet-tycoon founder, Elon Musk. But the launch was almost as important to the Obama administration, which has proposed a far greater role for commercial space companies in the future of NASA. After Friday's successful test launch -- unusual for a maiden voyage -- SpaceX plans to send a fully operational rocket and capsule into orbit this summer, and one to the space station next year. Obama's plan to cancel much of the Bush-era Constellation exploration system -- calling it too expensive and behind schedule -- has received an often-hostile reaction in Congress. Members of Congress whose states might lose jobs, along with veteran astronauts such as Neil Armstrong, have warned that NASA would cede its edge in space if commercial companies played a larger role in exploration. Obama went to the Kennedy Space Center last month to outline a NASA human exploration program, which includes crew and cargo transport to the international space station by commercial rockets in the years ahead, freeing up NASA for deep-space missions to asteroids, the moon and, ultimately, Mars. The congratulations quickly began flowing in after Friday's launch. NASA Administrator Charles F. Bolden Jr. said in a statement that SpaceX's "accomplishment is an important milestone in the commercial transportation effort, and puts the company a step closer to providing cargo services to the International Space Station." The Planetary Society, an advocate for commercial space ventures, also said in a release: "The proposal to refocus NASA's human spaceflight program beyond low-Earth orbit now looks more achievable, as this flight demonstrated that commercial rockets may soon be ready to carry supplies and, we hope, astronauts to the International Space Station."

SpaceX Good

No risk of disaster with current technology

SpaceX 11 (Developers, Falcon 9, “Falcon 9,” no specific date, http://www.spacex.com/falcon9.php#engine\_reliability, JM)

Falcon 9 has nine Merlin engines clustered together. This vehicle will be capable of sustaining an engine failure at any point in flight and still successfully completing its mission. This actually results in an even higher level of reliability than a single engine stage. The SpaceX nine engine architecture is an improved version of the architecture employed by the Saturn V and Saturn I rockets of the Apollo Program, which had flawless flight records despite losing engines on a number of missions. Another notable point is the SpaceX hold-before-release system — a capability required by commercial airplanes, but not implemented on many launch vehicles. After first stage engine start, the Falcon is held down and not released for flight until all propulsion and vehicle systems are confirmed to be operating normally. An automatic safe shut-down and unloading of propellant occurs if any off nominal conditions are detected.

SpaceX is avoiding chemical propulsion drawbacks

Moskowitz 11 (Clara, Senior Writer, space.com, April 6, http://www.space.com/11311-spacex-huge-private-rocket-moon-mars.html, JM)

A massive new private rocket envisioned by the commercial spaceflight company SpaceX could do more than just ferry big satellites and spacecraft into orbit. It could even help return astronauts to the moon, the rocket's builder says. SpaceX announced plans to build the huge rocket, called the Falcon Heavy, yesterday (April 5). To make the new booster, SpaceX will upgrade its Falcon 9 rockets with twin strap-on boosters and other systems to make them capable of launching larger payloads into space than any other rocket operating today. But the Falcon Heavy's increased power could also be put toward traveling beyond low-Earth orbit and out into the solar system, said SpaceX's founder and CEO Elon Musk during a Tuesday press conference. [Video: How SpaceX's Falcon Heavy Rocket Flies] "It certainly opens up a wide range of possibilities, such as returning to the moon and conceivably going to Mars," Musk said. Traveling that far requires more lift than most rockets flying today, including NASA's space shuttle. But the Falcon Heavy, which is designed to generate 3.8 million pounds (1,700 metric tons) of thrust, would be able to do the job, Musk said. The Falcon Heavy booster is designed to have more lifting capability than any other rocket in service today, and about half the capability of the most powerful rocket ever built, NASA's towering Saturn 5 booster, which sent the Apollo astronauts to the moon in the late 1960s and early 1970s. The Falcon Heavy may not be able to carry everything needed for a mission to the moon in a single go, but it could potentially launch various components separately. For example, the astronauts and moon lander could be launched in one trip, with another liftoff following to deliver the vehicle that would ferry the crew back home, Musk said. SpaceX's Falcon 9 rocket has so far made two successful test launches, one of which carried SpaceX's Dragon capsule to orbit for the first time. Both rockets will initially fly unmanned, but have been created with flying people in mind. [World's Tallest Rockets] "As far as human standards are concerned, they are designed to meet all of the published human standards," Musk said. SpaceX's commercial plans The Hawthorne, Calif.-based company hopes the Falcon rockets will be used to ferry astronauts to the International Space Station, and possibly beyond, after the space agency's space shuttles retire this year. SpaceX already has a $1.6 million contract to haul cargo to the space station aboard the Falcon 9. In addition to NASA missions, the Falcon Heavy could prove useful for other commercial space ventures. For example, the Las Vegas-based Bigelow Aerospace is designing a commercial space station, and eyeing establishing a private moon base. Such a destination would require a vehicle to help build it, as well as a rocket to ferry space tourists and other clients to and from the base. Even farther destinations like Mars are not out of the question with the Falcon Heavy, Musk said, though such a trip would probably require multiple launches. He brought up the possibility of a mission to collect samples of Martian dirt and return them to Earth for studying – an endeavor that has so far proven prohibitively complicated. "The Falcon Heavy has so much more capability than any other vehicle, I think we can start to realistically contemplate missions like a Mars sample return," Musk said. And the company isn't content to stop at the Falcon Heavy. SpaceX is also considering building an even more powerful rocket called a "super heavy-lift" vehicle that would have about three times the capability of a Falcon Heavy, or about 50 percent more power than the Saturn 5. Such a vehicle would likely have no trouble reaching the moon, Mars or beyond. Musk said SpaceX has a small contract with NASA right now to explore the possibility of building the super heavy-lift rocket.

SpaceX Good

SpaceX tech solves cost and safety issues

DefenseNews 10 (“Reliability, Cost Put Falcon 9 Rocket on Top,” August 2, http://www.defensenews.com/story.php?i=4731243&c=FEA&s=SPE, JM)

SpaceX has contracts for 30 flights of its Falcon 9 rocket over the next seven years and is angling to add to that docket by capturing launch deals for the Pentagon's Evolved Expendable Launch Vehicle (EELV) program, company officials say. "SpaceX is working toward being on-ramped for the U.S. national security space missions as an EELV provider," SpaceX officials said in a July 27 response to questions. "This means we'll be eligible to compete for EELV missions as part of the approved EELV acquisition process." The Falcon 9 is a "two-stage, liquid-oxygen and rocket-grade-kerosene-powered launch vehicle," according to a SpaceX fact sheet. It stands 180 feet tall and 12 feet wide. At takeoff, its thrust is 1.1 million pounds of force. The "heavy" version can carry 32 tons to low-Earth orbit. SpaceX touts reliability as the rocket's top selling point and operational characteristic. So what makes the Falcon 9 so much more reliable than other launch vehicles? "Propulsion and separation events are the primary causes of failures in launch vehicles. SpaceX designed Falcon 9 with boost stage propulsion redundancy," company officials said. "SpaceX also minimized the number of stages [two] to minimize separation events. "In addition, as a part of SpaceX's launch operations, the first stage is held down after ignition to watch engine trends. This capability is required for commercial airplanes, but not implemented on many launch vehicles," the officials said. "If an off-nominal condition exists, then an autonomous abort is conducted. This helps prevent an engine performance issue from causing a failure in flight." The company began developing the rocket in 2002 with an idea in mind: "Reliability and low-cost can go hand-in-hand," SpaceX officials said. It was the launch vehicle's low cost that led judges for the inaugural Defense News Technology and Innovation contest to pick the Falcon 9 as a winner in the new platform category. The company said the outlook for more U.S. government and commercial sales "is increasingly bright." The Falcon 9's buyer list include, according to the company: "NASA, Iridium, Bigelow Aerospace, Space Systems Loral, MDA Corp. (Canada), Astrium (Europe), CONAE (Argentina) and Spacecom (Israel), to name a few." Company officials said a recent $492 million deal with Iridium is "believed to be the single largest commercial deal ever." The Falcon 9 will lift Iridium's NEXT satellite into orbit. Over the long term, the Falcon 9 will be the "workhorse vehicle for SpaceX and its customers," the company officials said.

Chemical Propulsion Normal Means

No alternatives to chemical propulsion launch means it is normal means

Rotter 9 (John E., Lieutenant Commander, USN, Air Force Institute of Technology, March, p. 17, http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA496727&Location=U2&doc=GetTRDoc.pdf, JM)

In any engineering endeavor, greater efficiency and performance are always desirable. The goals of greater efficiency and performance are magnified in the realm of rocket propulsion, as the cost of placing a spacecraft in orbit is quite expensive. Any increase in the efficiency or performance of a propulsion system should allow the payload or mission mass to increase as well. The goal of the Integrated High Payoff Rocket Propulsion Technology Program (IHPRPT), which began its execution phase in 1996, has been to improve U.S. rocket technology, doubling its performance by 2010. [1] The goals of the IHPRPT Program include booster and orbit transfer applications as well as spacecraft propulsion applications. Booster applications are exclusively in the realm of chemical propulsion and while alternative propulsion technologies are being evaluated for orbit transfer applications, they are still primarily affected by chemical rocket technologies. In-space propulsion, however, allows us to venture beyond the realm of the chemical rocket.

Chemical Propulsion Good

Current chemical propulsion is cheap and safe – even the cautious agree

Spacenews, 6-13 (Staff, “SES Technology Chief Sings Praises of SpaceXs Falcon 9 Rocket,” http://spacenews.com/launch/110613-ses-tech-chief-praises-falcon9.html, JM)

Satellite fleet operator SES of Luxembourg, whose culture of risk aversion is widely known in the industry, has given a ringing endorsement of Space Exploration Technologies (SpaceX), saying the startup launch service provider’s twice-flown Falcon 9 rocket is “above any of the other launch vehicles.” The positive review of a supplier it has never used is all the more striking considering that it came not from the SES marketing department — the company has purchased a Falcon 9 launch — but from SES Chief Technology Officer Martin Halliwell. In a May 24 presentation to SES investors, Halliwell said SES’s decision to launch its SES-8 satellite aboard an upgraded version of the current Falcon 9 rocket in March 2013 is “a major step forward, not only for us, but for the industry in general.” SES is the first major operator of geostationary orbiting telecommunications satellites to [order a Falcon 9](http://www.spacenews.com/launch/110314-ses-selects-falcon.html). Hawthorne, Calif.-based SpaceX is obliged to demonstrate the flight worthiness of an upgraded main-stage engine, a larger propellant tank and a wider payload fairing before proceeding with the SES-8 launch. But it is not required to demonstrate a flight to geostationary transfer orbit, where most telecommunications satellites are dropped off in orbit. The satellites then use their own power to climb to final geostationary position 36,000 kilometers over the equator. In return for giving SpaceX a blue-chip name to add to its manifest, the SES contract was concluded for a price that industry officials said is unbeatable — well under $60 million for a satellite weighing a bit more than 3,000 kilograms. Halliwell said only that SpaceX’s current Falcon 9 pricing is “less than 60 percent of the price of other operators.” In his presentation to investors, Halliwell stressed SES’s policy of seeking a broader range of rockets to choose from to maintain and expand its fleet of 44 satellites. The company has signed multilaunch agreements with Arianespace of Evry, France, for Europe’s Ariane 5 rocket, and with International Launch Services (ILS) of Reston, Va., which markets Russia’s Proton heavy-lift rocket. Halliwell said if SpaceX falls behind schedule, SES will transfer the SES-8 launch contract to ILS or Arianespace. SES also is willing to launch its satellites with Sea Launch Co. of Long Beach, Calif., which is returning to flight this year following Chapter 11 bankruptcy reorganization. SES’s evaluation of launch vehicles is important because the company is one of the few commercial satellite operators that have the resources to conduct in-depth technical reviews of its satellite and rocket suppliers. Halliwell said the Falcon 9 rocket is “human-rated — which puts it above any of the other launch vehicles.” Most of SES’s satellites are too big to be launched by the Falcon 9 version to be launched in 2013. But SES is working with Princeton University in the United States on a new-generation electric propulsion system that could permit heavy satellites to become much lighter in the future. SES is funding the Princeton work as part of a two-year project to bring electric propulsion firmly into the commercial market. Several satellite operators have used one or another version of electric propulsion for years to reduce their satellites’ weight. But these are usually satellites that would have trouble finding a launch among today’s main commercial-launch vehicles, and they also carry chemical propulsion. Halliwell said SES’s work with Princeton on electric propulsion is designed to permit a large satellite to reduce its weight by up to 50 percent. That weight savings could be used to add more payload or to move from a heavy-lift to a less-expensive medium-lift rocket such as Falcon 9. In addition to what some operators view as its still-untested nature — despite being used on Russian telecommunications satellites for more than two decades — the technology requires more time for a satellite to reach its final destination, typically a month or two instead of just a few days. Halliwell said the Princeton technology should be ready for a flight demonstration within three or four years.

Chemical Propulsion Bad

Chemical propulsion systems are inefficient – same source for heat and reactants

Bromley 7 (Blair P, Reactor Physicist @ Chalk River Labs, June 29, http://www.astrodigital.org/space/nuclear.html, JM)

In chemical rocket engines1,2, such as the Space Shuttle Main Engine (SSME), the chemical reaction between the hydrogen and oxygen releases heat which raises the combustion gases (steam and excess hydrogen gas) up to high temperatures (3000-4000 K). These hot gases are then accelerated through a thermodynamic nozzle, which converts thermal energy into kinetic energy, and hence provides thrust. The propellant and the heat source are one in the same. Because there is a limited energy release in chemical reactions and because a thermodynamic nozzle is being used to accelerate the combustion gases that do not have the minimum possible molecular weight, there is a limit on the exhaust velocity that can be achieved. The maximum Isp that can be achieved with chemical engines is in the range of 400 to 500 s. So, for example, if we have an Isp of 450 s, and a mission delta-V of 10 km/s (typical for launching into low earth orbit (LEO)), then the mass ratio will be 9.63. The problem here is that most of the vehicle mass is propellant, and due to limitations of the strength of materials, it may be impossible to build such a vehicle to just ascend into orbit. Early rocket scientists got around this problem by building a rocket in stages, throwing away the structural mass of the lower stages once the propellant was consumed. This effectively allowed higher mass ratios to be achieved, and hence a space mission could be achieved with low-Isp engines. This is what all rockets do today, even the Space Shuttle. In spite of the relatively low Isp, chemical engines do have a relatively high thrust-to-weight ratio (T/W)2. A high T/W (50-75) is necessary for a rocket vehicle to overcome the force of gravity on Earth and accelerate into space. The thrust of the rocket engines must compensate for the weight of the rocket engines, the propellant, the structural mass, and the payload. Although it is not always necessary, a high T/W engine will allow orbital and interplanetary space vehicles to accelerate quickly and reach there destinations in shorter time periods. Nuclear propulsion systems have the ability to overcome the Isp limitations of chemical rockets because the source of energy and the propellant are independent of each other. The energy comes from a critical nuclear reactor in which neutrons split fissile isotopes, such as 92-U-235 (Uranium) or 94-Pu-239 (Plutonium), and release energetic fission products, gamma rays, and enough extra neutrons to keep the reactor operating. The energy density of nuclear fuel is enormous. For example, 1 gram of fissile uranium has enough energy to provide approximately one megawatt (MW) of thermal power for a day.3

Chemical Propulsion Bad

Growing precision and power demands cannot be met by chemical rockets

Hillier 11 (Adam C., Second Lieutenant, USAF, Air Force Institute of Technology, March, p. 1-2, http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA540018&Location=U2&doc=GetTRDoc.pdf, JM)

Cost, performance, and efficiency are the key factors in any engineering undertaking. It is an ongoing struggle to increase all three in any engineering discipline. In the field of space propulsion, the need for increased performance and efficiency is paramount as the effects are amplified greatly. Traditionally, propulsion efficiency refers to mass efficiency. Mass efficiency refers to how well a given mass changes the velocity of a spacecraft. The less propellant mass needed to maintain or change orbits in space, the more payload mass is able to be on orbit. This leads to less cost for space missions being flown. Another efficiency is electrical efficiency, which is specific to electric propulsion. Higher electric efficiency relaxes the requirements of the power subsystem, which also decreases mass and cost of a satellite. These gains motivate the industry to find better, more efficient propulsion systems. The demand for more aggressive space missions is ever increasing. Many of these missions demand mass efficient propulsion systems powerful enough to both maintain orbits and propel interplanetary satellites. Additionally, with the increasing 2 amount of Earth satellites on orbit, the need for more precise station keeping is becoming dangerously apparent. This is particularly true in the case of geosynchronous satellites, which are not perfectly stable. Geosynchronous satellites are being packed in closer to each other. The small amount of drift inherent in nearly all geosynchronous orbits must be precisely countered to prevent these satellites from colliding. To do so, requires constant updates to orbital velocity. Also, these satellites are built to endure longer than a typical low Earth orbiting satellite. This is because there is no notable air drag at this altitude, and the satellites are enormously more expensive to put on orbit. Therefore, the orbital maneuvers needed to correct position and velocity are not only frequent but are required over a long period of time. Such updates add up to a substantial load on the propulsion system. Electric propulsion systems answer this demand with high performance and high efficiency. Chemical propulsion, even at its theoretical maximum, is inadequate for the future of space propulsion. Humble et al. comment “Of the various methods for generating high speed reaction-mass, electromagnetic techniques offer the only way that, in principle, is not limited by the bond strengths of matter” [1]. Electric propulsion provides more reasonable solutions to the space propulsion missions. Humble et al. go on to describe electric propulsion theory: “In electric propulsion systems, electromagnetic forces directly accelerate the reaction-mass, so we are theoretically limited only by our ability to apply these forces at the desired total power levels” [1] . Mass efficiency is highly increased in electric propulsion systems due to this method of acceleration, the degree of which is determined by the type of electric system being used.

Chemical Propulsion Bad

Chemical propulsion doesn’t work in the long term

Ward 9 (Peter, Professor of biology and Earth @ U of Washington, *The Medea Hypothesis: Is Life on Earth Ultimately Self-Destructive?,* May, JM)

So how long would the trip to a nearby star take with today's technology? Currently, the fastest spacecraft built can achieve a ve­locity of about 30 km per second (relative to the Earth). At that rate, the journey to Proxima Centauri would take about 40,000years\ Ad­ditionally, at our current stage of space technology, the longest space missions that have been initiated are expected to have an operational lifetime of about forty years before failure of key components is likely to happen. Significant engineering advances such as automated self-repair may be required to ensure survival of any interstellar mission. In short, current spacecraft propulsion technology cannot send ob­jects fast enough to reach the stars in a reasonable time. Can any craft be built that will deliver humans within the maxi­mum voyage durations listed in the preceding chapter? Chemical propulsion, characterized by low specific impulse but enabling en­gines with very large thrusts, falls short for deep-space and interstel­lar missions. Although the near interstellar space can be reached using chemical propulsion, aided by gravitational assist, no mission in interstellar space can be performed in a reasonable time without improvements in propulsion.

Cryogenic Propulsion Bad

Cryogenic propellants are expensive, dangerous, and the main type of chemical propulsion.

SPS 5 (Space Propulsion Systems, “The MFC Propulsion Program,” November 23, http://www.sps.aero/Propulsion\_Program/MFC\_Intro.htm, JM)

Liquid fuel rockets for commercial applications use either bipropellants or cryogenic propellants. Bipropellants are liquid at normal temperatures. Some of the bipropellants are hypergolic, meaning that they ignite spontaneously when mixed, requiring no source of ignition. Cryogenic propellants are gases that are liquids only when super-cooled. Cryogenic propellants are, for instance, liquid oxygen and liquid hydrogen. Both oxygen and hydrogen are liquids only at very low temperatures (Oxygen: -360 °F; Hydrogen: -422 °F). Since these propellants are liquids only at such low temperatures, they are difficult, costly, and dangerous to use. There are other liquid propellants available that are sometimes used as rocket propellants, for instance, Red Fuming Nitric Acid (oxygen source) and kerosene, or RP-1 (fuel – a hydrocarbon like gasoline) and H2O2 (oxidizer – hydrogen peroxide). But these propellants do not produce enough thrust to be used in large rockets. Other "liquid" propellants are, for example, Dinitrogen Tetroxide (oxygen source) and Hydrazine (fuel – like liquid ammonia). This liquid propellant blend also lacks the power of a cryogenic propellant, and both these liquids must be maintained under high pressure. Hydrazine is a highly toxic carcinogen that is dangerous to handle. Nearly all large liquid fueled rockets that are currently used for commercial space operations use cryogenic liquid hydrogen and liquid oxygen propellants due to the power these liquid propellants produce.

Liquid propellants fail – dangerous, technical barriers, and they interfere with space missions.

SPS 5 (Space Propulsion Systems, “The MFC Propulsion Program,” November 23, http://www.sps.aero/Propulsion\_Program/MFC\_Intro.htm, JM)

The only new liquid propellant engine to be developed since the early eighties (the Space Shuttle Main engines) is the Aerospike engine, currently under development for use in the Lockheed-Martin Venturestar X-33 Spaceplane. In most cases, the main engines of the new generation Spaceplanes will use cryogenic liquid hydrogen and liquid oxygen as propellant. Liquid propellant motors, particularly those using these cryogenic propellants, will principally be used since they produce a great deal of power and can be throttled, meaning the power produced by the rocket motor can be increased, decreased, or the motor shut off and restarted a number of times. This ability to throttle is critically important for space operations, both during launch and for maneuvering in space, and is the primary reason for using this type of engine. However, all liquid propellant motors suffer from a number of problems that limit their usefulness for commercial space applications: Liquid, non-cryogenic, bipropellants do not produce the power needed to launch large payloads into space, unless at least one of the two components is a cryogenic propellant such as liquid oxygen Cryogenic propellants are difficult and dangerous to both handle, as in spaceport based refueling of spacecraft, and in storage, since they must be supercooled and maintained at extremely low temperatures, and stored under high pressure Many non-cryogenic liquid bipropellants must also be stored and used under high pressures, and some of the best, such as hydrazine, are extremely deadly carcinogenic toxins Both liquid hydrogen and liquid oxygen are extremely combustible gases, posing severe fire/explosion safety hazards Liquid propellants require fuel tanks two or more times larger than those used for solid propellants. Due to limitations in spacecraft size/cost, this reduces the amount of cargo and personnel carrying capacity of the launch vehicle. Liquid propellant rocket motors, particularly those using cryogenic propellants, are extremely complex. Liquid propellant feed systems consist of pumps, valves, and both liquid feed and recycle piping. All these components must be lightweight and designed into compact packages. The high degree of complexity increases maintenance requirements and costs, and poses a significant threat to launch safety. With the planned routine, almost daily, operations of space launch vehicles, the likelihood of catastrophic failure of these motors increases. Space-based manufacture of liquid propellants and in-space re-fueling of spacecraft with liquid propellants will both be extremely difficult, dangerous, and costly. Although it is the goal of the commercial space industry to reduce launch costs from the current average cost of $10,000 per pound to low earth orbit to $1,000 per pound within the next 10 years, if commercial launch vehicles were to rely on liquid propellant propulsion systems for either expendable launch vehicles or manned spaceplanes, the likelihood of their achieving this launch cost goal within the projected time frame is small.

Solid Propulsion Bad

Solid propellants are difficult to manufacture and not useful

SPS 5 (Space Propulsion Systems, “The MFC Propulsion Program,” November 23, http://www.sps.aero/Propulsion\_Program/MFC\_Intro.htm, JM)

Generally, solid propellant rocket engines promise good performance with lower operating cost, and higher safety as compared to liquid bi-propellant motors. These features should make them good candidates for use as main propulsion systems. However, this promise is only partially realized. In practice, the method of manufacture of solid propellant motors limits their usefulness for several reasons: The fuel and oxidizer in solid propellants are exposed to each other. This exposure prevents manufacturing of solid propellants with the best fuels and oxidizers, since the fuel and oxidizer would spontaneously ignite on contact, or produce a highly unstable and dangerous propellant; Many desirable oxidizers are sensitive to the presence of moisture (high humidity). If propellants are made using moisture sensitive materials, they can become unstable, leading to misfires, erratic performance of the motor, or even spontaneous combustion of the propellant within the motor during storage or handling; The manufacture of solid propellants is very dangerous, and must be done at a remote location. The solid rocket motors must be made in pieces (booster segments) an d transported over long distances to the launch site for final assembly into a launch vehicle. This process is both extremely costly and dangerous. NO CURRENT SOLID ROCKET MOTOR CAN BE STARTED, STOPPED, AND THROTTLED USING TODAY'S SOLID ROCKET PROPELLANT TECHNOLOGY. NO SOLID ROCKET MOTOR CAN BE DESIGNED TO PERFORM ANY OF THESE FUNCTIONS USING CURRENT TECHNOLOGY. Once ignited, they must burn to completion. This is a very serious limitation for their widespread use as main propulsion systems in expendable launch vehicles and spaceplanes.

Current Tech = Accidents

Accidents are imminent with present technology, and they lengthily sideline space programs.

Malik 6 (Tariq, Staff Writer, space.com, January 27, http://www.space.com/1990-remembering-challenger-shuttle-disaster-refocus-nasa.html, JM)

NASA will also honor the seven STS-107 shuttle astronauts lost in the 2003 Columbia accident next week. The Columbia orbiter broke apart during reentry on Feb. 1, 2003 after a successful 16-day science mission. Wing damage sustained during launch by a chunk of fuel tank insulation was later cited as the accident cause. "This is a time to think about those kinds of losses," NASA chief Michael Griffin said in a news conference last week. "Spaceflight is the most technically challenging things nations do...it is difficult, it is dangerous and it is expensive, given the technology we have today." NASA held an agency-wide Day of Remembrance on Jan. 26 for all three accidents. Each fatal accident grounded NASA spacecraft as the agency rooted out their causes and dealt out new safety plans before again launching astronauts into space. It took more than two years following both the Challenger and Columbia accident before NASA launched another shuttle - most recently with last year's STS-114 flight aboard Discovery on a test flight which proved that still more work was needed to prevent fuel tank debris at liftoff. STS-121 Commander Looks Toward Launch "The anniversaries remind us that we can never be complacent about anything," astronaut Steven Lindsey, commander of NASA's next shuttle flight STS-121, told SPACE.com. "[They] help us remind each other, each year, to refocus...because the next several years, that's all we're going to think about, but what about 10 years from now? If we've been successful for 10 years and haven't had an accident, that's what you worry about. "We've got to pay attention to the past so that we don't repeat it," Lindsey said. Lindsey's STS-121 mission, currently set to launch no early than May 3, will mark NASA's second shuttle flight since the Columbia disaster and complete a series tests designed to increase shuttle safety.

Until failsafe launch mechanisms are developed, spaceflight will inevitably lead to malfunctions.

Malik 6 (Tariq, Staff Writer, space.com, January 27, http://www.space.com/1990-remembering-challenger-shuttle-disaster-refocus-nasa.html, JM)

The very public loss of Challenger and Columbia were vivid reminders of the risks inherent to human spaceflight, astronauts said. "There's been a perception for as long as I've been in the program until this recent accident that spaceflight's routine, that's the public perception," said Lindsey, who joined NASA's astronaut corps in 1995. "It wasn't until I came here and started getting involved that I realized how close to the edge we always are when we fly this, and recognize the inherent danger in what we do. It's not routine." But the results, including scientific research, unexpected spin-offs and pushing the boundaries of human exploration are worth the risk, the astronaut added. "I think that you could wake up in the morning, and until you go to bed at night, and even while you sleep, wherever you are, you could look at multiple things that came out of the space program," Lindsey said. "It impacts everything that we do." Some space experts believe that, statistically, another spaceflight accident will occur in the future, forcing NASA or other space agency to once again take a close look at the processes and the risks involved in human spaceflight. NASA's chief also said that the progress of human spaceflight will likely suffer painful setbacks, much like the early air industry, adding that the lessons learned from each experience will lead to safer craft. "I know that in the course of this, there will be other opportunities to learn, and they will be sober opportunities surrounded with black crepe," Griffin said. "But we will learn in the same way that the nation and the world learned how to do air transport, and it will be difficult." Risk will always go hand-in-hand with human spaceflight, Lindsey added. "If we want a completely safe program, then we shouldn't fly at all," the shuttle commander said. "Because there's no such thing."

Politics – Launch Failure = Plan Unpopular

Launch explosions doom Obama’s ability to push space legislation.

Moskowitz 10 (Clara, Senior Writer, Space.com, “First Attempt to Launch New Falcon 9 Aborted,” June 4 2010, http://www.space.com/8539-attempt-launch-falcon-9-rocket-aborted.html, JM)

However, he acknowledged that malfunctions are very common for untried rockets and that test flights often go wrong, and predicted only a 70 to 80 percent [chance of success](http://www.space.com/8536-stakes-high-falcon-9-rocket-test-flight.html). SpaceX's first rocket, the smaller Falcon 1, suffered three false starts before successfully reaching orbit on its fourth launch try. The vehicle already has a $1.6 billion contract with NASA to haul cargo to the International Space Station, and may one day carry astronauts as well. A major malfunction or mishap could affect support for President Barack Obama's plan to shift responsibility for ferrying astronauts to the International Space Station to the commercial space sector. "If they blow up on the pad, Obama's lost it," space policy expert Roger Handberg, a political scientist at the University of Central Florida, said of the administration's chances of getting the proposal through Congress.

\*\*NUCLEAR\*\*

Mars- Nuclear Link

Mars mission necessitates nuclear power

Grossman 4 (Karl, Journalism prof @ the State U of NY and author of "Cover Up: What You Are Not Supposed To Know About Nuclear Power”, Earth First Journal, March-April 2004, http://westgatehouse.com/art154.html) JPG

"Only nuclear can work in space," maintains Dr. Robert Zubrin, president of the Mars Society, a group lobbying the government for going to Mars. "By restarting the languishing space nuclear power program, NASA and the Bush administration are making a critical contribution to science and the human future." NASA stresses that nuclear-propelled rockets would shorten voyages in space. "Project Prometheus will develop the means to efficiently increase power for spacecraft, thereby fundamentally increasing our capability for solar system exploration," says NASA.

Unique link- only a commitment to go back to Mars will cause nuclear rocket use.

Madrigal 9 (Alexis, Staff @ Wired Science, 11/3, http://www.wired.com/wiredscience/2009/11/nuclear-propulsion-in-space/)

There were several attempts to resurrect nuclear propulsion of various types, most recently the mothballed Project Prometheus. None, though, have garnered much support. One major reason is that NASA picks its propulsion systems based on its targets — and true exploration of the solar system and beyond hasn’t really been a serious goal, the Constellation plans for a return to the moon aside. “The destinations dictate the power system,” said Rao Surampudi, a Jet Propulsion Laboratory engineer who works on the development of power systems. By and large, it’s cheaper and easier to go with solar power or very low-power radioisotope generators like the one that powers the Cassini mission. McDaniel agreed that the targets drive things, citing the general decline of pure technology development research at NASA. “Until we commit to going back to Mars, we’re not going to have a nuclear rocket,” McDaniel said.

Mars/Asteroids- Nuclear Link

Mars or asteroid missions necessitate nuclear propulsion

Grossman 10 (Karl, Journalism prof @ the State U of NY and author of "Cover Up: What You Are Not Supposed To Know About Nuclear Power”, 6/11/10, http://nuclearfreeplanet.org/articles/obama-and-the-nuclear-rocket.html) JPG

Comments Bruce Gagnon, coordinator of the Global Network Against Weapons & Nuclear Power in Space: “Despite claims that ‘new’ and innovative technologies are under development at NASA, the story remains much the same—push nuclear power applications for future space missions. Obama is proving to be a major proponent of expansion of nuclear power—both here on Earth and in space. His ‘trip to an asteroid and missions to Mars’ plan appears to be about reviving the role of nuclear power in space. The nuclear industry must be cheering.”

\*\*Weaponization

Weaponization Link

The pentagon will use nuclear rockets for space weaponization

GNAWNPS 5 (Global Network Against Weapons & Nuclear Power in Space, 5/31/5, http://www.thepowerhour.com/news/space\_statement.htm) JPG

The Pentagon has long maintained they need nuclear reactors in order to provide the enormous power required for weapons in space.  In a Congressional study entitled Military Space Forces: The Next 50 Years it was reported that "Nuclear reactors thus remain the only know long-lived, compact source able to supply military forces with electric power...Larger versions could meet multimegawatt needs of space-based lasers....Nuclear reactors must support major bases on the moon..."  In an article printed in the Idaho Statesman on April 20, 1992 military officials stated "The Air Force is not developing [the nuclear rocket] for space exploration.  They're looking at it to deliver payloads to space."  Considering that NASA says all of their space missions will now be "dual use," meaning every mission will be both military and civilian at the same time, it is important to ask what the military application of the Project Prometheus will be.

Weaponization Link

NASA nuclear space exploration is a Trojan horse for space militarization

Gagnon 3 (Bruce, Coordinator of the Global Network Against Weapons & Nuclear Power in Space group, 1/27/3, http://www.spacedaily.com/news/nuclearspace-03b.html) JPG

Critics of NASA have long stated that in addition to potential health concerns from radiation exposure, the NASA space nukes initiative represents the Bush administration's covert move to develop power systems for space-based weapons such as lasers on satellites. The military has often stated that their planned lasers in space will require enormous power projection capability and that nuclear reactors in orbit are the only practical way of providing such power. The Global Network Against Weapons & Nuclear Power in Space maintains that just like missile defense is a Trojan horse for the Pentagon's real agenda for control and domination of space, NASA's nuclear rocket is a Trojan horse for the militarization of space. NASA's new chief, former Navy Secretary Sean O'Keefe said soon after Bush appointed him to head the space agency that, "I don't think we have a choice, I think it's imperative that we have a more direct association between the Defense Department and NASA. Technology has taken us to a point where you really can't differentiate between that which is purely military in application and those capabilities which are civil and commercial in nature."

Weaponization Link

Nuclear propulsion guarantees space weaponization – civilian sector will be coopted by the military

Grossman 4 (Karl, Journalism prof @ the State U of NY and author of "Cover Up: What You Are Not Supposed To Know About Nuclear Power”, Earth First Journal, March-April 2004, http://westgatehouse.com/art154.html) JPG

Space nuclear power also has boosters among the military, which has been considering space-based weapons--devices that need substantial amounts of power. Additionally, the military has been interested in nuclear-powered rockets. In the late 1980s, an earlier series of nuclear rocket projects was first revived with Project Timberwind, a program to build atomic rockets to loft heavy Star Wars equipment and also for trips to Mars. This kind of "dual use" now runs through all NASA operations, says Bruce Gagnon, coordinator of the Global Network Against Weapons and Nuclear Power in Space. "Right after Bush swore the new NASA chief into office, O'Keefe told the nation that from now on every mission would be dual use. By that he meant that every mission would carry military and civilian payloads at the same time. This is further evidence that the space program has been taken over by the Pentagon." "Space is viewed today," says Gagnon, "as open territory to be seized for eventual corporate profit" and for US military control. Gagnon speaks of proposals to "mine the sky"--to extract minerals from celestial bodies, with the moon considered a prime source for rare Helium-3. This elemental substance would be brought back to Earth to fuel supposedly cleaner fusion-power reactors. Gagnon says that the US military wants to establish bases in space, including on the moon, to protect these operations and to control the "shipping lanes of the future." "The Bush space plan will be enormously expensive, dangerous and will create unnecessary conflict as it expands nuclear power and weapons into space," notes Gagnon, "all disguised as the noble effort to hunt for the 'origins of life'."

Weaponization Link – Star Wars

Star wars is contingent upon nuclear propulsion

Grossman 97 (Karl, Journalism prof @ the State U of NY and author of "Cover Up: What You Are Not Supposed To Know About Nuclear Power”, 2/3/97, http://www.flybynews.com/archives/karl/kg9105we.htm) JPG

Star Wars is contingent on the launching of 100 orbiting battle platforms, each with a large nuclear reactor to provide power for its laser weapons, hypervelocity guns and particle beams. GE is now busy manufacturing what is to be the main Star Wars space reactor, the SP-100. In coming days, the Synthesis Group, a panel established last year (1990) by NASA and the White House, is expected to recommend nuclear-powered rockets for the manned Moon-Mars missions proposed by President George Bush. And the Pentagon, amid great secrecy to avoid public objections (not for national defense reasons) is developing a nuclear-propelled rocket to haul Star Wars weaponry into space. To spread radioactivity, a nuclear-propelled rocket need not crash back to Earth. As they fly, these rockets would inevitably trail clouds of radioactivity in their exhaust. A flight test in space above Antarctica is being planned for the Star Wars nuclear rocket. It seems the location was chosen so that if there is a malfunction, the chief victims would be penguins. Unfortuntely, New Zealand also gets in the way. One U.S. government study says that the likelihood of the nuclear-powered rocket crashing into New Zealand is 1 in 2,325. This may sound like fairly good odds, but remember, NASA put the odds of a space shuttle crash at 1 in 100,000, before the Challenger exploded.

Weaponization Link – Star Wars

Nuclear propulsion would lead to Star Wars

Broad 91 (William, writer @ NYT, 4/3/91, http://www.nytimes.com/1991/04/03/us/secret-nuclear-powered-rocket-being-developed-for-star-wars.html) JPG

In great secrecy, the Pentagon is developing a nuclear-powered rocket for hauling giant weapons and other military payloads into space as part of the "Star Wars" program. The goal is to build a special type of nuclear reactor that would power engines far more energetic than any rocket engines now in use, allowing very large and heavy payloads to be lofted high above the earth. The program was disclosed by the Federation of American Scientists, a private group based in Washington that has opposed the "Star Wars" anti-missile program and some uses of space reactors. The existence of the secret effort was confirmed by internal Government documents obtained by The New York Times.

NASA and the DoD are intertwined

Broad 91 (William, writer @ NYT, 4/3/91, http://www.nytimes.com/1991/04/03/us/secret-nuclear-powered-rocket-being-developed-for-star-wars.html) JPG

While currently run by the Defense Department, the effort is being quietly evaluated by the National Aeronautics and Space Administration, which is considering nuclear reactors to power a manned mission to Mars.

\*\*Accidents

Accidents

There is a ten percent chance of nuclear rocket accidents – the plan only increases that number

Gagnon 3 (Bruce, Coordinator of the Global Network Against Weapons & Nuclear Power in Space group, 1/27/3, http://www.spacedaily.com/news/nuclearspace-03b.html) JPG

Included in NASA plans are the nuclear rocket to Mars; a new generation of Radioisotope Thermoelectric Generators (RTGs) for interplanetary missions; nuclear-powered robotic Mars rovers to be launched in 2003 and 2009; and the nuclear powered mission called Pluto-Kuiper Belt scheduled for January, 2006. Ultimately NASA envisions mining colonies on the Moon, Mars, and asteroids that would be powered by nuclear reactors. All of the above missions would be launched from the Kennedy Space Center in Florida on rockets with a historic 10% failure rate. By dramatically increasing the numbers of nuclear launches NASA also dramatically increases the chances of accident. During the 1950s and 1960s NASA spent over $10 billion to build the nuclear rocket program which was cancelled in the end because of the fear that a launch accident would contaminate major portions of Florida and beyond.

Accidents

Nuclear propulsion inevitably causes accidents – empirically proven

Grossman 97 (Karl, Journalism prof @ the State U of NY and author of "Cover Up: What You Are Not Supposed To Know About Nuclear Power”, 2/3/97, http://www.flybynews.com/archives/karl/kg9105we.htm) JPG

.The record of nuclear power in space is poor. The United States has launched 24 nuclear-fueled space devices, including a navigational satellite with plutonium aboard that disintegrated in the atmosphere as it plunged to Earth in 1964. The U.S. failure rate for nuclear-powered space devices has been about 15 percent. The Soviet Union has the same failure rate. The Soviets have sent up more than 30 nuclear-fueled devices, including the Kosmos 954, which littered a broad swath of Canada with radioactive debris when it crashed in 1978. The United States spent some $2 billion of taxpayer money on developing nuclear-powered rockets from 1955 to 1973, but none ever got off the ground. That effort was finally canceled because of the concern that a rocket might crash to Earth. Now we're turning to nuclear power in space -- with its inevitable mishaps -- again. Last year the United States launched the Ulysses plutonium-fueled probe to survey the sun. A December Associated Press dispatch noted, "The Ulysses spacecraft is wobbling like an off-balance washing machine, threatening to cripple the $760-million mission." Fortunately, the probe is not coming back for an Earth flyby.

Accidents

Other types of propulsion are comparatively better – captures solvency with no risk of accidents

Grossman 3 (Karl, Journalism prof @ the State U of NY and author of "Cover Up: What You Are Not Supposed To Know About Nuclear Power”, February 2003, http://www.envirovideo.com/nuclearspacestory.html) JPG

"NASA hasn’t learned its lesson from its history involving space nuclear power," says Kaku, "and a hallmark of science is that you learn from previous mistakes. NASA doggedly pursues its fantasy of nuclear power in space. We have to save NASA from itself." He cites "alternatives" space nuclear power. "Some of these alternatives may delay the space program a bit. But the planets are not going to go away. What’s the rush? I’d rather explore the universe slower than not at all if there is a nuclear disaster." Dr. Ross McCluney, a former NASA scientist now principal research scientist at the Florida Solar Energy Center, says NASA’s push for the use of nuclear power in space is "an example of tunnel vision, focusing too narrowly on what appears to be a good engineering solution but not on the longer-term human and environmental risks and the law of unintended consequences. You think you’re in control of everything and then things happen beyond your control. If your project is inherently benign, an unexpected error can be tolerated. But when you have at your project’s core something inherently dangerous, then the consequences of unexpected failures can be great."

Accidents – ! Helper

The plan creates a Chernobyl in the sky – spreads radiation across the globe

Grossman 4 (Karl, Journalism prof @ the State U of NY and author of "Cover Up: What You Are Not Supposed To Know About Nuclear Power”, Earth First Journal, March-April 2004, http://westgatehouse.com/art154.html) JPG

Opponents of using nuclear power in space warn of serious accidents from Project Prometheus. And it's not a matter of the sky falling--accidents have already happened in the use of nuclear power in space. In 1964, there was an accident in which a SNAP-9A, plutonium-powered US satellite fell back to Earth, disintegrating and spreading plutonium over every continent at every latitude. Dr. John Gofman, professor emeritus of medical physics at the University of California-Berkeley, has long linked the SNAP-9A accident to an increased level of lung cancer. Warning of a "Chernobyl in the sky," Dr. Michio Kaku, professor of nuclear physics at the City University of New York, points to alternatives to atomic power in space--among them solar power and long-lived fuel cells. "Some of these alternatives may delay the space program a bit. But the planets are not going to go away." Indeed, as a result of the SNAP-9A accident, NASA intensified its work on solar energy systems, and its satellites are now powered by solar energy, as is the International Space Station. NASA has a division working on the additional uses of space solar power.

More ev

Grossman 3 (Karl, Journalism prof @ the State U of NY and author of "Cover Up: What You Are Not Supposed To Know About Nuclear Power”, February 2003, http://www.envirovideo.com/nuclearspacestory.html) JPG

The Transit 4A’s plutonium system was manufactured by General Electric. Then, in 1964, there was a serious accident involving a plutonium-energized satellite. On April 24, 1964, the GE-built Transit 5BN with a the SNAP-9A (SNAP for Systems Nuclear Auxiliary Power) board failed to achieve orbit and fell from the sky and disintegrating as it burned in the atmosphere. The 2.1 pounds of Plutonium-238 (an isotope of plutonium 280 times "hotter" with radioactivity than the Plutonium-239 which is used in atomic and hydrogen bombs) in the SNAP-9A dispersed widely over the Earth. A study titled Emergency Preparedness for Nuclear-Powered Satellites done by a grouping of European health and radiation protection agencies later reported that "a worldwide soil sampling program carried out in 1970 showed SNAP-9A debris present at all continents and at all latitudes." Long connecting the SNAP-9A accident and an increase of lung cancer on Earth has been Dr. John Gofman, professor emeritus of medical physics at the University of California at Berkeley, an M.D. and Ph.D. who was involved in isolating plutonium for the Manhattan Project and co-discovered several radioisotopes.

Accidents Link/Impact

The plan causes nuclear accidents to be inevitable – isn’t necessary and kills thousands

Grossman 97 (Karl, Journalism prof @ the State U of NY and author of "Cover Up: What You Are Not Supposed To Know About Nuclear Power”, 2/3/97, http://www.flybynews.com/archives/karl/kg9105we.htm) JPG

While getting into position to make a low-level (186-mile high), high-speed (33,000 miles an hour) "flyby" of the Earth, the Galileo plutonium-fueled space probe has gone out of whack. The probe, which is supposed to send us information about Jupiter and its moons, unexpectedly shut down all but in essential functions in late March. It took the National Aeronautics and Space Administration 13 days to fix that. Then NASA ordered the probe to unfurl its main communications antenna. But the antenna wouldn't unfurl. Next, on May 2, all but essential functions were lost again. NASA blames the March and May malfunctions on a "stray electronic signal." It still can't figure out why the antenna isn't working. Galileo, with its 50 pounds of plutonium aboard - theoretically enough to give a lethal dose of lung cancer to everyone on Earth - will be buzzing our planet in December, 1992. This "slingshot maneuver" is designed to use the Earth's gravity to give Galileo the velocity to get to Jupiter. It is to be hoped that there will be no foul-ups in Galileo'a functioning then, causing it to make what is called an "Earth-impacting trajectory." With the probe just above the Earth's atmosphere on the flyby, it would take only a small malfunction to cause it to drop and disintegrate, showering plutonium down on Earth. The United States is proceeding rapidly with the nuclearization of space, and the threat we face from Galileo is the kind of danger we will be undergoing constantly if we allow the government to continue to send nuclear hardware into space. If we tolerate Chernobyls in the sky, deadly accidents will be inevitable. Yet this risk is unnecessary. The potential catastrophes are avoidable. After Galileo was launched in 1989, I received, under the Freedom of Information Act, NASA-funded studies declaring that nuclear power was not necessary to generate electricity on the Galileo mission; solar energy would do. The plutonium on board Galileo is being used not for propulsion but as fuel in generators providing a mere 560 watts of electricity for the probe's instruments - electricity that could be produced instead by solar energy. A decade ago NASA's Jet Propulsion Laboratory concluded: "A Galileo Jupiter-orbiting mission could be performed with a concentrated photovoltaic solar array [panels converting sunlight to electricity] power source without changing the mission sequence or impacting science objectives." Five years ago, another JPL study said that it would take only two to three years to build the alternative solar-power source. Still another JPL report stressed that using the sun for power would cost less than using plutonium. It is humanity's destiny to explore the heavens, but what a folly it will be if in doing this, we needlessly cause the deaths of tens of thousands of people and contaminate the Earth with deadly plutonium.

Accidents- Turn the case

NASA pursuing nuclear propulsion would doom the space program is there was a failure.

Grossman 3 (Karl, Investigative reporter,http://www.21stcenturyradio.com/articles/03/0224176.html

In contrast, NASA’s renewed emphasis on nuclear power in space “is not only dangerous but politically unwise,” says Dr. Michio Kaku, professor of theoretical physics at the City University of New York. “The only thing that can kill the U.S. space program is a nuclear disaster. The American people will not tolerate a Chernobyl in the sky. That would doom the space program.” “NASA hasn’t learned its lesson from its history involving space nuclear power,” says Kaku, “and a hallmark of science is that you learn from previous mistakes. NASA doggedly pursues its fantasy of nuclear power in space. We have to save NASA from itself.” He cites “alternatives” space nuclear power. “Some of these alternatives may delay the space program a bit. But the planets are not going to go away. What’s the rush? I’d rather explore the universe slower than not at all if there is a nuclear disaster.”

\*\*Production D/As

Nuclear Fuel Low- Plan -> New Production

NASA is running out of fuel for rocket propulsion

Borenstein 9 (Seth, Associated Press, 5/7, http://www.usatoday.com/tech/science/space/2009-05-07-nasa-fuel\_N.htm, accessed 6/23, AL)

NASA is running out of nuclear fuel needed for its deep space exploration. The end of the Cold War's nuclear weapons buildup means that the U.S. space agency does not have enough plutonium for future faraway space probes — except for a few missions already scheduled — according to a new study released Thursday by the National Academy of Sciences. Deep space probes beyond Jupiter can't use solar power because they're too far from the sun. So they rely on a certain type of plutonium, plutonium-238. It powers these spacecraft with the heat of its natural decay. But plutonium-238 isn't found in nature; it's a byproduct of nuclear weaponry. The United States stopped making it about 20 years ago and NASA has been relying on the Russians. But now the Russian supply is running dry because they stopped making it, too.

U.S. and Russia plutonium 238 supplies low now

Berger 8 (Brian, Staff Space News, 3/6, http://www.space.com/5054-plutonium-shortage-thwart-future-nasa-missions-outer-planets.html, accessed 6/23, AL)

In the future, in some future year not too far from now, we will have used the last U.S. kilogram of plutonium-238,” Griffin said. “And if we want more plutonium-238 we will have to buy it from Russia.” Griffin, who has said many times that he finds it “unseemly” that the United States may have to depend entirely on Russia to access the space station between the space shuttle’s retirement in 2010 and the introduction several years later of the Orion Crew Exploration Vehicle or a commercial alternative, made clear he was no more pleased with the prospect of relying entirely on Russia for flying space missions requiring nuclear power sources. “I think it’s appalling,” he said. But even the Russian supply might not last for much longer. When the hearing resumed March 6, Griffin told lawmakers Russia has advised the United States “that they are down to their last 10 kilograms of plutonium.” “We are now foreseeing the end of that Russian line,” he said. Griffin also clarified that NASA has been assured of enough plutonium-238 to do the MSL, a 2013 or 2014 Discovery-class mission and an outer-planets flagship mission targeted for 2016 or 2017. “When those missions are allocated, we have no more,” he said. Griffin said absent a national decision to restart production, NASA’s planetary science program “would be severely hampered.” John Logsdon, executive director of the Space Policy Institute at George Washington University here, said not restarting plutonium-238 production puts the U.S. space program in an undesirable position of vulnerability. “The major risk is political,” Logsdon said. “It begs the question whether Russia is a reliable enough source, under plausible future political scenarios, that we can count on it.” Logsdon said the United States also could find itself paying dearly for Russia’s remaining supply. “Any monopoly supplier can name their own price,” he said.

Contamination D/A

Plutonium production process necessary for fuel contaminates workers

Gagnon 3 (Bruce, Coordinator of the Global Network Against Weapons & Nuclear Power in Space group, 1/27/3, http://www.spacedaily.com/news/nuclearspace-03b.html) JPG

Beyond accidents impacting the planet, the space nuclear production process at the DoE labs will lead to significant numbers of workers and communities being contaminated. Historically DoE has a bad track record when it comes to protecting workers and local water systems from radioactive contaminants. During the Cassini RTG fabrication process at Los Alamos 244 cases of worker contamination were reported to the DoE. Serious questions need to be asked: How will workers be protected? Where will they test the nuclear rocket? How much will it cost? What would be the impacts of a launch accidents?

Plutonium Natives D/A

Uranium production contaminates the land of Natives

Gerritsen 9 (Jeff, Medicine Resident at Albert Einstein Medical Center, 2/25/9, http://www.culturechange.org/cms/content/view/336/1/) JPG

“In Situ Leach Mining” is presently happening in Crawford, Nebraska at the Crow Butte Resources, Inc. Uranium Mine, which is owned by Cameco, Inc., the multinational energy corporation headquartered in Saskatchewan, Canada. Cameco, Inc. is the worlds’ largest Uranium producer. This Crow Butte Uranium Mine has spilled or leaked thousands of gallons of contaminated water into our land, air, and ground water. The High Plains Aquifer that is under the Crow Butte Resources (CBR) Uranium Mine also flows under the Eastern portion of the Pine Ridge Reservation. The High Plains Aquifer contains portions of the Arikaree Aquifer. The Crow Butte Uranium Mine is auhtorized to use 5,000 to 9,000 gallons of Aquifer water per minute the “In Situ Leach” method. The CBR has at least three “evaporation ponds” where they store the contaminated water. The ponds are as big as a football field, lined with plastic and vinyl. And filled with radioactive sludge. The “monitoring wells” where CBR stores contaminated water after the Uranium has been leached out are actually underground cement containers which hold the water for a period of time before it is placed in the “evaporation pond”. The CBR Uranium Mine produces one million pounds of “Yellow Cake” per year at its processing plant onsite. This “Yellow Cake” is stored in 55-gallon steel drums until transported. “Yellow Cake” is used to power Nuclear Power Plants and to make Nuclear Bombs through production of the world’s most powerful and most dangerous element: Plutonium. Crow Butte Resources well soon seek renewal of their existing license and is proposing to expand their Uranium Mine north of Crawford, Nebraska, to an area near Whitney Lake and Dam, and the White River. The names of these two satellite ISL mines are the North Trend Area and the Three Crow area. The existing mine currently has 4,000-8,000 wells at Crow Butte. There is more information regarding the proposed North Trend Satellite Mine, which Owe Aku and others have filed, in November 2007, an intervention asking for a hearing from the Nuclear Regulatory Commission. ISL Uranium Mining is also planned to occur in the Black Hills area near Edgemont, SD by the Powertech Uranium Company which is now drilling exploratory wells for their proposed In Situ Leach Uranium Mine, and at the Wild Horse Sanctuary near Hot Springs, SD by the Newtron Energy Corporation. **Impacts of Mining on Humans and the Environment** The scientific community has conclusively determined that Inorganic Arsenic and Alpha Emitters are cancer causing to humans. Arsenic and Alpha Emitters are pulled out of the ground during the mining process, entering the groundwater, people drink the groundwater and become contaminated. There can be a 5, 10, or 20-year latency period of exposure to Arsenic and Alpha Emitters before cancer develops. CBR proposes 20 more years of Uranium Mining near Crawford, Nebraska. The Cameco, Inc. website states they have “a proven reserve of 60 million pounds of Uranium to extract”. How much water is that at 9,000 gallons per minute? 24 hours per day, 365 days per year for 20 more years… What will the number of gallons increase to once the two new Uranium Mines are developed and running? There are about 321 people diagnosed with Diabetes each year on Pine Ridge. Currently, of our 25,000 residents, 10% of our Tribal Members have Diabetes. What will that number be after 20 more years of mining which has the potential of contamination of our groundwater? Our people who are Diabetic patients seem to move to the Dialysis stage of the disease quickly, can this be a result of kidney damage sustained over many, many years of contamination of ingesting even low doses of Arsenic and Alpha Emitters? The homes across the Pine Ridge whose test results revealed an illegal MCL of Arsenic now have filters provided by the Indian Health Service to filter Arsenic out of the water as it comes out of our kitchen faucet to purify the water we drink and cook with, but the water we bath our children in, wash our clothes with, water our lawns with, and shower with is not filtered. The Arsenic is still pouring into our homes. According to the Indian Health Service official at the Aug 15, 2007 Environmental Health Tech Team meeting, “this shouldn’t be a concern because you have to drink it to be effected by it”. I wonder what scientists from other parts of the world say about that? Western Science is not the only science who studies such matters, a German scientist states he has proof that a low dose over time can have a more dramatic result than previously understood. With the Crow Butte Resources’ existing mine and two new proposed mines 38 miles to the southeast of Pine Ridge, and the proposed Powertech Uranium Mine 60 miles to the Northwest of Pine Ridge, In Situ Leach Mining for Uranium has the potential to contaminate all of the groundwater our people depend on for drinking water.

Plutonium Natives D/A

Nuclear mining creates unintended pollution that impact Native Americans

Gerritsen 9 (Jeff, Medicine Resident at Albert Einstein Medical Center, 2/25/9, http://www.culturechange.org/cms/content/view/336/1/) JPG

Nuclear power is often billed as clean base-load electrical energy. However, few if any nuclear power proponents mention the unintended consequences or the externalized costs associated with this technology to support the unsustainable U.S. lifestyle. A crucial part of this story is told by Native Americans. I have included three shocking, detailed articles outlining these unintended consequences impacting the Native Americans in South Dakota and neighboring states -- in particular the Cheyenne River radiation poisoning from nearby uranium mining impacting the Pine Ridge Indian Reservation.

Testing = Radiation

Nuclear rocket testing causes radiation – cancer

Rutschman 6 (Avi, writer @ The Acorn, 10/16/6, http://www.calisafe.org/\_disc1/40000016.htm) JPG

The Santa Susana Field Laboratory Panel, an independent team of researchers and health experts, released a report last week concluding that toxins and radiation released from the Rocketdyne research facility near Simi Valley could be responsible for hundreds of cancers in the surrounding areas. The Santa Susana Field Laboratory was built in 1948 by North American Aviation and consists of 2,850 acres in eastern Ventura County. Over the years, it has been used as a test site for experiments involving nuclear reactors, high-powered lasers and rockets. The report was completed by experts in the fields of reactor accident analysis, atmospheric transport of contaminants, hydrology and geology. The study took five years to complete and was funded by the California Environmental Protection Agency. "We want to thank the many legislatures that have attended meetings, provided funds and pressured public agencies into action," said Marie Mason, a community activist and longtime resident of the Santa Susana Knolls area in Simi Valley, who helped to form the advisory panel. The panel originally formed 15 years ago after a 1959 nuclear meltdown that occurred at the Santa Susana Field Laboratory was made public. Concerned about the possibility of facing adverse health affects due to the meltdown, area residents pressured legislators into funding a panel to study the impact of the incident. "We were fearful of what our families and communities may have been exposed to," said Holly Huff, another community member who pushed for the formation of the panel. The first study conducted by the panel was performed by UCLA researchers and focused on the adverse health effects the meltdown had on Rocketdyne employees. Completed in 1997, that report indicated workers did indeed suffer a higher rate of lymph system and lung cancers. Boeing, the current owner of the Santa Susana Field Laboratory, has challenged the validity of the studies, calling into question the scientific methods used by researchers. "We received a summary of the report Thursday, and we were not given an advance copy to look through and prepare with," said Blythe Jameson, a Boeing spokesperson. "Based on our preliminary assessment," Jameson said, "we found that the report has significant flaws and that the claims are baseless without scientific merit and a grave disservice to our employees and the community." After the UCLA study concluding that laboratory workers had faced adverse health effects because of the meltdown, the panel was given federal and state funds to conduct another study of potential impacts on neighboring communities and their residents. According to the panel, Boeing was unwilling to disclose a large amount of data concerning the accident and certain operations. This forced the researchers to base some of their studies on models of similar accidents. "One simply does not know with confidence what accidents and releases have not been disclosed, nor what information about the ones we do know of also has not been revealed," the panel stated in its report. After five years of research, the panel concluded that between 260 and 1,800 cancer cases were caused by the field laboratory's contamination of surrounding communities. The incident released levels of cesium-137 and iodine-131, radio nucleotides that act as carcinogens that surpass the amount of contaminants released during the Three Mile Island incident. The report also stated that other contaminants have escaped, and still could, from the Boeing-owned laboratory through groundwater and surface runoff.

\*\*Nuclear Politics Links

Obama Pushing Nukez Now

Obama is pushing for nuclear propulsion

Grossman 10 (Karl, Journalism prof @ the State U of NY and author of "Cover Up: What You Are Not Supposed To Know About Nuclear Power”, 6/11/10, http://nuclearfreeplanet.org/articles/obama-and-the-nuclear-rocket.html) JPG

The Obama administration is seeking to renew the use of nuclear power in space. It is calling for revived production by the U.S. of plutonium-238 for use in space devices—despite solar energy having become a substitute for plutonium power in space. And the Obama administration appears to also want to revive the decades-old and long-discredited scheme of nuclear-powered rockets—despite strides made in new ways of propelling spacecraft. Last month, Japan launched what it called its “space yacht” which is now heading to Venus propelled by solar sails utilizing ionized particles emitted by the Sun. “Because of the frictionless environment, such a craft should be able to speed up until it is traveling many times faster than a conventional rocket-powered craft,” wrote Agence France-Presse about this spacecraft launched May 21. But the Obama administration would return to using nuclear power in space—despite its enormous dangers. A cheerleader for this is the space industry publication Space News. “Going Nuclear” was the headline of itseditorial on March 1praising the administration for its space nuclear thrust. Space New declared that “for the second year in a row, the Obama administration is asking Congress for at least $30 million to begin a multiyear effort to restart domestic production of plutonium-238, the essential ingredient in long-lasting spacecraft batteries.” The Space News editorial also noted that “President Obama’s NASA budget [for 2011] also includes support for nuclear thermal propulsion and nuclear electric propulsion research under a $650 million Exploration Technology and Demonstration funding line projected to triple by 2013.”

Politics Links

Bipartisan consensus against nuclear power – Japan meltdowns

Broder 11 (John, writer @ NYT, 3/13/11, http://www.nytimes.com/2011/03/14/science/earth/14politics.html) JPG

The fragile bipartisan consensus that nuclear power offers a big piece of the answer to America’s energy and global warming challenges may have evaporated as quickly as confidence in Japan’s crippled nuclear reactors. President Obama is seeking tens of billions of dollars in government insurance for new nuclear reactor construction. Senator Joseph I. Lieberman wants to “put the brakes” on nuclear construction for now while studying what happened in Japan. Until this weekend, President Obama, mainstream environmental groups and large numbers of Republicans and Democrats in Congress agreed that nuclear power offered a steady energy source and part of the solution to climate change, even as they disagreed on virtually every other aspect of energy policy. Mr. Obama is seeking tens of billions of dollars in government insurance for new nuclear construction, and the nuclear industry in the United States, all but paralyzed for decades after the Three Mile Island accident in 1979, was poised for a comeback. Now, that is all in question as the world watches the unfolding crisis in Japan’s nuclear reactors and the widespread terror it has spawned.

Opponents wont fight

Broder 11 (John, writer @ NYT, 3/13/11, http://www.nytimes.com/2011/03/14/science/earth/14politics.html) JPG

But even staunch supporters of nuclear power are now advocating a pause in licensing and building new reactors in the United States to make sure that proper safety and evacuation measures are in place. Environmental groups are reassessing their willingness to see nuclear power as a linchpin of any future climate change legislation. Mr. Obama still sees nuclear power as a major element of future American energy policy, but he is injecting a new tone of caution into his endorsement.

Politics Links

Nuclear power in space is politically publicly and unpopular

Gagnon 3 (Bruce, Coordinator of the Global Network Against Weapons & Nuclear Power in Space group, 1/27/3, http://www.spacedaily.com/news/nuclearspace-03b.html) JPG

NASA's expanded focus on nuclear power in space "is not only dangerous but politically unwise," says Dr. Michio Kaku, professor of nuclear physics at the City University of New York. "The only thing that can kill the U.S. space program is a nuclear disaster. The American people will not tolerate a Chernobyl in the sky." "NASA hasn't learned its lesson from its history involving space nuclear power," says Kaku, "and a hallmark of science is that you learn from previous mistakes. NASA doggedly pursues its fantasy of nuclear power in space." Since the 1960s there have been eight space nuclear power accidents by the U.S. and the former Soviet Union, several of which released deadly plutonium into the Earth's atmosphere. In April, 1964 a U.S. military satellite with 2.1 pounds of plutonium-238 on-board fell back to Earth and burned up as it hit the atmosphere spreading the toxic plutonium globally as dust to be ingested by the people of the planet. In 1997 NASA launched the Cassini space probe carrying 72 pounds of plutonium that fortunately did not experience failure. If it had, hundreds of thousands of people around the world could have been contaminated.

Nuclear propulsion unpopular with public- Cassini proves

Lemos 7 (Robert, Staff @ Wired Science, 9/20,http://www.wired.com/science/space/news/2007/09/space\_nukes

Yet, concerns that an accident at launch would expose people to radioactivity have caused some citizens to staunchly oppose the technology. In 1997, public outcry over the use of 73 pounds of plutonium almost scrapped the Cassini mission, a probe which is now delivering stunning vistas and scientific data from Saturn. In 2006, NASA launched the New Horizons mission to Pluto and the outer solar system, but the radioactive material required to power the probe resulted in a lot of political hand-wringing, said Todd May, deputy associate administrator for NASA's Science Mission Directorate, who worked on the New Horizons mission. "The stack of documents that it took to launch that small amount of plutonium on the New Horizons mission was enormous," May said.

Politics Link – Plutonium Production

NASA has no more plutonium – producing more is unpopular in the house and senate

Smith 9 (Marcia, writer @ Space Policy Online, 8/8/9, http://www.spacepolicyonline.com/pages/index.php?option=com\_content&view=article&id=305:house-and-senate-cut-plutonium-production-funding-imperling-nasa-space-science-mission-plans&catid=67:news&Itemid=27) JPG

The House and Senate have cut the funding requested by the Department of Energy (DOE) to restart production of plutonium-238 (Pu-238) that is needed to power some NASA space science and lunar exploration spacecraft. Pu-238 is needed to fuel radioisotope power sources (RPSs) that supply power for systems and instruments on spacecraft that cannot rely on solar energy because they travel too far from the Sun or land on surfaces with long "nights" or other characteristics that make solar energy a poor or impossible choice. Under the Atomic Energy Act of 1954, only DOE is allowed to possess, use and produce nuclear materials and facilities. Thus, NASA must rely on DOE to produce these power sources and the fuel. The National Research Council (NRC) issued a report on Pu-238 production for NASA missions in May 2009. It urged the government to restart Pu-238 production immediately or imperil NASA's lunar and planetary exploration plans. The NRC report emphasized that "the day of reckoning has arrived" and immediate action is required, estimating that it would cost at least $150 million to reestablish production. "Previous proposals to make this investment have not been enacted, and cost seems to be the major impediment. However, regardless of why these proposals have been rejected, the day of reckoning has arrived. NASA is already making mission limiting decisions based on the short supply of 238Pu. NASA is stretching out the pace of RPS-powered missions by eliminating RPSs as an option for some missions and delaying other missions that require RPSs until more 238Pu becomes available." Pu-238 does not occur in nature, and the United States has not produced any since the late 1980s. It purchased Pu-238 for NASA missions from Russia during the 1990s, but those supplies reportedly are now exhausted. The NRC based its estimate of NASA's Pu-238 requirements on a letter NASA sent to DOE on April 29, 2008 detailing space science and lunar exploration missions planned for the next 20 years.

Appropriations committee specifically doesn’t want more production

Smith 9 (Marcia, writer @ Space Policy Online, 8/8/9, http://www.spacepolicyonline.com/pages/index.php?option=com\_content&view=article&id=305:house-and-senate-cut-plutonium-production-funding-imperling-nasa-space-science-mission-plans&catid=67:news&Itemid=27) JPG

The Senate Appropriations Committee report (S. Rept. 111-45) expressed similar reservations. "The Committee recommends no funding for this program at this time. The Committee understands the importance of this mission and the capability provided to other Federal agencies. However, the Department's proposed plutonium reprocessing program is poorly defined and lacks an overall mission justification as well as a credible project cost estimate. Sustaining the plutonium mission is a costly but an important responsibility. The Committee expects the Department to work with other Federal agency customers to develop an equitable and appropriate cost sharing strategy to sustain this mission into the future."

Appropriations committee controls congress – specifically discretionary spending like the plan

Alarkon 10 (Walter, writer @ The Hill, 5/14/10, http://thehill.com/homenews/house/97995-cbc-could-see-its-spending-clout-increase-next-congress) JPG

By having clout on the Appropriations Committee, the CBC would have a greater voice to be able to push their priorities, said CBC Chairwoman Barbara Lee (D-Calif.). "It's about equity in our federal resources," she told The Hill. Seniority on the Appropriations Committee is a sought-after commodity because of the power the panel wields over the federal budget. Discretionary spending measures -- including those funding wars and each government agency -- are typically considered by the House and Senate Appropriations Committees before they come up for full votes on either chamber. Each federal agency's budget request is first considered by a subcommittee, making the subcommittee chairmen -- known on Capitol Hill as "cardinals" -- far more powerful than junior appropriators. Federal discretionary spending for 2010, excluding the $33 billion in Iraq and Afghanistan war funding expected to pass this month, is expected to be $1.4 trillion. The influence of appropriations can be seen by looking at the list of congressional leaders; Speaker Nancy Pelosi (D-Calif.), Senate Majority Leader Harry Reid (D-Nev.), Senate Majority Whip Dick Durbin (D-lll.) and Senate Minority Leader Mitch McConnell (R-Ky.) have all been appropriators.

Politics Link – Plutonium Production – Ext.

No plutonium left for use

Dillow 9 (Clay, writer @ Popular Science, 9/29/9, http://www.popsci.com/military-aviation-amp-space/article/2009-09/nasas-plutonium-shortage-threatens-deep-space-exploration) JPG

Right now, NASA has enough plutonium-238 for the Mars Space Laboratory and the next planned mission to the outer planets. With any leftovers the agency could launch a research mission to test technology that could convert the heat from plutonium-238 to electricity more efficiently. Of course, after that there will be no more plutonium-238, so it seems that mission is a bit of a moot point. After that, NASA is grounded until it can find another fuel, or convince those holding the purse strings to turn on the cash spigot and refuel deep space exploration.

Producing more is politically unpalatable and the public hates it

O’Neill 9 (Ian, writer @ Universe Today, 5/8/9, http://www.universetoday.com/30610/nasa-is-running-out-of-plutonium/) JPG

So the options are stark: Either manufacture more plutonium or find a whole new way of powering our spacecraft without radioisotope thermal generators (RTGs). The first option is bound to cause some serious political fallout (after all, when there are long-standing policies in place to restrict the production of plutonium, NASA may not get a fair hearing for its more peaceful applications) and the second option doesn’t exist yet. Although plutonium-238 cannot be used for nuclear weapons, launching missions with any kind of radioactive material on board always causes a public outcry (despite the most stringent safeguards against contamination should the mission fail on launch), and hopelessly flawed conspiracy theories are inevitable. RTGs are not nuclear reactors, they simply contain a number of tiny plutonium-238 pellets that slowly decay, emitting α-particles and generating heat. The heat is harnessed by thermocouples and converted into electricity for on board systems and robotic experiments.

\*\*Nuclear Bad\*\*

NTP Bad- Solvency

Nuclear thermal propulsions design flaws mitigate its advantages

Claybaugh et. al 4 (William, The Planetary Society, .http://www.planetary.org/programs/projects/aim\_for\_mars/study-report.pdf, accessed 6-27, JG)

With such enhanced performance, the amount of propellant needed for the mission can be reduced by more than half, with a concomitant reduction in launch costs. The advantages of NTP are mitigated by numerous material compatibility issues. The heated hydrogen tends to erode the reactor fuel ore, and as with any nuclear reactor there is a high level of high-energy radiation emitted, which severely constrains the design and configuration of the overall vehicle. Also, although the higher specific impulse does offer the capability to carry more payload or less fuel, the improvement in overall performance as compared with chemical propellants is not as great as might be suggested from consideration of the improved specific impulse. Because of the weight of the reactor and associated structure, the overall thrust-to-weight ratio of an NTP system will be substantially poorer than for a chemical system, nullifying part of the presumed payload advantage.

NTP is dependent on Hydrogen – can’t leave Earth

Sloan 5 (James, Information Universe, 9-1, http://commercialspace.pbworks.com/f/Proposal+for+a+Common+Vehicle+for+Earth+to+Orit+and+Lunar+Transfer.pdf, accessed 6-27, JG)

The President’s support of nuclear power in space has opened the door to the use of Nuclear Thermal and Nuclear Electric propulsion in space. Nuclear Thermal propulsion has been proposed as a way of reducing trip time and hence cosmic ray exposure to the astronauts for a manned Mars Mission. Trip times could also be reduced for Lunar Transfer and the availability of a high Delta-V could permit by-passing a Lagrange base and going directly to the Lunar Pole Base 10 . The Nuclear Thermal Rocket (NTR) was well developed in the 1960s but its dependence on Hydrogen as its propellant essentially ties it to the Earth.

A nuclear thermal propulsion system can only operate for minutes

Iannotta 2 (Ben, Aerospace America, http://www.aiaa.org/aerospace/Article.cfm?issuetocid=244&ArchiveIssueID=29, accessed 6-27, JG)

A nuclear-thermal propulsion system would be more powerful, but its specific impulse would be 600-700 sec. Although the thermal propulsion system would provide a sudden burst of acceleration, it would operate for minutes compared to years for the nuclear-electric system. Think of the nuclear thermal system as a gas-guzzling V8 engine and the nuclear-electric system as a V4 economy car that could run for 10 years on a tank of gas, Taylor says.

Too many barriers to solving

Sharma 7 (Rahul, Lethbridge Journalism, http://www.lurj.org/article.php/vol1n2/chariots.xml, accessed 6-27, JG)

From the point of view of mass and flight time, Nuclear Thermal Propulsion (NTP) may well represent the best technology for human exploration beyond the Earth-Moon system. However, although it is well understood in concept, there is no program currently developing NTP flight systems (in contrast to chemical, SEP, and NEP). Thus NTP is a technology for which the entire burden of investment and advocacy would need to be borne by the human exploration program. In addition, there are serious environmental issues and infrastructure investments that would need to be addressed to enable development and testing of NTP technology. Ground tests of NTP rockets would produce effluent gases for which new handling and cleaning facilities would be required. These investments and political concerns are a significant hurdle, and so we assert that the preferred solution is to establish workable first-generation human exploration architecture without relying on NTP.

NTP Bad- Solvency

NTP heat melts the rocket & causes engine failure

Jessa 9 (Tega, Universe Today, 6-17, http://www.universetoday.com/32722/nuclear-propulsion/, accessed 6-27, JG)

So how does each of the present concepts for nuclear propulsion work? The principals are simple but the execution can be complicated. NTP works on the same concept as a hydrogen rocket. The material that makes thrust is heated by a heat source. In this case it is a nuclear reactor. The sheer energy this system can produce when properly managed can exceed that of normal rocket systems. Unfortunately this type of propulsion is highly inefficient as the temperatures needed to make it truly effective would actually melt any known material now used to make rockets. To prevent this, the engine would have to lose 40% of its efficiency.

NTP Bad- Solvency- No Testing

NTP can’t be tested today – regulations and public perception

Claybaugh et. al 4 (William, The Planetary Society, .http://www.planetary.org/programs/projects/aim\_for\_mars/study-report.pdf, accessed 6-27, JG)

Arguments concerning performance aspects of NTP relative to other options are as valid today as they were in 1972. However, the social environment for conducting technical R&D related to nuclear systems has changed dramatically, making any such task much more difficult than in earlier decades. International treaty obligations preclude the open air testing techniques employed for the original NTP testing, while public opinion is far less tolerant of any nuclear systems. Moreover, the government and industrial nuclear infrastructure has atrophied considerably in the last 30 years as a result of the demise of commercial nuclear power and the end of the Cold War.

Lack of testing ensures mission failure and tanks solvency

Powell et. al 4 (James, Plus Ultra Technologies, January, http://www.aiaa.org/aerospace/Article.cfm?issuetocid=445&ArchiveIssueID=46, accessed 6-27, JG)

Technical risk is another factor to consider in assessing nuclear propulsion systems. Unlike sensors and electronics, nuclear propulsion does not allow use of a redundant or back-up nuclear propulsion system. There is only one reactor, and it, together with the associated hardware, must function reliably during the entire mission. Going ahead with missions without having fully demonstrated propulsion system reliability, and without extensive long-term testing, risks mission failure.

NTP- Spending Link

Nuclear Thermal Propulsion and Rockets cost up to 3.5 billion dollars

Howe & O’Brien 10 (Steven and Robert, U.S. Department of Energy, September, http://www.inl.gov/technicalpublications/Documents/4731768.pdf, accessed 6-27, JG)

The second issue has been studied by several review groups and by NASA for the past two decades. In 2008, a NASA supported team of government and industry participants spent several months designing a Fission Surface Power (FSP) system for the moon and estimating the cost of development [21]. The study estimated that the FSP would cost under $2B. This estimate encompassed three main categories: 1) reactor system development, 2) qualification of the system for space, and 3) alteration of facilities and security at the Kennedy Space Center to handle the system. The FSP estimate did not include any costs for ground based testing of a full power system nor any fuel, development costs. The most recent estimate by NASA is that development of a NTR would cost around $3-3.5 B. This is consistent with the FSP estimate in that fuel development and ground testing of the NTR will increase the costs. In all, the costs are modest compared to the savings in launch costs, the improvement in mission performance, and the reduction in mission risk.

NEP Bad- Solvency- No Testing

Nuclear Electric Propulsion takes years to test – won’t be successful

Osenar 4 (Michael, http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA431030, accessed 6-27, JG)

There are many other issues that go beyond pure feasibility, however, including testing, safety and radiological hazards. Testing nuclear systems is a long and complicated process, costing billions of dollars. Key to determining the price of nuclear testing and development, especially NEP systems, is whether or not reactors and thrusters have to be tested for the full operational lifetime. If so, NEP testing will require enormous facilities capable of monitoring a reactor for a decade or more of operation, and ensure safety in case of mishap. Funding must be approved by Congress, and because of the long time scale of the project, it is repeatedly subject to being cut as new politicians are elected and administrations change.

Testing failure tanks solvency

Powell et. al 4 (James, Plus Ultra Technologies, January, http://www.aiaa.org/aerospace/Article.cfm?issuetocid=445&ArchiveIssueID=46, accessed 6-27, JG)

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Here’s more testing evidence – long-term problems without testing

Powell et. al 4 (James, Plus Ultra Technologies, January, http://www.aiaa.org/aerospace/Article.cfm?issuetocid=445&ArchiveIssueID=46, accessed 6-27, JG)

Development time for NEP is likely to be considerably longer than for NTP, for two reasons. First, to ensure reliability, systems must be tested for periods comparable to their anticipated operating time. Testing an integrated NEP system for two or three years will not prove that the system can operate reliably in space for 12 years. Questions about long-term behavior of high-burnup nuclear fuel at elevated temperatures, corrosion effects, fatigue and mechanical failure, and coolant leaks from piping and radiators, for example, cannot be resolved without long-term testing.

NEP Bad- Space War

**NEP uses a Radioisotope Thermoelectric Generator**

Jessa 9 (Tega, Universe Today, 6-17, http://www.universetoday.com/32722/nuclear-propulsion/, accessed 6-27, JG)

The other approach is Nuclear Electric Propulsion. This works on the concept of using electrical power to heat the rocket propellant. The main design concept now in use for this type of propulsion is the Radioisotope Thermoelectric Generator. The generator is powered by the decay of radioactive isotopes. The heat generated by the isotopes is captured by thermocouples which convert this heat to the electricity need to heat rocket propellants.

Nuclear space exploration leads to an international space race

Smith 3 (Wayne Smith, CIP Senior Fellow, 1-28, http://www.spacedaily.com/news/nuclearspace-03d.html, accessed 6-27, JG)

Little response was generated overseas as nuclear power in the form of RTG's (Radioisotope Thermionic Generators) for space probes and satellites is nothing new. However, the latest announcement places nuclear power at the forefront of future space development. Spacefaring nations such as the European Union and Russia cannot ignore this challenge. In particular the newest emerging superpower, China, will closely watch how events unfurl. In just over three years, China has gone from Satellite launches to planning a human spaceflight in October of this year. This remarkably rapid advancement was spurred by the realization of the strategic importance of space. Space will be central to tomorrow's world order and national security dictates that a space presence is a sign of strength. Huang Chunping, commander-in-chief of the chinese Shenxhou space launch program has said, "Just imagine, there are outer space facilities of another country at the place very, very high above your head, and so others clearly see what you are doing, and what you are feeling. That's why we also need to develop space technology." Clearly the Chinese have more on their minds than national prestige in attempting to become the third nation to ever have launched a man into space. Manned aerospace is the epitome of space technology. National prestige is clearly an important consideration, and one which westerners can easily relate to as they fondly reminisce about the moon landings. However, the military implications are just as important, if not greater, a consideration. China has already invested too much money into developing a space launch capability to consider pulling back now. In past interviews, they have announced the intention to build space stations, reach the moon and build bases there, and even boasted they will beat the United States with a manned mission to Mars.

Space racing leads to global perpetual wars

Krepon and Clary 3 (Michael , CEO of the Henry L. Stimson Center, Christopher, Research Assistant for the Weaponization of Space Project @ Stimson Center, http://www.stimson.org/wos/pdf/space3.pdf, 5-22, accessed 6-28, JG)

U.S. initiatives to “seize” the high ground of space are likely to be countered by asymmetric and unconventional warfare strategies carried out by far weaker states—in space and to a greater extent on Earth. In addition, U.S. initiatives associated with space dominance would likely alienate longstanding allies, as well as China and Russia, whose assistance is required to effectively counter terrorism and proliferation, the two most pressing national security concerns of this decade. No U.S. ally has expressed support for space warfare initiatives. To the contrary, U.S. initiatives to weaponize space would likely corrode bilateral relations and coalition-building efforts. Instead, the initiation of preemptive or preventive warfare in space by the United States based on assertions of an imminent threat—or a threat that cannot be ameliorated in other ways—is likely to be met with deep and widespread skepticism abroad. The international community has long been aware of latent threats to satellites residing in military capabilities designed for other purposes. Common knowledge of such military capabilities designed for other means has not generated additional instability in crisis or escalation in wartime. The flight-testing and deployment of dedicated space weaponry would add new instability in crisis and new impulses toward escalation. It would be folly to invite these consequences unless it is absolutely necessary to do so. Space warfare, far more than terrestrial combat, does not lend itself to the formation of “coalitions of the willing.” U.S. initiatives to weaponize space could therefore result in a lonely journey that leads to war without end and to war without friends. The burdens and risks placed upon the shoulders of U.S. expeditionary forces would be exceedingly great. In addition, the quest for space dominance would undoubtedly accentuate domestic political divisions on national security issues, which results in diminished U.S. security.

NEP- Spending Link

Nuclear Electric Propulsion costs billions just for testing

Osenar 4 (Michael, http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=ADA431030, accessed 6-27, JG)

There are many other issues that go beyond pure feasibility, however, including testing, safety and radiological hazards. Testing nuclear systems is a long and complicated process, costing billions of dollars. Key to determining the price of nuclear testing and development, especially NEP systems, is whether or not reactors and thrusters have to be tested for the full operational lifetime. If so, NEP testing will require enormous facilities capable of monitoring a reactor for a decade or more of operation, and ensure safety in case of mishap. Funding must be approved by Congress, and because of the long time scale of the project, it is repeatedly subject to being cut as new politicians are elected and administrations change.

Nuclear-electric propulsion costs billions and takes 20 years

Moomaw 3 (Bruce, writer @ SpaceDaily, 1/21/3, http://www.spacedaily.com/news/rocketscience-03a1.html) JPG

Nuclear-electric exploration of the Solar System has tremendous scientific potential in the middle-range future -- and such reactors would use uranium-235, which is far more expensive than plutonium but also thousands of times less radioactive when a reactor is shut down, thus being virtually totally safe to launch into orbit. But developing such miniature spacegoing reactors, as mentioned, will still be a difficult task, costing one or two billion dollars -- and there is simply no unmanned Solar System scientific mission planned for flight within the next 15 to 20 years that needs such a powerful propulsion system badly enough to be worth that expense in such a short time.

EMP D/A (1/2)

Nuclear propulsion causes EMPs – crushes electricity outages for the continental US

Pearson 3 (Ben, science degree @ Central Arizona College, writer @ SpaceDaily, 1/22/3, http://www.spacedaily.com/news/nuclearspace-03a.html) JPG

However, if you were to look at the patent of Dr. Stanislaw Ulam filled by the AEC in 1959, you would see perhaps the strangest idea of them all, to launch a spaceship by launching nuclear bombs out of it's back end repeatedly. The idea was called at that time Project Orion. I came to study Orion in the year 2001. At first I just looked at existing research, studying its pros and cons. Soon I came to one big problem. There was nothing that I studied that had anything to do with Electromagnetic Pulse shockwaves that would result from the use of so many nuclear bombs. Electromagnetic Pulse is the affect of nuclear weapons that has a tendency to destroy electronics in a large area. It is caused by radiation ionizing the atoms in a band around the earth approximately 20-30 km high. It can be extremely damaging. A 1.4 Megaton bomb launched about 400 kilometers above Kansas would destroy most of the unprotected electronics in the entire Continental United States. However, Electromagnetic Pulse remains almost untested for small nuclear bombs.

**Small outages have a cascading effect throughout the grid**

**Glauthier 3** (T. J., President & CEO of the Electricity Innovation Institute, 9/21/3, "LIGHTING UP THE BLACKOUT**:** TECHNOLOGY UPGRADES TO AMERICA'S ELECTRICAL SYSTEM" lexis/nexis) JPG

I sincerely appreciate the opportunity to address this distinguished Committee on a subject about which we are all concerned. The electric power system represents the fundamental national infrastructure, upon which all other infrastructures depend for their daily operations. As we learned from the recent Northeast blackout, without electricity, municipal water pumps don't work, vehicular traffic grinds to a halt at intersections, subway trains stop between stations, and elevators stop between floors. The August 14th blackout also illustrated how vulnerable a regional power network can be to cascading outages caused by initially small--and still not fully understood--local problems. In response to the Committee's request, my testimony today provides some of EPRI's and E2I's views on technology issues that require further attention to improve the effectiveness and reliability of the nation's interconnected power systems. This testimony will be supplemented with a matrix table as requested by the Committee. Context for power reliability Power system reliability is the product of many activities--planning, maintenance, operations, regulatory and reliability standards--all of which must be considered as the nation makes the transition over the longer term to a more efficient and effective power delivery system. While there are specific technologies that can be more widely applied to improve reliability both in the near- and intermediate-term, the inescapable reality is that there must be more than simply sufficient capacity in both generation and transmission in order for the system to operate reliably. The emergence of a competitive market in wholesale power transactions over the past decade has consumed much of the operating margin in transmission capacity that traditionally existed and helped to avert outages. Moreover, a lack of incentives for continuing investment in both new generating capacity and power delivery infrastructure has left the overall system much more vulnerable to the weakening effects of what would normally be low-level, isolated events and disturbances.

Blackouts cost the economy 30 Billion Dollars PER DAY. Just a few days of outage brings economic growth down to ZERO

Bryan 3 (Jay, writer @ The Gazette, “Power grids vital in information age: "Just a few days could theoretically take economic growth ... right down to zero", lexis/nexis)

This worsened the already-anemic state of a U.S. economy that had been hammered by a massive stock-market meltdown and a series of confidence- sapping corporate scandals. It hurt Canada, too, weakening our biggest market. So now, just when there are signs of healthy growth in both countries, is the last time you'd want to see a large part of the continent's electric-power network collapse. We can be grateful that the immediate impacts look modest. David Rosenberg, chief North American economist with Merrill Lynch, estimates that the U.S. impact could amount to as much as $30 billion for each day of interrupted activity. That's roughly one percentage point of quarterly economic growth, which means that just a few days could theoretically take economic growth in the third quarter right down to zero. But this is just the first step in his analysis. In reality, most activity was returning to something close to normal by yesterday. More important, Rosenberg says, any losses in August are likely to be recouped in September, much as economic activity rebounds to wipe out most losses after a severe winter storm. But even if we do look back on the great blackout of '03 as a mere hiccup for the economy, there will be little reason for complacency. As Royal Bank economist John Anania notes, the reliability of the power grid is absolutely indispensable in an information-age economy.

EMP D/A (2/2)

US economy is key to global economy

News Ratings 6 (Staff, 6/23/6, http://www.newratings.com/analyst\_news/article\_1304298.html) JPG

Analysts at Dresdner Kleinwort Wasserstein say that the US economic slowdown is likely to have a significant impact on the global economy. In a research note published this morning, the analysts mention that exports continue to be the key growth driver in major economies, such as Japan and the Eurozone. Any deceleration in the US economy would impact exports and adversely affect domestic demand, the analysts say. Moreover, the reversal of interest rate expectations, triggered by a US slowdown, is likely to weaken the US dollar, maybe very substantially, Dresdner Kleinwort Wasserstein adds. A slowdown in demand from the US, combined with a weaker dollar, has historically exerted pressure on global economic growth, the analysts point out.

Economic collapse causes nuclear war- extinction

Broward 9 ((Member of Triond) http://newsflavor.com/opinions/will-an-economic-collapse-kill-you/ AD: 7-7-09 )ET

Now its time to look at the consequences of a failing world economy. With five offical nations having nuclear weapons, and four more likely to have them there could be major consequences of another world war. The first thing that will happen after an economic collapse will be war over resources. The United States currency will become useless and will have no way of securing reserves. The United States has little to no capacity to produce oil, it is totatlly dependent on foreign oil. If the United States stopped getting foreign oil, the government would go to no ends to secure more, if there were a war with any other major power over oil, like Russia or China, these wars would most likely involve nuclear weapons. Once one nation launches a nuclear weapon, there would of course be retaliation, and with five or more countries with nuclear weapons there would most likely be a world nuclear war. The risk is so high that acting to save the economy is the most important issue facing us in the 21st century.

EMP D/A – Fission Link

Fission is more powerful than thermonuclear bombs

Pearson 3 (Ben, science degree @ Central Arizona College, writer @ SpaceDaily, 1/22/3, http://www.spacedaily.com/news/nuclearspace-03a.html) JPG

This one was really stretching the truth; in all actuality fission bombs create more radiation, and thus do more damage, than thermonuclear bombs. And lastly, I took no consideration at all of the Earth's magnetic field lines, which can potentially greatly influence the sphere of influence of Electromagnetic Pulse.

Normal Means = Plutonium

NASA uses plutonium for nuclear propulsion

Gagnon 3 (Bruce, Coordinator of the Global Network Against Weapons & Nuclear Power in Space group, Synthesis/Regeneration 30 (Winter 2003), http://www.greens.org/s-r/30/30-13.html) JPG

Last year the Department of Energy (DoE) and NASA announced that present facilities must be expanded. The DoE will spend over $35 million to renovate the Oak Ridge National Laboratory in Tennessee to help with space plutonium production. Oak Ridge workers would purify the plutonium, which then would be shipped to Los Alamos National Laboratory in New Mexico where it would be formed into pellets used in space power systems.

Uq – No Plutonium

NASA is out of plutonium – its out of alternatives

O’Neill 9 (Ian, writer @ Universe Today, 5/8/9, http://www.universetoday.com/30610/nasa-is-running-out-of-plutonium/) JPG

Decommissioning nuclear weapons is a good thing. But when our boldest space missions depend on surplus nuclear isotopes derived from weapons built at the height of the Cold War, there is an obvious problem. If we’re not manufacturing any more nuclear bombs, and we are slowly decommissioning the ones we do have, where will NASA’s supply of plutonium-238 come from? Unfortunately, the answer isn’t easy to arrive at; to start producing this isotope, we need to restart plutonium production. And buying plutonium-238 from Russia isn’t an option, NASA has already been doing that and they’re running out too… This situation has the potential of being a serious limiting factor for the future of spaceflight beyond the orbit of Mars. Exploration of the inner-Solar System should be OK, as the strength of sunlight is substantial, easily powering our robotic orbiters, probes and rovers. However, missions further afield will be struggling to collect the meagre sunlight with their solar arrays. Historic missions such as Pioneer, Voyager, Galileo, Cassini and New Horizons would not be possible without the plutonium-238 pellets. So the options are stark: Either manufacture more plutonium or find a whole new way of powering our spacecraft without radioisotope thermal generators (RTGs). The first option is bound to cause some serious political fallout (after all, when there are long-standing policies in place to restrict the production of plutonium, NASA may not get a fair hearing for its more peaceful applications) and the second option doesn’t exist yet. Although plutonium-238 cannot be used for nuclear weapons, launching missions with any kind of radioactive material on board always causes a public outcry (despite the most stringent safeguards against contamination should the mission fail on launch), and hopelessly flawed conspiracy theories are inevitable. RTGs are not nuclear reactors, they simply contain a number of tiny plutonium-238 pellets that slowly decay, emitting α-particles and generating heat. The heat is harnessed by thermocouples and converted into electricity for on board systems and robotic experiments. RTGs also have astonishingly long lifespans. The Voyager probes for example were launched in 1977 and their fuel is predicted to keep them powered-up until 2020 at least. Next, the over-budget and delayed Mars Science Laboratory will be powered by plutonium-238, as will the future Europa orbiter mission. But that is about as far as NASA’s supply will stretch. After Europa, there will be no fuel left.

More ev

Dillow 9 (Clay, writer @ Popular Science, 9/29/9, http://www.popsci.com/military-aviation-amp-space/article/2009-09/nasas-plutonium-shortage-threatens-deep-space-exploration) JPG

Imagine you’re driving across the Mojave Desert, and somewhere in the middle of absolutely nowhere you realize that the next gas station is further away than your car can travel on its current supply of gasoline. What next? That’s the problem NASA mission planners are facing as the agency's supply of plutonium-238, the fuel used to power deep space probes like Cassini and surface scouts like the upcoming Mars Science Laboratory, are dwindling. Unfortunately, that leaves NASA in a pretty tight spot: we’ve depleted our reserves of plutonium-238, and there isn’t anywhere to refuel ahead on the horizon either. Plutonium-238 powers spacecraft via heat given off by its radioactive decay. A small pellet—smaller than one’s fist—glows red from its own heat and can power equipment in extremely hostile environments like the vacuum of space, where temperatures vary greatly. For missions to the outer planets or the Kuiper belt, where sunlight is a thousand times lower and the temperature near absolute zero, plutonium-238 is the only option, as solar power is too weak to provide an effective charge. But this special brand of plutonium was a byproduct of Cold War activities and hasn’t been produced by the U.S. since the ‘80s (plutonium-239 goes in nuclear warheads, so naturally we keep plenty of that laying around). NASA has launched nearly two dozen missions over the past four decades that were powered by plutonium-238, including the Voyager probes, the Galileo probe that studied Jupiter and its moons, and the Cassini that is currently doing laps around Saturn. Those missions ran on either U.S. reserves of plutonium-238 or excess stock purchased from Russia. But now neither nation is producing the stuff, and even if we started again today, it would take eight years to build up production to the volumes necessary for annual deep space missions.

Timeframe – 10 years

Development of the necessary tech takes at least 10 years

Moomaw 3 (Bruce, writer @ SpaceDaily, 1/21/3, http://www.spacedaily.com/news/rocketscience-03a1.html) JPG

However, this -- to put it mildly -- is not the same thing as saying that NASA plans to try to develop a very large nuclear rocket engine capable of launching a manned ship to Mars within a decade. Pae quotes O'Keefe as saying: "We're talking about doing something on a very aggressive schedule to not only develop the capabilities for nuclear propulsion and power generation but to have a mission using the new technology within a decade." But O'Keefe has spent the past year talking constantly about his hopes for a deep space mission using nuclear-powered propulsion within a decade or so -- while making it clear that he is talking about an unmanned, relatively small probe. NASA's Nuclear Electric Propulsion program -- for which it included $46.5 million in its FY 2003 budget request -- would have been just such a system.

$ Link

A manned nuclear rocket costs tens of billions and takes decades

Moomaw 3 (Bruce, writer @ SpaceDaily, 1/21/3, http://www.spacedaily.com/news/rocketscience-03a1.html) JPG

Such a huge nuclear-powered manned ship would certainly take tens of billions of dollars to develop, and it is utterly ridiculous to say that there is any chance that NASA could develop a manned Mars ship (nuclear-powered or not) quickly enough to launch it within a decade.

\*\*Fusion\*\*

Fusion Bad- Solvency

Fusion is inefficient and overheats engines

Crowl 5-31 (Adam, Contributor, Discovery News, “Project Icarus: The Gas Mines of Uranus,” http://news.discovery.com/space/project-icarus-helium-3-mining-uranus-110531.html, JM)

Thus, no deuterium accumulates in the sun and in the rest of the natural world it's relatively rare -- 1 in every 6,500 atoms of the hydrogen we drink is deuterium. However, because deuterium, in so-called "Heavy-Water," is used to moderate neutrons in some nuclear reactor designs, it is separated from regular water on a large scale. Pure deuterium can already be fused by technological means and was used in the first hydrogen bomb detonated in 1952, but fusing it with tritium (hydrogen with two neutrons, so it's heavier than deuterium) is even easier and this is the preferred reaction used by fusion research today. Unfortunately, if this method was used to fuel a starship -- such as the Icarus interstellar vehicle -- the deuterium-tritium (D-T) reaction produces high-energy neutrons that transfer heat from the reaction directly to the engine's structure. About 80 percent of the fusion energy released is in the form of those neutrons, so the reaction isn't very healthy (or useful) for a starship. Pure deuterium reactions also produce neutrons, though only about 1/3 of the fusion energy is released as such. That's better than the D-T reaction, but when we're talking about engine powers in the hundreds of gigawatts to terawatts, then such percentages mean gigawatts of heat that must be gotten rid of, adding to the mass of the engines and degrading the overall performance.

Fusion Bad- Solvency

Fusion destroys its own reactor – at best it makes spaceships too large for interstellar travel.

Lidsky 83 (Lawrence M., *MIT Technology Review*, October, p. 4-6, http://www.askmar.com/Robert%20Bussard/The%20Trouble%20With%20Fusion.pdf, JM)

One of the first issues posed by the D-T fusion reaction was how to supply sufficient tritium. Tritium is radioactive, with a relatively short half-life of 12.4 years, and therefore it exists only in minute quantities in nature. Luckily, the neutron emitted in D-T fusion can react with an isotope of lithium to produce tritium and even release additional energy in the process. Though nothing compares with the vast store of deuterium in seawater; the world’s lithium resources are enough for several thousand years of energy production. The lithium-neutron reaction resolves the tritium-supply problem. However, it introduces additional engineering difficulties. The severity of the technical problems associated with the D-T reaction was not fully understood in the early years of the fusion program. But these difficulties have gradually been revealed by the extraordinarily detailed series of conceptual reactor designs produced under Department of Energy (DOE) funding over the last decade. The object of these studies is to describe a plausible fusion reactor based on the underlying physics and reasonable extrapolations of the technology. Of course, no one can be certain exactly what a D-T fusion reactor will look like. Nevertheless, several difficult questions that might seem to depend on this knowledge can already be answered. In particular: will a fusion reactor be simpler or more complex, cheaper or more expensive, safer or more dangerous, than a fission reactor? The answers depend only on the broad outlines of future reactors. The main fusion reaction will take place in a gas-like plasma in which deuterium and tritium atoms are so energetic — so hot — that the nuclei have lost their electrons. The temperature of this gas will probably exceed 150,000,000° C. This plasma cannot be contained by physical walls, not only because no material could withstand the heat, but also because walls would contaminate the plasma. Instead, the plasma will be bottled within a vacuum by magnetic forces, Four-fifths of the energy from the D-T reaction is released in the form of fast-moving neutrons. These neutrons are 15 to 30 times more energetic than those released in fission reactions. The first wall surrounding the plasma and vacuum region will take the brunt of both the neutron bombardment and the electromagnetic radiation from the hot plasma. This first wall is expected to be made of stainless steel or, better, one of the refractory metals such as molybdenum or vanadium that retain their strength at very high temperatures. In colliding with this wall, the neutrons will give up some of their energy as heat. This heat must be removed by rapidly circulating coolant to prevent the wall from melting. After being piped out of the reactor, the heated coolant is used to produce steam and generate electricity. The fusion of deuterium (D) with tritium (T) is 100 to 1,000 times more reactive than the fusion of combinations involving helium 3 (He3), protons (p), or boron 11 (B11). In other words, a DT based power plant would yield 100 to 1,000 times more energy than an identical plant using the other fuels. That is why almost all research has focused on D-T fusion. However, the energetic neutrons it releases would damage and induce radioactivity in the reactor structure. Many of the collisions between neutrons and atoms in the first wall actually knock the atoms forming the metal out of their original positions. Each atom in the first wall will, on average, be dislodged from its lattice position about 30 times per year. Obviously, this causes the structure of the metal to deteriorate. A few of the neutrons colliding with atoms in the first wall will have the beneficial effect of dislodging some neutrons from the atomic nuclei. These dislodged neutrons, plus the original ones generated by the fusion, pass through the wall and into the so called “blanket,” which contains lithium in some form. Here, the bulk of their energy is used to produce heat, which also is used to create steam for generating electricity, and eventually the neutrons are absorbed by the lithium to “breed” tritium. Lithium itself poses serious engineering problems. It is an extremely reactive chemical: it burns violently when it comes in contact with either air or water and even capable of undergoing combustion with the water contained in concrete. The lithium may be either in liquid form or in a solid compound. Liquid lithium blankets produce substantially more tritium and allow it to be more easily removed. However, the need to handle large amounts of this metal in liquid form leads to technical complexity and poses safety hazards. The tritium-breeding region has other engineering requirements. It must be designed in such a way that the structural materials, as contrasted with the actual lithium, capture a minimum of neutrons. Also, the operating temperature must be high enough so that the coolant, when piped outside the reactor, can generate steam efficiently. Outside the blanket, powerful magnets must provide the magnetic fields to contain the plasma. These fields will exert enormous forces on the magnets themselves, equivalent to pressures of hundreds of atmospheres. If made from copper wire, these magnets would consume more power than produced by the reactor, so they will have to be superconducting. Superconducting magnets, cooled by liquid helium to within a few degrees of absolute zero, will be extremely sensitive to heat and radiation damage. Thus, they must be effectively shielded from the heat and radiation of the plasma and blanket. Temperatures within the fusion reactor will range from the highest produced on earth (within the plasma) to practically the lowest possible (within the magnets). The entire structure will be bombarded with neutrons that induce radiation and cause serious damage to materials. Problems associated with the inflammable lithium must be managed. Advanced materials will have to endure tremendous stress from temperature extremes and damaging neutrons. The magnetic fields will exert forces equivalent to those seen only in very high pressure chemical reactors and specialized laboratory equipment. All in all, the engineering will be extremely complex. A working fusion reactor would also have to be very large. This conclusion is based on fundamental principles of plasma physics and fusion technology. To begin with, because of the properties of magnetic fields, a fusion reactor must be tubular. There is still dispute as to whether this tube should be bent into a toroidal (doughnut) shape, as in the device known as the “tokamak,” or kept as a long, straight tube with end plugs, as in the device known as the “tandem mirror.” However, the main conclusions as to the size and complexity of a D-T reactor are independent of this choice. The first wall of the reactor encloses the plasma. The best theories available suggest that the radius of the plasma must be at least two to three meters if the fusion reaction is to be self-sustaining. Even if a breakthrough in physics were to allow a smaller plasma, separate engineering requirements would prevent the radius of the first wall from being appreciably less than three meters. These requirements arise from the need to avoid excessive differences in power density.

Fusion Bad- Solvency

Large fusion reactors are undesirable and impossible to shrink

Lidsky 83 (Lawrence M., *MIT Technology Review*, October, p. 7, http://www.askmar.com/Robert%20Bussard/The%20Trouble%20With%20Fusion.pdf, JM)

Such a large reactor would not meet the needs of utilities. Plagued by financially crippling cost overruns on fission reactors, managers are loathe to invest several billion dollars in any single plant, fission or fusion. Smaller plants, such as coal plants with scrubbers, are much easier to finance, not only because the investment is far lower, but also because the final cost is predictable. And if a small plant breaks down, the effects on regional electricity production are much less serious. Thus; utility managers find large plants undesirable. Suppose fusion reactors could be built despite the inherent difficulties of size and complexity. Another critical engineering problem would still have to be faced. That is the matter of heat transfer — the way in which heat is removed from the reactor structure by the circulating coolant. The history of much large scale power engineering has been dominated by the effort to achieve ever higher temperatures and heat transfer rates. High temperatures imply high efficiency, and high heat-transfer rates imply high power density. Because these goals are so desirable, heat transfer systems have been pushed close to their limits. Above these limits, materials either melt or fail from excessive stress caused by heat. Additional gains are coming only slowly. Consider heat transfer in fission and fusion reactors. In today’s typical light-water reactor (LWR), there is generated by fission in fuel pins containing uranium. The heat is then transferred to the coolant at the surfaces of a relatively large number of small diameter pins. This arrangement provides a larger surface area to transfer heat than, say, a single large fuel cylinder. Indeed, by decreasing the diameter of the pins even further (but increasing their number to keep the amount of uranium unchanged), the total surface area available to transfer heat would be further increased. Thus, the actual heat-transfer rate through any given square inch of surface on a fuel rod is not critical. SuScient heat can always be removed merely by increasing the total area. This strategy does not work in a fusion reactor. The heat-transfer surface is limited to the inside of the wall surrounding the plasma, and the relatively small surface area of this wall cannot be increased without further increasing the size of the reactor. In fact, bigger reactors need larger heat-transfer rates. Thus, the actual heat-transfer rate per square inch must be extremely large and cannot simply be reduced by a design change.

Fusion is unstable, expensive, and nearly impossible to improve

Lidsky 83 (Lawrence M., *MIT Technology Review*, October, p. 7-8, http://www.askmar.com/Robert%20Bussard/The%20Trouble%20With%20Fusion.pdf, JM)

On these counts, a comparison between current LWR fission reactors and the somewhat optimistic fusion designs produced by the DOE studies yields a devastating critique of fusion. For equal heat-transfer rates, the critical inner wall of the fusion reactor is subject to ten times greater neutron flux than the fuel in a fission reactor. Worse, the neutrons striking the first wall of the fusion reactor are far more energetic — and thus more damaging — than those encountered by components of fission reactors. Even in fission reactors, the lifetimes MIT Technology Review, October 1983 7 of both the replaceable fuel rods and the reactor structure itself are limited because of neutron damage. And the fuel rods in a fission reactor are far easier to replace than the first wall of the fusion reactor, a major structural component. The drawbacks of the existing fusion program will weaken the prospects for other fusion programs, no matter how wisely redirected. But even though radiation damage rates and heat transfer requirements are much more severe in a fusion reactor, the power density is only one-tenth as large. This is a strong indication that fusion would be substantially more expensive than fission because, to put it simply, greater effort would be required to produce less power.

Fusion Bad- Solvency

Fusion propulsion doesn’t solve space travel – not enough thrust

Czysz and Bruno 9 (Paul A. and Claudio, Prof. of Aeronautical Engineering @ Parks College & Prof. of Aerospace Engineering @ State Univ. of Rome La Sapienza, *Future Spacecraft Propulsion Systems: Enabling Technologies for Space Exploration*, March 16, JM)

This simile should not suggest that the problems posed by interstellar or QI travel and examined in Sections 8.1 to 8.5 can be quickly solved by fusion propulsion. Thrust still depends on thrust power, the product *IspF.* The much larger />p possible with fusion rockets implies that, depending on spacecraft mass, reasonable acceleration to shorten long voyages needs large V and. accordingly, very large power. For instance, a thrust of order 50 tons with /sp of order I0ft m/s needs a 500-GW reactor. Such power is not outlandish, but the volumetric energy density in MCF reactors so far tested (tokamak and other types effusion machines) is low, and suggests that high-/Np, high-thrust MCF rockets must be voluminous and presum­ably also massive. Nevertheless, because of its inherent simplicity, thermal fusion propulsion is appealing to most propulsion experts, who think it is the better mode of propulsion. The most natural way of conceiving a thermal fusion propulsion system is that just described, where the propellant fuses and is exhausted in a continuous manner. This operation mode is sometimes called open magnetic con­finement (OMC). and a technical analysis of its theory, issues, and work in progress is the subject of Appendix B at the end of this book.

Fusion is not beneficial or functional

New Scientist 3 ( January 23, http://www.newscientist.com/article/dn3294-nuclear-fusion-could-power-nasa-spacecraft.html, JM)

To achieve fusion, scientists heat the hydrogen isotopes deuterium and tritium to at least 100 million kelvin. This strips electrons from the isotopes, creating a plasma of bare nuclei. If this plasma is hot and dense enough, the two types of nuclei fuse, giving off neutrons and huge amounts of energy. However, the plasma can only be contained by strong magnetic fields, and creating containment fields that do not leak has proved very difficult. What is more, no one has managed to generate a stable fusion reaction that passes the "break-even" point, where the reaction is generating more energy than it takes to sustain it. Fortunately for Emrich, the reaction would not need to go far beyond the break-even point to generate thrust. And containment is less of a headache because you actually want some of the plasma to escape, he says. "That's where the thrust comes from." The problem is 100 million kelvin is not hot enough to generate thrust. At that temperature, the fusion reaction only generates neutrons, which are uncharged and therefore cannot be steered and fired through a magnetic jet nozzle. To produce thrust, you need charged particles.

Ionic Fusion Bad – Solvency

Ion propulsion wears itself out – two ways

Sengupta 5 (Anita, Senior Engineer @ NASA’s Jet Propulsion Laboratory, October 31, http://sgc.engin.umich.edu/erps/IEPC\_2005/pdffiles/papers/026.pdf, JM)

Several wear mechanisms exist relating to the discharge-cathode-assembly performance degradation. A leading cause for several of the known failure modes is erosion and eventual removal of the discharge-cathode-keeper plate. Keeper erosion is a well-documented wear process for the NSTAR thruster and was tracked photographically during the course of the ELT. Ion-bombardment-sputter-erosion of the keeper plate by the discharge plasma led to the complete removal of the plate after 30,000 hrs of operation. The primary function of the keeper plate is to protect the cathode from discharge-plasma ion-bombardment. As the keeper erodes, it exposes the cathode-orifice plate, heater, and radiation shield to discharge-plasma ion-bombardment. Excessive erosion of the heater may lead to breach of the heater sheath, and therefore heater failure. Heater failure causes cathode failure because without a functioning heater, the cathode cannot be ignited. Keeper erosion can result in orifice-plate removal. During the ELT, following the removal of the keeper, the cathode-orifice-plate-to-tube weld was eroded by discharge-plasma ion-bombardment. If the orifice plate had fallen off, the cathode operation would have ceased. Cathode inability to start due to a cathode-common-keeper short is also a result of wear of the cathode assembly. The source of the shorting material is likely erosion of the discharge-keeper plate 4,s. Although not a failure for the cathode itself, erosion of the radiation shield due to discharge-plasma ion-sputtering led to the formation of tantalum (Ta) flakes large enough that they could lodge themselves between the grids or defocus individual beamlets, causing rogue hole formation. The other primary cathode wear mechanism, not related to keeper erosion is excessive, is performance degradation or cathode failure-to-start due to insert depletion. Removal of impregnate material is a temperature- and runtime-dependent process. When impregnate material is removed or is not readily available for diffusion to the surface, electron emission cannot occur and the cathode cannot operate.

Ionic Fusion Bad-- Solvency

Ionic propulsion still faces technical barriers – not reliable enough for long journeys

MacLeod and Gow 10 (Christopher and Kenneth S., Faculty, Gordon University, *Journal of the British Interplanetary Society* 63, 5, pp. 192-205, December 6, JM)

As alluded to in the sections above, there are several practical problems which need to be overcome before these devices can become viable. Although these issues appear present technical obstacles to a working system, none of them seems to be insoluble in the light of current knowledge. This section outlines two particular areas which need further work in order to make IEC systems an engineering reality. The first of these is the achievement of high density in the active area and the second is good energy reclamation. These two areas are now considered in turn. The importance of a high particle density has already been described in some detail in the preceding sections. There are also some related issues which need some further consideration. One is the isolation of high and low densities in the machine. For the ion source and acceleration system to work effectively they need to operate in a good vacuum. Stray particles cause unwanted collisions, scattering the beam and resulting in an increase of waste heat. This means that good containment of the target particles is important, and this is the principle reason why ions and plasmas are the main focus of research - both can be effectively contained. As well as being difficult to physically separate from the beam, neutral atoms also contain bound electrons and some of the incident beam energy is used up ionising these. A plasma can be contained, but although the electrons are now separate from their parent nuclei, they are still present and are scattering sites for the beam; they can spill easily into the main vacuum with the deleterious effects already described, and can also carry away heat energy (although some of the reclaim systems mentioned in the section above may ameliorate the problem by recovering these). Ionic systems therefore have several advantages over neutral ones. The target particle cloud needs to be dense and well contained for the reasons already mentioned. It also needs to be shaped appropriately. If the target is too large or the wrong shape, then scattered and fused products will undergo further secondary scattering in the cloud with several undesirable consequences. These include the transfer of heat to the cloud, raising its entropy and removing recoverable energy from the system and the spillage of scattered particles out of the trap and into the main chamber with the results already discussed. This is why the long, thin, sausage-shaped topology described in the sections above is useful. Although a system based on ionic entrapment is in some respects ideal, there are two problems associated with it. The first of these is overcoming the natural coulombic repulsion of the ions in order to gain a dense enough target. This issue has already been discussed. The second is the form of the ion trap necessary to contain a high enough density. Paul and Penning traps tend to enclose the ions in metal structures and this stops the scattered and fusion products escaping freely as required by the energy capture systems. However, as previously discussed, novel trap topologies are available and there is still research to be done, ideally to produce a trap with the field topology shown in Fig. 20. Such a structure should ideally have no physical protrusions into its active region. Although this might not be possible as a static system, dynamic approaches such as standing waves and collapsing field profiles have still to be explored. Other nonlinear field phenomena – for example field arrangements similar to those which cause charge bunching in Gunn diodes might also be explored. The use of neutral beams was discussed in a previous section as a possible solution to the density issue. However, as already noted, neutral particles are difficult to contain and also use energy in ionisation (although this is small, only 13 eV for a Deuterium atom). Any neutral beam system would probably therefore be pulsed, the individual pulses being sent to reach the reaction area at exactly the same time as the accelerated beam. Scattered and fused components would then be expelled from the centre quickly, due to their inherent velocity, and captured by the retrieval system. The remaining neutral particles would need to be evacuated before a new pulse was initiated. In such a system, timing would be critical. Consider now the practical problems associated with the accelerated ion beam. The technology of ion acceleration is fairly simple; however, if the device is to operate in a pulsed mode there are some added complications. These mostly involve ensuring that the ion pulses arrive at the target with optimal timing - this is critical for cavity efficiency. Ideally the density profile of the beam should be a sinusoidal variation. However, in practice this may be difficult to achieve due to different initial ion velocities. Reducing the variability of ion velocity is a significant way of improving the beam profile, and this can be achieved by sorting the ions before acceleration into a narrow velocity band. This is often done in Ion Scattering Spectroscopy [50] for the same reason. The ions are injected into a curved duct or tube under the influence of a constant magnetic field, only those with exactly the energy required to emerge from the other end without hitting the tube walls are accelerated. The idea is shown in Fig. 21. This is one of several useful techniques which can be adapted from this field. Another practical issue concerns power-management in the system. The energy inputs and outputs can be divided up into two classes - “internal” and “external.” This classification differentiates the power produced and consumed within the device from the power delivered-to or drawn-from external sources. In the steady-state the system is a net source of power; however, in the start-up phase, external power is probably required. Figure 22 illustrates the broad input and output groupings and details some of the internal sources and loads. The key to running the system efficiently will be the intelligent handling of these by the management system.

Fusion Bad -Weaponization (1/2)

Fusion research inevitably leads to weapon development – other explanations are just rationalizations

Makhijani and Zerriffi 98 (Arjun & Hisham, PhD in engineering & former Senior Scientist @ Institute for Energy and Environmental Research, July, http://www.ieer.org/reports/fusion/chap5.html, JM)

One of the central military and disarmament issues facing the international community today is to decide whether pursuit of research whose aim it is to achieve pure fusion explosions in the laboratory is compatible with disarmament goals and treaties, including, most importantly, the Comprehensive Test Ban Treaty. The development of pure fusion weapons is now a distinct possibility, though it is not a certainty, since their scientific feasibility remains to be established. One central challenge to disarmament and non-proliferation today is that the scientific feasibility of such weapons could be established using the same devices that are being promoted as essential for the ratification of the Comprehensive Test Ban Treaty (the treaty has been signed by about 150 countries, with the notable exceptions of India and Pakistan, since September 1996). The nuclear weapons powers, notably the United States and France, have programs for the "stewardship" of their existing stockpiles of nuclear weapons. As part of their stewardship programs they are building or operating facilities that will be used to maintain the skills of nuclear weapons designers, and which could be sued to develop a qualitatively different class of nuclear weapons. ICF facilities and research are an important part of these programs. Since its May 11 nuclear tests, India has also announced its own stockpile stewardship program. The stated goals of the US stockpile stewardship program are to maintain the safety and reliability of existing weapons. We have shown in a previous report that most of the US program of SBSS is marginal or irrelevant to nuclear safety.1We have also argued that fusion facilities such as NIF and the proposed X-1, are not relevant to maintaining the reliability of current nuclear weapons, particularly if the United States were to adopt a nuclear policy based upon deterrence rather than first-strike. The evidence for this conclusion is summarized below. Pursuit of programs with explicit potential for designing new nuclear weapons is counter to Article VI of the NPT and to the CTBT. This applies whether the new weapons follow on current generation fission-triggered weapons or are part of an entirely new class of weapons, such as pure fusion weapons. In this context, it is worthwhile to recall that Article VI of the NPT relates, among other things, to the "cessation of the nuclear arms race at an early date." ICF researchers claim that their research could also lead to commercial power production from fuels that are widely available and plentiful. However, the energy applications of any explosive fusion research should be justified on their own merits and in comparison to other energy projects. Many environmentally sound energy technologies are much further ahead than ECF and yet receive far fewer resources. Further, ECF approaches will take decades to develop into economical energy sources, if they prove feasible at all. The fact that large resources have been spent over decades on fusion power research without even establishing scientific feasibility needs to be more carefully considered, given the urgency of reducing greenhouse gas emissions. Military rationalizations and the relatively great pull of nuclear bureaucracies on governmental energy programs seem to be the forces driving ECF programs rather than serious evaluations of the world's energy and environment needs.

Fusion Bad –Weaponization (2/2)

That means uncontrollable proliferation

Makhijani and Zerriffi 98 (Arjun & Hisham, PhD in engineering & former Senior Scientist @ Institute for Energy and Environmental Research, July, http://www.ieer.org/reports/fusion/chap5.html, JM)

If pure fusion weapons were developed, the restraints on proliferation via materials control would be weak and, in the long term, could disappear altogether. Initially, control of tritium production might provide an avenue for limiting proliferation. But tritium can be produced in commercial reactors (through the use of lithium target rods in light water reactors or by the extraction of the tritium produced in heavy water reactors, like CANDUS, due to the conversion of deuterium to tritium).15Separation facilities are also needed to extract the tritium for the target rods, but these are less complex than those for extracting plutonium from irradiated reactor fuel and could be more readily developed and operated. Tritium is hard to detect if it is properly shielded and put into appropriate containers, making development of effective radioactive and monitoring systems very difficult, although not impossible. Further, tritium is currently not under international safeguards and there are no official plans for such safeguards. In fact, the US is in the process of greatly loosening restraints. It has initiated a program to produce test quantities of tritium for its weapons program in commercial nuclear reactors and may initiate a large-scale program for military tritium production in commercial reactors owned by the Tennessee Valley Authority. Even more troubling, however, is the possible future use of lithium and deuterium in either fusion research or in potential fusion weapons programs. While this is speculative at present so far as pure fusion weapons are concerned, it is important to note here that the thermonuclear component of fission-triggered nuclear weapons consists of a combination of these two elements in the form of lithium-deuteride. Both lithium and deuterium are non-radioactive and are readily available. There will be essentially no way to control their production or to keep track of it. In the short term it is necessary to bring tritium stockpiles under international safeguards. This would provide a small but not sufficient measure of restraint. Perhaps more importantly, tritium production for weapons should be halted as it is inconsistent with nonproliferation and disarmament goals. (Commercial requirements are far smaller than weapons and can be met from current stockpiles and by-products from Canadian heavy water reactors).16Certainly, the program in the United States to develop a new tritium production source should be halted since it is unnecessary. Current tritium supplies are more than adequate to meet US stockpile needs if further efforts towards reducing the number of nuclear weapons are made.17

Fusion Bad – CTBT

Fusion weapon development collapses CTBT

Makhijani and Zerriffi 98 (Arjun & Hisham, PhD in engineering & former Senior Scientist @ Institute for Energy and Environmental Research, July, http://www.ieer.org/reports/fusion/chap5.html, JM)

In the long term, facilities such as the National Ignition Facility and MTF facilities pose even greater threats to both the CTBT and the disarmament process. As discussed above, if ignition is demonstrated in the laboratory, the weapons labs and the DOE would likely exert considerable pressure to continue investigations and to engage in preliminary design activities for a new generation of nuclear weapons (even if it is just to keep the designers interested and occupied). Ignition would also boost political support and make large-scale funding of such activities more likely. Even without the construction of actual weapons, these activities could put the CTBT in serious jeopardy from forces both internal and external to the United States. Internally, those same pressures, which could lead to the resumption of testing of current generation weapons, could also lead to the testing of new weapons (to replace older, less safe or less reliable weapons). Externally, the knowledge that the United States or other weapons states were engaging in new fusion weapons design activities could lead other states to view this as a reversal of their treaty commitments. Comparable pressures to develop pure fusion weapons would be likely to mount in several countries. This would have severe negative repercussions for both non-proliferation and complete nuclear disarmament. The time to stop this dangerous thermonuclear quest for explosive ignition is now, before its scientific feasibility is established.

CTBT is key to prevent proliferation and nuclear war

Lalanne 2 (Dominique, Speaker @ NPT Review Conference Preparatory Committee, April, http://www.reachingcriticalwill.org/legal/npt/NGOpres02/5.pdf, JM)

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) is an integral part of our global efforts to reduce the dangers of weapons of mass destruction. All states should recognise that action on the CTBT is all the more important in light of heightened awareness regarding the dangers of terrorism generally and nuclear terrorism in particular. The states presently resisting the CTBT are undermining their own security as well as the security of the entire world. The CTBT was brought about through the hard work and determination of NGOs and millions of ordinary people around the world. In all these years, the NGO community has not faltered in its advocacy for a test ban treaty. People throughout the world understood that ending nuclear testing was essential for two powerful reasons: to halt the spiraling arms race once and forever; and to prevent further devastation of human health and the global environment, already contaminated from decades of atmospheric and underground explosions. We are profoundly disappointed with the countries that failed to attend the Second Conference on Facilitating the Entry into Force of the Comprehensive Nuclear-Test-Ban Treaty, in November 2001, especially those states whose signature or ratification is essential for entry into force. We are pleased, however, at the support for the CTBT demonstrated by three nuclear-weapon states (France, Russia, and the UK) and we call on them to maintain and strengthen their support. Entry into force of the CTBT is crucial to the stability and future of the non-proliferation regime, as all NPT states parties confirmed at the 2000 Review Conference. Among the 13 practical steps for systematic and progressive nuclear disarmament identified in the final document of that conference, two are devoted to the CTBT and nuclear testing. The first of these steps stressed “the importance and urgency of signatures and ratifications, without delay and without conditions and in accordance with constitutional processes, to achieve the early entry into force of the Comprehensive Nuclear-Test-Ban Treaty.” The second step called for “a moratorium on nuclear-weapon-test explosions or any other nuclear explosions pending entry into force of that Treaty.” Both of these goals are in serious danger today. This conference should take stock on progress towards these goals and make practical recommendations on how to achieve early entry into force of the test ban treaty. A ban on testing is an essential step towards nuclear disarmament because it helps block dangerous nuclear competition and new nuclear threats from emerging. However, technological advances in nuclear weapons research and development mean that a ban on nuclear test explosions by itself cannot prevent some qualitative improvements of nuclear arsenals.

Ramjets Bad

Ramjet propulsion won’t work

Froning 81 (H.D., Senior Staff Engineer, AIAA, “Investigation of a ‘quantum ramjet,’” http://www.greenstone.org/greenstone3/nzdl?a=d&d=HASH8a0afea69cce9a9819cf36.4&c=envl&sib=1&dt=&ec=&et=&p.a=b&p.s=ClassifierBrowse&p.sa=, JM)

This investigation indicates that so-called "quantum interstellar ramjets" would have to accomplish propulsive interactions with the invisible, illusive and ever-changing quantum fluctuation energies of the vacuum over scales of time and distance that are many orders of magnitude less than those required for accomplishing any known ramjet combustion processes. As such, this investigation indicates that ramjet-like quantum propulsion systems are far beyond even the boldest and most optimistic extrapolations of our ramjet art. But this investigation has also revealed that a quantum propulsion system need only extract an infinitesimal fraction of the enormous vacuum fluctuation energies which may exist over submicroscopic scales of distance along a starship's entire interstellar route. Therefore, perhaps some hope remains that some type of quantum propulsion system might eventually exploit the stupendous fluctuation energies of cosmic space for propulsive purposes. And although such a system would surely be bizzare and beyond our current scientific understanding, perhaps it would be but one exciting example of what may unfold during the next century of flight as mankind delves deeper into the mystery of matter, time and space.

Ramjets Bad

Ramjet intake is limited – can’t reach high speeds

Martin 73 (A.R., Freelance physicist, *Astronautica Acta* 18, 1, abst., February, JM)

Description of a physical model of a magnetic intake for an interstellar ramjet. The particle collection properties of the intake are formulated by applying two criteria. First, all particles with more than a certain amount of their initial momentum in the transverse component are reflected by the magnetic field peak near the vehicle. Second, all particles with an initial gyration radius larger than a certain value are not injected into the vehicle power plant, even if the particles are not reflected. A brief discussion of proton reactors allows a numerical value of the necessary particle collection rate to be derived, and this value is used in conjunction with the intake fractions to determine the minimum possible intake dimensions. It is found that, while intakes of radius about 1 km are possible at large fractions of the speed of light, the intake radii at low velocities during the initial part of the journey are of the order of 10,000,000 km. This places a severe restriction upon the feasibility of the magnetic ramjet concept.

Ramjets lack propellant and fusion technology

Jones 6 (Antonia J., Department of Computing @ Imperial College, London, July 23, http://users.cs.cf.ac.uk/O.F.Rana/Antonia.J.Jones/Lectures/Specials/SelfReplicatingAutomata.pdf, JM)

Consideration of mass ratios for various propulsion systems show that it would be highly desirable to acquire propulsion mass from interstellar space. The only available propellant is the interstellar matter. This is extremely rarefied with typically 1 - 2 atoms/cm3, or even less. Since these atoms are primarily hydrogen this translates to a density of about 2 X 10-24 g/cm3. In 1960 [Bussard 1960] published his classic paper on the interstellar ramjet. He proposed collecting the matter by ionising it and using an electromagnetic field to concentrate the matter in order to initiate fusion. Because concentrations of interstellar hydrogen are so dilute Bussard found that the scoop intake would have a diameter of around 100 kms. Controlled thermonuclear fusion was achieved for several seconds on the 9 November 1991 at the Joint European Torus near Oxford, although the temperature reached was insufficient to make the reaction self-sustaining. It will probably take 20-30 years to get the first fusion based electricity generating stations on line but the important point is that it has been proved to be feasible. This, combined with recent advances in high temperature superconducting technology, makes the design and construction of a Bussard Ramjet at least a possibility in principle. Fishback [Fishback 1969] examined in more detail the collection by a magnetic field and developed equations limiting the speed of the ramjet relative to the plasma, in [Martin 1971] some corrections were made to the numerical results. The limitation is not severe in regions with densities of 1-2 protons/cm3 but at ten times this density the speed for an aluminium structure is limited to 0.94c and at 100 times to only 0.075c. Obviously the scoop can be considerably smaller in high density regions, but we shall not be able to take advantage from this. Moreover, such regions are not uncommon in the Galaxy [Martin 1972]. Other limitations of the ramjet are studied in detail in [Martin 1973], [Matloff 1977]. In addition the proton-proton reaction is difficult to sustain because of the small cross section [Whitmire 1975]. It may be possible to add a nuclear catalyst, such as carbon-12, which could be recovered, to speed up the reaction [Whitmire 1975] by a factor of 1018 which would make the ramjet project more feasible. The success at JET suggest that practical fusion is a possibility but it seems likely that the demonstration of such catalytic reactions will not be accomplished in the near future. A lot of invention and research is needed, however, before the Bussard ramjet becomes a reality. The fusion reactor must be light-weight and long-lived, it must be able to fuse protons, not the easier to ignite mixture of deuterium and tritium. The reactor must be able to fuse incoming protons without slowing them down, or the frictional loss of bringing the fuel to a halt, fusing it, and reaccelerating the reaction products will put an undesirable upper limit on the maximum velocity obtainable.

\*\*\*SOLAR\*\*\*

Solar Sails Bad- Solvency

Don’t have tech for navigation – results in travel error

Vieru 9 (Tudor, Science Editor, 8-19, http://news.softpedia.com/news/The-Challenges-of-Navigating-a-Solar-Sail-119545.shtml, accessed 6-24-11, JG)

The concept of solar sails, devices that would rely on solar winds and photons to power up spacecraft traveling through the solar system and beyond, has been around for quite some time now. Although some of the materials theoretically needed for them have been developed, and even a few not-that-successful attempts have been made to launch solar sail-powered devices, the technology is still considered to be some time away from mass implementation. Now, astronomers are beginning to realize that they are still short on basic knowledge of future spaceships, such as how to navigate them. Theoretically speaking, a space probe weighing in at 150 kilograms, attached to a solar sail with a radius of about a kilometer and a mass of 150 kilograms, could move through the solar system in no time. If it is deployed in orbit at about 0.1AU (astronomical units) away from the Sun, where the solar wind pressure is higher, and set on a parabolic trajectory, then it could accelerate by as much as 0.6G. With such an acceleration, the craft would reach the Kuiper belt, located some 200 AU away, in just 2.5 years. An astronomical unit is a measure of distance, equal to the average distance between the Sun and the Earth. Therefore, the theory implies that a spaceship needs to be launched very close to the star, in order to benefit from the full advantages of massive amounts of radiation pressure, which could send it to the Oort Cloud, some 2,500 AU away, in under 30 years. This is a time duration that space agencies could consider feasible, experts say. In short, implementing space sail technologies would undoubtedly open up new frontiers for space exploration. But one of the main problems that a future solar sail-powered spacecraft is most likely to have resides in its controls. The probe will not be able to steer its sails like a boat does in the ocean, and will have to be set on the correct trajectory from the start. The smallest variations could lead, in a 2,500 AU-long journey, to errors of up to a million miles, which are naturally to be avoided. Experts believe that, with it being launched so close to the Sun, the spacecraft's orbital planners will have to keep in mind the theory of general relativity, as well as the precession of the perihelion of orbiting objects.

Hard to design for favorable space travel

Alhorn 11 (Alhorn, NASA Engineer, 02-03, http://www.pbs.org/wgbh/nova/space/alhorn-solarsails-au.html, accessed 6-24-11, JG)

It's not something that—It's basically on the cusp of being accepted in general. You have to design a system, which is very hard to test here on the ground, because these structures are very, very lightweight. There's a term called "gossamer"—they're very flimsy, they're very lightweight, and they're very hard to test. That's one of the main challenges. Another challenge is to design it such that it will go off and do what you want it to do, because these materials are sort of thin and flimsy that it takes special mechanisms to make them behave the way you want them to. So it's a challenging mechanical design.

Solar sails one of the hardest things to build without failure

ITOD 6 (ITOD News, 6-19, http://itotd.com/articles/573/solar-sails/, accessed 6-24-11)

Even so, if a solar sail is going to push a spacecraft of any significant mass, it’ll have to be enormous. And therein lies a problem: with greater size comes greater mass—not so much from the sail itself but from the support structure that’s needed to keep it rigid and connect it to craft’s payload. The greater the mass to be pushed, the greater the size of the sail that’s needed, and so on. Thus, in solar sail design, thinner and lighter materials are almost always better. Sail thickness is measured in micrometres (µm)—millionths of a meter—with some being as thin as 2 µm. (By comparison, the average human hair is about 80 µm thick.) This brings up a second problem: fragility. You’ve got to fold or roll up a huge sheet of material that’s a zillionth of an inch thick, get it into space, and then unfurl it perfectly—without ripping or mutilating it, and without creating a support structure so massive that it’ll cancel out the sail’s low mass.

Solar Sails Bad- Solvency

Solar sails don’t support human space travel

Vulpetti 8 (Giovanni, Physicist, “Solar sails: a novel approach to interplanetary travel”, pg. 103, accessed 6-24-11, JG)

Human-Exploration Sailships Current-technology, micron-thick, Earth-launched sails are not yet up to the support of human exploration of the solar system. These sails are too small to carry the tens of thousands of kilograms necessary to support humans between the planets and exploration gear. Also, sail-implemented missions to Mars (for example) using today's sail technology would be of longer duration than rocket-propelled interplanetary ventures.

Can’t test on Earth – ensures problems in space

Orzulik 6 (Ryan, Science and Engineering @ York, 10-25, http://www.students.yorku.ca/~orszulik/Specification%20and%20Milestones%20Report.pdf, accessed 6-24-11, JG)

The sail will also include a steering and control algorithm based on control vanes at the tips of the sail axes. The largest obstacle that must be overcome in this project is finding a way to actually test the solar sail. The first main requirement, is that a light bright enough to generate a flux large enough to move the solar sail be used. The other main problems with testing is that the solar sail is designed to be used in the microgravity of space, but it will be tested in the gravity environment of the Earth. Thus a test setup that supports the weight of the solar sail must be constructed. However, the test setup must be mounted on rollers with very small static and kinetic friction coefficients so that the small acceleration exerted on the sail will allow it to move.

Won’t work – too many engineering challenges

Leipold 99 (M., Institute of Space Sensor Technology and Planetary Exploration, http://www.esa.int/esapub/bulletin/bullet98/LEIPOLD.pdf, accessed 6-25-11, JG)

Technological challenges of solar-sail deployment Although the basic idea behind solar sailing appears simple, challenging engineering problems have to be solved to exploit photonic propulsion for orbit transfer. Since the spiral orbit-raising efﬁciency depends basically on the overall spacecraft mass to solar sail area ratio, lightweight technological solutions for large insolar sails for space exploration Figure 7. The DLR solar-sail mock-up orbit deployed sail surfaces are required. The technical challenges are: – to fabricate the sails using ultra-thin ﬁlms and lightweight deployable booms able to carry the in-orbit loads – to package the sails and booms into a small volume – to deploy these lightweight structures successfully in space, and – to control the large but low-mass structure

Solar Sails Bad- Solvency

Solar sails fail – solar rays, radiation, & flares

Vulpetti 8 (Giovanni, Physicist, “Solar sails: a novel approach to interplanetary travel”, pg. 103, accessed 6-24-11, JG)

But alas, that is not the entire story! The near-Sun environment is a far-from-tranquil region. Streams of electrically charged partides—the elec-trons, protons, and ionized helium nudei of the solar wind—hurry outward from the Sun at velocities of hundreds of kilometers per second. Although most solar electromagnetic radiation is in the form of relatively benign radio, infrared, or visible light, a considerable fraction is in the ultraviolet, x-ray, or gamma-ray spectral ranges. These photons are energetic enough to ionize sail atoms. As we saw in Chapter 17, considerably better and safer strategies entail solar flybys in either direct or reversal motion. And this may not be a good thing! All this is occurring during a typical "quiet Sun" period. A sun-diving ship foolhardy enough to attempt a dose solar pass during the more active phase of the solar cycle would run the risk of encountering the emissions from a solar flare or from the so-called coronal mass ejection (CME, a huge release of the solar-corona matter). Even at Earth's comfortable distance from the Sun, flares can affect weather and disrupt communications. Close up, they would likely be fatal to a sundiving sail.

Current tech doesn’t solve – tears in the solar sail

Vulpetti 8 (Giovanni, Physicist, “Solar sails: a novel approach to interplanetary travel”, pg. 103, accessed 6-24-11, JG)

A solar sail must be lightweight enough to move itself and a payload (in space) when sunlight reflects from it. To meet the design requirements for many of the missions discussed in this book (see Chapters 9 and 17), even the first solar sails must be gossamer-like; hence they will be very fragile. Unfortunately, they must also be large. The sail must be large to reflect enough light to produce thrust and propel itself and its payload to a destination elsewhere in the solar system. First-generation solar sails will have areal densities of 10 g/m2 or less and be tens of meters in diameter. (This is the loading of the bare sail, not that of the whole sailcraft we denoted by a in Chapter 16.) At first glance, these sails will resemble common aluminum foil found in many kitchens. Who hasn't attempted to pull aluminum foil off a roll, only to have it hopelessly torn to shreds, forcing you to start over with another piece? However, appearances are misleading. Aluminum foil used in the kitchen is typically 0.013 mm thick, about 10 times thicker than the first-generation solar sails. Now imagine fabricating a sail 100-m by 100-m square out of something ten times thinner than aluminum foil. Not only must the sail be this large, but it has to be strong enough to sustain its own weight under gravity during testing. Even our best materials are too fragile (by themselves) under these conditions and require bracing with cords embedded in them to provide additional strength and to reduce the effects of the inevitable tears. This cord serves the same ripstop function as those found in parachutes. If a tear starts, it will spread until it encounters the cord, where it will be stopped. The edges of the sails are reinforced and securely fastened to the booms during operation.

Solar Thermal Bad- Solvency

Solar propulsion can’t get humans into space

Battat 10 (John, Engineering, http://ardent.mit.edu/real\_options/Real\_opts\_portfolio%20applications/2010%20APs/Battat\_report.pdf, accessed 6-24-11, JG)

SEP‐ shown below involves very large solar arrays to collect energy.  Propulsion is achieved by an electric engine which is an order of magnitude more fuel efficient 1 than chemical propulsion. While electric thrusters and solar arrays are not new technologies, developing them at sufficiently large sizes has not yet been demonstrated. Since the solar energy available at any given time (and location) limits the thrust of the engine, SEP systems have very low thrust despite their high efficiency.  The thrust level influences time‐of‐flight to a destination.  For most cargo, this does not matter much, however for transferring crew (people) it leads to transit times that are logistically infeasible due to extra mass of consumables and radiation shielding required.  The result is that SEP cannot be the only in‐space propulsion technology for space exploration with humans.

Solar heat leaks from storage – tanks solvency

Battat 10 (John, Engineering, http://ardent.mit.edu/real\_options/Real\_opts\_portfolio%20applications/2010%20APs/Battat\_report.pdf, accessed 6-26-11, JG)

No reason to use solar propulsion – no benefits from other types of propulsion Solar Thermal Propulsion (STP) offers no unique mission capabilities not available through alternate propulsion technologies. State of the art chemical propulsion can perform all the missions for which STP is a candidate, albeit at a performance disadvantage in many cases. STP could provide better payload mass performance than alternate propulsion technologies in many cases, but as noted next, STPs with this performance don’t fit in the fairings. Solar propulsion leaks solar energy – increases mission times If the STP operates with intermittent burns near periapse, gravity losses are minimized and the STP can approach the delta V of a high-thrust system. The price for this is increased trip time. The question, clearly, is how much of a trip time increase must be incurred. This, in fact, was the motivation for the energy storage STP concept: one could collect solar energy all around the orbit and deliver it quickly near periapse. Also, if solar energy collection is discontinued during thrusting, simultaneous pointing to the Sun and of the thrust vector is not required, and the STP overall configuration is simplified. However, the very poor demonstrated efficiency of the storage concept (due to heat leak out of the storage system) in early tests led us to doubt its viability.

\*\*\*Solar Pollution DA\*\*\*

Solar Bad 1NC (1/2)

Government slashing solar energy now – aff keeps robust solar production alive

Samuelsohn and Goode 11 (Darren and Darren, POLITICO Writers, 6-19, http://www.politico.com/news/stories/0611/57322.html, accessed 6-26, JG)

The budget-slashing mentality permeating the halls of Congress is forcing lawmakers and lobbyists to get creative when it comes to financing energy projects. The political viability of any one particular idea notwithstanding, the wheels are desperately turning, and members are throwing out a myriad of ideas — new and old — to see what might stick. “If we’re not creative now, we’re headed towards a very rough patch,” said Richard Kauffman, chairman of Levi Strauss & Co. and a participant in the nonprofit Coalition for Green Capital, a group of businesses, investors and attorneys that advocates investments in renewable energy and efficiency projects. Popular programs offering cash grants and loan guarantees to renewable and other advanced energy projects are set to expire this year, and other production and investment tax incentives for wind and solar may run out as well in the near term. These industries are going to need some type of continued assistance to help President Barack Obama keep his pledge to create and sustain hundreds of thousands of green jobs.

Solar energy production uses toxic cadmium

Flux Energy 11 (Flux Energy, Solar Industry, 06-08, http://sundial365.com/pdfs/EnvironmentalMyths\_final.pdf, accessed 6-26-11, JG)

Operators of solar installations are currently under fire to find ways to reverse the negative environmental impact their systems deliver. One issue of great concern is the production of PV panels utilizing the newer thin-film technology. Thinfilm technology reduces the amount of material required in creating a solar cell. Thus, it is quickly becoming a preferred manufacturing process due to cost, flexibility, lighter weight and ease of integration compared to wafer silicon cells. The thin-layer production of panels, however, involves the mining of rare earth minerals such as cadmium and selenium. These minerals are so rare that the yield per truckload of ore is very small, implying that many truckloads are required to feed the global need for these elements. As more and more solar installation operators elect to center their production on thin-layer PV elements, the industry will respond. As with many rare elements, when demand goes up, price goes up. These minerals also possess a level of toxicity that can be dangerous to the environment as well as to humans. They are considered hazardous materials. Assuming a 30- to 40-year life for most PV panels, there are grave concerns over the proper disposal of thin-film panels to keep these minerals from leaking into waste and water streams. Additionally, the mining processes for these elements are very invasive and pollutive. China is the primary global producer due to the lower standards for invasive mining. The mining of cadmium and other toxic elements is allowed in the U.S. as a by-product of other mining efforts such as the extraction of zinc. However, following in the standards set by the European Union to ban the use of some of these elements from all products, regulations and cleanup mandates continue to limit the production of cadmium and other minerals in the U.S. The manufacturers of solar panels and other energy industry lobbyists continue to push for more relaxed regulations. While the production and disposal of thin-film PV panels is certainly one issue attracting a lot of environmentalist opposition in the industry, there are many others.

Solar Bad 1NC (2/2)

Cadmium can spread its toxics through global air currents

UN 8 (United Nations Environment Program, http://www.chem.unep.ch/pb\_and\_cd/SR/Files/2008/UNEP\_Cadmium\_review\_Interim-APPENDIX-MAR2008.pdf, accessed 6-26, JG)

Some small portion of anthropogenic cadmium from North America has been noted in the Russian Arctic. Further, aerosol measurements in Taiwan show that a portion of airborne cadmium can be transported over a thousand kilometres from developing areas of China. Besides, some indication of cadmium potential to intercontinental transport can be obtained from measurements of stable isotope signatures of the airborne dust in combination with air-mass back trajectories. These measurements indicate the origin of dust particles transported by air masses, and provide evidence that aerosols are transported intercontinentally, as well as from industrialized regions to remote regions with few local emission sources such as the Arctic. As cadmium is transported in the atmosphere adhered to aerosol particles, these studies indicate that cadmium has a potential to be transported intercontinentally.

Cadmium has a direct link to global warming

Pinkham 93 (Sandra, Doctor @ Columbus, http://www.bodycenteredtherapies.com/pinkhammedical/documents/Scan\_2a.pdf, accessed 6-26, JG)

According to ''the precautionary principle,'' it is better to accept as true what cannot be perfectly proved, even though it might be wrong, if doing so can lead to actions which will protect our ecosystem. This paper uses this guideline to assess the effects of cadmium exposure and its toxicity. This highly toxic metal is apparently used by the cell in the stress response to get rid of damaged, virus-infected, and cancerous cells. Indiscriminant exposure to global cadmium air pollution alters the cellular content of free cadmium ions and the minerals that antagonize its effects, affecting the response of cells, organs, and individuals to all other stimuli. Cadmium's effects at low dose are thus influenced by many factors, not just dose. These factors include age, gender, species, genetic factors, prior nutritional history and exposure to cadmium and other stressors, and current nutritional history and exposure to other stressors. Other toxic metals, organic compounds, biological pathogens and emotional stresses interact with cadmium to produce effects. Stress effects at a cellular level appear linked with current global problems affecting the environment, such as global warming, and human health effects, like the increase in disabling fatigue and infectious disease.

Warming causes extinction

Henderson 6 (Bill, Environmental Scientist, 8-19-06, http://www.countercurrents.org/cc-henderson190806.htm, accessed 6-25-11, JG)

The scientific debate about human induced global warming is over but policy makers - let alone the happily shopping general public - still seem to not understand the scope of the impending tragedy. Global warming isn't just warmer temperatures, heat waves, melting ice and threatened polar bears. Scientific understanding increasingly points to runaway global warming leading to human extinction. If impossibly Draconian security measures are not immediately put in place to keep further emissions of greenhouse gases out of the atmosphere we are looking at the death of billions, the end of civilization as we know it and in all probability the end of man's several million year old existence, along with the extinction of most flora and fauna beloved to man in the world we share.

Uniq – Cuts Now

Congress cuts are coming – republicans want spending cuts and hate solar power

Kelly 11 (Erin, Republic Washington Bureau, 6-26, http://www.azcentral.com/business/articles/2011/06/26/20110626solar-power-congress-funding-cuts.html, accessed 6-26, JG)

WASHINGTON - Congress is threatening to turn off power to the solar-energy industry, sending companies scrambling to save federal programs that have helped finance the creation of a massive solar plant in Gila Bend and other projects throughout the nation. A conservative House bent on slashing federal spending and philosophically opposed to subsidizing solar power and clean energy is trying to reduce or eliminate federal programs that offer grants and loans to the solar industry. And the potential for a national clean-energy standard, advocated by President Barack Obama, that could boost the use of solar power also is fading in a Congress that takes a dim view of government mandates about what kind of energy Americans should use. On the endangered list is a U.S. Treasury grant program, set to expire in December, that solar companies say has kept them alive through the economic downturn. Also threatened: an Energy Department loan-guarantee program that provided a $1.45billion guarantee for the Solana project in Gila Bend, which will be one of the world's largest solar plants, and a conditional guarantee of nearly $1 billion to build the Agua Caliente power plant in Yuma County, which has solar panels made from Tempe-based First Solar Inc. Part of that loan program is slated to end Oct. 1. If Congress does not renew the programs, all of the recent progress made by the solar industry could be derailed. The industry grew 67 percent last year - faster than any other U.S. industry - and employs about 100,000 people nationwide, according to the Solar Energy Industries Association, a national trade group with about 1,000 solar companies as members.

Deep cuts happened already – more to come

Schow 11 (Ashe, Heritage Action, 6-15, http://heritageaction.com/2011/06/2012-energy-and-water-appropriations-bill-approved/, accessed 6-26, JG)

Earlier today, the House Appropriations Committee approved the 2012 Energy and Water appropriations bill, which will be voted on in the full House of Representatives after the July 4th recess. This is the fifth of 12 spending bills approved by the committee. The bill, which totals $30.6 billion, actually cuts $1 billion compared to current spending levels and is $5.9 billion below what President Obama’s budget proposed. It contains a 42% cut to President Obama’s clean energy priorities like fuel-efficient vehicles, research and solar energy. Committee Chairman Hal Rogers (R-KY) boasted that bill shows that conservatives in Congress are committed to: “Restoring restraint and responsibility to the appropriations process in a time when we cannot spend as we used to.”

GOP cutting millions in solar energy

Nouvea 11 (Trent, Staff Writer, 6-3, http://www.tgdaily.com/business-and-law-features/56382-gop-slashes-clean-energy-funding, accessed 6-26, JG)

To be sure, the above-mentioned legislation - which the Appropriations Energy and Water panel moved to full committee on Thursday - cuts $97 million in solar energy funding, fuel-efficient vehicle technologies by $46 million and vehicle technology deployment by $200 million.  Although Obama's Office of Management and Budget said it does not have a position on the controversial bill at this stage, Democrats harshly criticized the cuts. "Renewable energy programs in this bill are drastically reduced. We can debate whether renewable energy is an environmental program, and whether it is a market problem," stated Rep. Ed Pastor (D-Ariz). "In either case, it is a national security problem." But Energy and Water subcommittee Chairman Rodney Frelinghuysen (R-N.J.) defended the reduction in funds.  "The highest priorities are protected by supporting the Department of Energy's national defense programs, and by preserving activities that directly support American competitiveness, such as water infrastructure and basic science research.

Uniq – Chinese Cuts

China cutting rare materials exporting – solar energy production stops

Cohen 10 (Bonner, Heartland Institute, 12-22, http://www.heartland.org/environmentandclimate-news.org/article/29058/China\_Cuts\_Back\_on\_Rare\_Earth\_Exports\_Jeopardizing\_Wind\_and\_Solar\_Power.html, accessed 6-26, JG)

China is substantially cutting back its rare-earth export quotas to Western nations, a move that will drive up prices and further reduce the feasibility of renewable energy production in the United States.  Long known to geologists for their unique properties, rare earths, unevenly deposited around the world, have become essential to today’s high-tech industries. The minerals are a group of 17 metals vital to the production of certain high-technology electronics that have become indispensable to the renewable-energy industry, where they are used to make wind turbines and solar panels. China Flexes Its Muscles In slowing down its exports of rare earths, China is both flexing its economic muscles to the rest of the world and ensuring its own booming economy retains an adequate supply of the precious metals. China currently produces 97 percent of the world’s rare earths, even though the country has only 37 percent of known global reserves of the metals.

Chinese solar company cuts now – revenues lacking

CSIS 8 (Chinese Stock Information, 10-31, http://www.chinesestock.org/show.aspx?id=25386&cid=11, accessed 6-26, JG)

China's solar power firms are facing cuts of around 25-26 pct in average selling prices next year as a result of contract renegotiations and the depreciation of the euro against the dollar, Credit Suisse said.  "While solar firms have not yet revised down 2009 output guidance, the pace of new contract additions has slowed and we believe contract renegotiations are likely across the whole industry chain," it said. The bulk of China's solar power companies are listed in the US but most of their sales in Europe, making them vulnerable to currency revaluations.  New York-listed Suntech, China's biggest photovoltaic panel producer, has more direct exposure to the European market, insulating it from the fall in the euro.

Link – Demand

Solar industries will respond to demand for energy

Flux Energy 11 (Flux Energy, Solar Industry, 06-08, http://sundial365.com/pdfs/EnvironmentalMyths\_final.pdf, accessed 6-26-11, JG)

These minerals are so rare that the yield per truckload of ore is very small, implying that many truckloads are required to feed the global need for these elements. As more and more solar installation operators elect to center their production on thin-layer PV elements, the industry will respond. As with many rare elements, when demand goes up, price goes up.

Demand increases solar production

SB 11 (Sustainable Business , 6-23, http://www.sustainablebusiness.com/index.cfm/go/news.display/id/22589, accessed 6-26, JG)

"With analysts predicting the U.S. to become the world's largest solar market within the next few years, manufacturers are increasingly looking to the U.S. to site their facilities," says Tom Kimbis, SEIA Vice-President of Strategy and External Affairs. "They are finding significant value in manufacturing close to their expected source of demand. This strong demand continues to make solar one of the fastest growing industries in the United States and a source of thousands of solar jobs from manufacturing and installation to engineering and sales."

Impact – Disease

Cadmium can spread its toxins globally

UN 8 (United Nations Environment Program, http://www.chem.unep.ch/pb\_and\_cd/SR/Files/2008/UNEP\_Cadmium\_review\_Interim-APPENDIX-MAR2008.pdf, accessed 6-26, JG)

These measurements indicate the origin of dust particles transported by air masses, and provide evidence that aerosols are transported intercontinentally, as well as from industrialized regions to remote regions with few local emission sources such as the Arctic. As cadmium is transported in the atmosphere adhered to aerosol particles, these studies indicate that cadmium has a potential to be transported intercontinentally.

Cadmium can cause infectious diseases

Pinkham 93 (Sandra, Doctor @ Columbus, http://www.bodycenteredtherapies.com/pinkhammedical/documents/Scan\_2a.pdf, accessed 6-26, JG)

Cadmium has complicated interactions with other metal ions and chemicals. Additions of metal ions, like lead and aluminum, and organic chemicals, like ethanol, can increase cadmium absorption and lead to cadmium toxic effects. There is suggestive evidence that cadmium contributes to global warming, forest decline, increased virulence of infectious diseases, and a

Cadmium is empirically linked to diseases – it makes chances of infection one-hundred percent likely if spread globally

Pinkham 93 (Sandra, Doctor @ Columbus, http://www.bodycenteredtherapies.com/pinkhammedical/documents/Scan\_2a.pdf, accessed 6-26, JG)

With the HIV epidemic arriving in the time period of falling lead pollution and rising cadmium pollution, it would be most helpful to know whether cadmium played a role in the progression of HIV to AIDS. There is a body of circumstantial evidence that suggests this to be true, in that many of the substances that block cadmium toxic effects, or enhance its excretion, also block the replication of HIV (Stewart- Pin kha m, ] 991 b). Although no studies have been conducted to test this hypothesis directly in a laboratory setting, studies have been done on Herpes simplex virus, a chronic virus that is activated in a variety of stressful circumstances. Cadmium is the only metal that activates Herpes simplex from a latent state (Pawl 1993). Continued administration of cadmium increases the yield of infectious virus by 10 to 100 fold, an effect unmatched by any other activator studied. It also prolongs the recovery of infectious virus from 6 to II days. Zinc, nickel and manganese, on the other hand, block the cadmium - induced infectious virus. Likewise, lithium blocks Herpes activation.

Uncontrolled disease causes extinction

Steinbrunner 97 (John, Senior Fellow at Brookings, “Biological Weapons: A Plague Upon all Houses”, JSTOR, accessed 6-22-11, JG)

The use of a pathogen, by contrast, is an extended process whose scope and timing cannot be precisely controlled. For most potential biological agents, the predominant drawback is that they would not act swiftly or decisively enough to be an effective weapon. But for a few pathogens - ones most likely to have a decisive effect and therefore the ones most likely to be contemplated for deliberately hostile use - the risk runs in the other direction. A lethal pathogen that could efficiently spread from one victim to another would be capable of initiating an intensifying cascade of disease that might ultimately threaten the entire world population. The 1918 influenza epidemic demonstrated the potential for a global contagion of this sort but not necessarily its outer limit.

Cadmium Bad

Majority of solar cells are made of toxic cadmium

GGR 10 (Go Green Resources, 2-8, http://www.gogreenresources.org/tag/solar-cells, accessed 6-26, JG)

Even though solar power systems boast of a prolonged life, the issue of getting rid of the parts implemented to acquire and store the power has not already been addressed. The majority of solar cells are partially composed of cadmium, a hugely poisonous substance. The later removal of this toxic material may result in a severe environmental hazard if dealt with ineptly. Sufficient access to sunlight for a decent portion of a typical day is another factor to weigh.

Cadmium is toxic – airborne and water pollution

Hope 4 (L. California Energy Commission, http://www.energy.ca.gov/reports/500-04-053.PDF, accessed 6-26, JG)

Cadmium is potentially of concern with the thin-film technologies. Cadmium compounds are used in CdTe, CIS, and CIGS (copper indium gallium selenide) cells, although in very small quantities in the latter two types of cells. (Cadmium compounds are not used by amorphous silicon and crystalline silicon cells or GaAs cells.) CIS and CIGS cells can be made with or without a top CdS layer. Use of cadmium can generate cadmium-containing wastewater, and possibly cadmium fumes and dusts. Tests using standard leaching protocols show that cadmium could be leached out of crushed CdTe modules, although these tests overestimate leaching from intact cells. Recent tests on CdTe and CIS modules show that Cd concentrations were below the TCLP limit.

\*\*\*Solar Pollution Aff \*\*\*

Uniq – No Cuts (1/2)

Despite cuts the Department of Energy and Businesses are investing in solar energy

BNEF 11 (Bloomberg New Energy Finance, 6-22, http://www.climatespectator.com.au/commentary/give-and-take-us-clean-energy-feels-pinch, accessed 6-26, JG)

Aside from the budgetary concerns, last week also saw developments aimed at improving the financing conditions for renewable energy projects. First, the US Department of Energy issued more than $US2.2 billion loan guarantees to solar plants, clearly signalling that the Obama administration remains keen on building up the country's renewable power capacity. NextEra Energy Resources and the solar energy unit of Abengoa received conditional loan guarantee offers to develop solar-thermal projects of 250MW each, in Southern California, while Sempra Energy, California's third-largest utility, received a $US359.1 million guarantee to build a 150MW PV plant in Arizona.

Democrats will balance the solar cuts debate – suppresses GOP cuts

York 11 (Anthony, LA Times, 6-18, http://www.latimes.com/news/local/la-me-state-budget-20110617,0,1532584.story, accessed 6-26, JG)

Reporting from Blythe, Calif. -- Gov. Jerry Brown on Friday warned Republican lawmakers that if they failed to negotiate a budget compromise with Democrats, he would seek to go around them. That could include signing a budget that has only Democratic support, and having initiatives put before voters on the tax questions that have brought bipartisan talks to a standstill. He has been frustrated by the inability to win four Republican votes needed for the Legislature to put the tax issue on the ballot. "I may be in initiative circulation … in the next few months," he said, after attending a groundbreaking ceremony for what is scheduled to be the largest solar-energy project in the world. "I'm going to solve the problem. I'd like to solve it in a week or two, but if I can't … I can take actions of many kinds, including going to the people themselves through the direct initiative process." Under that scenario, Brown said, lawmakers would have to make deeper cuts to schools and other state programs until voters have a chance to vote on higher taxes. "It's more time consuming, more devastating to our schools and more expensive, but I am going to stop at nothing to get this budget done in a sustainable, balanced way," he said. Brown also implied that he could work for an even larger Democratic legislative majority in the 2012 elections that could relegate GOP lawmakers to virtual obscurity. He accused Republicans of "undermining the state and thumbing their nose at the people and their democratic rights.

**Even if there are cuts there is bipartisan support for a new solar panel bill**

McGowan 11 (Elizabeth, 6-8, http://www.reuters.com/article/2011/06/08/idUS41670750020110608, accessed 6-26, JG)

Sen. John Boozman, a Republican with little 'green' cred, has become an unexpected ally for efforts to spark installation of rooftop solar power systems WASHINGTON—With members of Congress up to their armpits in acrimony on Capitol Hill, Sen. Bernie Sanders figures bipartisanship isn't enough to advance ideas anymore. So he is trying a broadened approach to lift legislators out of that muddled morass: tripartisanship. The adept Vermont independent has lured New Mexico Democratic Sen. Jeff Bingaman and Arkansas Republican Sen. John Boozman into co-sponsoring his reinvented measure aimed at sparking installation of solar power systems atop 10 million homes and businesses within the next decade. Sanders expects his "10 Million Solar Roofs Act of 2011" (S. 1108) to have its first public airing this month at a Senate Energy and Natural Resources Committee hearing, a panel Bingaman chairs.

Uniq – No Cuts (2/2)

Military Solar Energy not being cut

Davenport 11 (Coral, National Journal, 5-31, http://www.nextgov.com/nextgov/ng\_20110531\_6856.php?oref=topstory, accessed 6-26, JG)

So the Pentagon has launched an aggressive program to change all that, with a slew of ambitious plans to convert the oil-hungry U.S. military to alternative-energy sources--and, at the same time, spur creation of a commercial industry capable of producing enough renewable energy at affordable prices for civilians. The hope is that demand from a massive consumer like the armed forces could affect supply--scaling up energy production, driving down cost, and leading to technological breakthroughs for biofuels, solar panels, hybrid vehicles, and similar products. That would reduce the need for oil throughout the U.S. economy and spare the armed forces from future missions in war-torn, oil-exporting states. It's not the military's job to fight climate change, but many senior Defense officials contend that there is a clear national-security reason to do so, because government studies show that the fossil-fuel emissions behind global warming will induce food shortages, drought, and rising sea levels--inviting a world of political volatility.

Obama just increased solar incentives

CalFinder 11 (Solar Power Contractors, http://solar.calfinder.com/blog/news/obama-cuts-solar-costs-new-funding/, accessed 6-26-11, JG)

President Obama is on a mission to make solar cost-competitive with coal, and today the Department of Energy Secretary Steven Chu announced another milestone in that objective: $27 million in new funding for the solar SunShot Initiative. The program is designed to cut the fees you pay upfront to go solar, which account for almost half the costs of most residential installations. Essentially, Obama aims to streamline the expensive and cumbersome hurdles in your way, including permitting processes, zoning laws and regulations, interconnection, net metering standards, and access to financing.

Uniq – No Chinese Cuts

No cuts – large scale solar production by 2015

CMA 11 (China Mining Association, 6-9, http://www.chinamining.org/News/2011-06-09/1307586323d46441.html, accessed 6-26, JG)

At a solar energy research center in Shanghai, nearly 6,000 solar panels line the walls and rooftop. They generate 1 million kilowatt-hours of electricity each year, just enough to supply to over 300 families. As wind and hydro-electricity are more widely used now, turning to renewable energy may be the demand to the inconsistent supply. Professor Cai Xu, vice director of the State Energy Smart Grid R&D Center of China (Shanghai) Administrative said: "China has a huge land area. Hydro-electricity resources are concentrated in the West where a lot of wind energy resources are in the North. But the Central and Southern areas are where the most demand for electricity is."

And researchers said as the cost of solar power is falling, they are optimistic that this clean energy can be used more widely to ease China's power shortage by 2015. Dr. Hao Guoqiang, vice president of the Shanghai Solar Energy Energy Research Center said: "The drop in the cost of solar energy is about 10 per cent to 20 per cent each year. This is to say in 2015 the cost of supplying solar electricity is basically about the same as our electricity fees right now. That will be an era whereby solar energy is used on a large scale. "

Japan’s nuclear accident refueled the Chinese solar industry

Bayani 11 (Oliver, Staff Writer, 5-31, http://www.ecoseed.org/business/renewable-energy/article/95-renewable-energy/10026-china-most-attractive-for-renewable-energy-projects-besting-u-s-once-again-%E2%80%93-ernst-young, accessed 6-26, JG)

With regard to solar, the United States was on top of the rankings while China trailed behind India at third place. Its market grew 67 percent from $3.6 billion in 2009 to $6 billion in 2010. The growth was primarily driven by loan guarantees provided by Department of Energy, supporting solar panel makers with $1.13 billion and solar generation projects with $6.95 billion worth of loans. The second largest of these loan guarantees was $2.1 billion awarded to Solar Trust of America in March for a 484-megawatt solar thermal plant in Blythe, California. Of the seven solar generation loan guarantees the department has given, 4 of them were solar thermal projects.

Meanwhile, the March 11 tsunami that triggered a nuclear disaster in Japan has drove renewable energy interest in China, particularly solar power in the past quarter, according to the report. The National Development and Reform Commission, the country’s main development agency, called for an increase in China’s solar capacity target from 20 GW to 50 GW by 2020 this month. “There is pressure on China to develop its own solar market and reduce reliance on the export of components, amid concerns that cuts to European feed in tariff schemes and a growing supply chain in the United States could lead to an oversupply of panels,” the report noted. China seems to be focusing more in concentrating solar thermal in a bid to diversify its energy mix.

African buyers – ensure no cuts

AP News 11 (Associated Press, 3-4, http://m.news24.com/fin24/Economy/Africa/China-solar-producers-woo-African-business-20110303, accessed 6-26, JG)

Johannesburg - In a show of commercial muscle that highlights China's growing investment in Africa, Chinese solar power producers dominated exhibits on Thursday at an energy conference on a continent where nearly two-thirds of the population lives off the electric grid. "Wow! It's like an invasion!" exclaimed a South African exhibitor at the African Energy Indaba, where 60 of 80 stands were Chinese vendors, according to event organisers. Chinese producers are working hard to maximise their impact among African clients. Those could include governments that want to power health centres and schools in remote areas, rural farmers who want electricity for water pumps and cellphones. They also could include villagers who walk long distances to find wood for cooking, and middle-class families fed up with soaring power prices and urban power cuts. Only Chinese producers offered solar powered technology at the conference ending on Thursday in Johannesburg.

Link Answer – Plan Irrelevant

The plan isn’t perceived as solar energy increase

Wasson 11 (Erik, The Hill, 6-2, http://thehill.com/blogs/on-the-money/appropriations/164409-dems-clamor-for-more-stimulus-get-shot-down, accessed 6-26, JG)

Most of the cuts come from the Department of Energy and renewable projects. Solar energy, fuel efficient vehicle funding, energy efficiency research, weatherization and biomass research and development are together set at $1.9 billion below Obama’s request. The Obama administration has made clean energy a signature issue for “winning the future.” Rogers told The Hill that renewable energy needs to rely on the marketplace for growth. “If renewables are to grow it is because there will be a profit incentive, not because the government spends money,” Rogers said Dicks said he does not yet know if Democrats will offer amendments to the bill in full committee, whereas Fattah said he is looking at amendments related to community grants for energy efficiency and weatherization.

**Link Answer– Inevitable**

Link will be inevitably triggered – solar energy will eventually be in high demand

Lior 1 (Noam, Energy @ Philadelphia Uni., http://www.seas.upenn.edu/~lior/lior%20papers/Power%20from%20Space.pdf, accessed 6-26. JG)

Power can be produced in space for terrestrial use by a using a number of energy sources, including solar, nuclear, and chemical. On the one hand, in view of the rising demand for energy, the diminishing fuel and available terrestrial area for power plant siting, and the alarmingly increasing environmental effects of power generation. The use of space for power generation seems to be inevitable: (1) it allows highest energy conversion efficiency, provides the best heat sink, allows maximal source use if solar energy is the source, and relieves the Earth from the penalties of power generation, and (2) it is technologically feasible, and both the costs of launching payloads into space and those of energy transmission are declining because of other uses for space transportation, dominantly communications.

Impact – Oil Reserves

Without the plan the U.S. will have to tap into their strategic oil reserves

Boyd 11 (James, CEO Tierra Verde Solar Inc., 6-7, http://www.renewableenergyworld.com/rea/news/article/2011/06/can-solar-survive-without-incentives, accessed 6-26, JG)

In closing, let’s look at the worst case scenario. Let’s assume our decision makers kill incentives at the federal level as part of their budget cutting efforts. They also cut other programs that support budgets in each of the fifty states. Since the states, who are today in a financial crisis, cannot afford more federal spending cuts, local solar energy incentives may need to be cut to avoid severe cuts in essential services. Now let’s assume the solar industry eventually withers and dies (like renewables did after it’s false start in the 1970’s) and Middle Eastern oil stops flowing. Assuming domestic oil production won’t have time to offset our demand for foreign oil, we must then either tap our strategic oil reserves, risking our ability to defend ourselves or ration energy nationwide. I truly believe — and again this in my personal opinion — that we shouldn’t be choosing between oil production and renewables. What we should be focusing on is energy, regardless of the source. Put another way, our energy independence will only come from aggressive support for all types of domestic energy, so rather than cutting incentives to any sector of the energy industry, we should be spending more.

Tapping strategic oil reserves causes worldwide panic – buoys prices to all time high

Levi 11 (Michael, Council on Foreign Relations, 3-4, http://blogs.cfr.org/levi/2011/03/04/its-too-early-to-use-the-strategic-petroleum-reserve/, accessed 6-26, JG)

Indeed policymakers should be concerned that it would do precisely the opposite. Tapping the reserves right now could validate fears in the market – after all, it would signal that the United States government was worried. That could simply induce more precautionary buying, thus buoying prices, rather than depressing them. Such an outcome would be doubly dangerous, since, since it would undermine the psychological value of the reserves.

Worldwide panic and buoyed prices ignite resource wars

Gleason Report 10 (Investing Company, April, http://www.gleasonreport.com/documents/The%20Real%20Gold%20Standard.pdf, accessed 6-26, JG)

That price level implies gold will be $1500 (10x) to $2400 (16x) and possibly higher by 2015. The market is not psychologically ready for a higher multiple but it could happen during war or political upheaval. High oil prices will incite resource wars. The Iraq/Afghan wars are about energy. War with Iran is likely. Iran has 9% of the world’s remaining oil reserves and borders the coveted Caspian Sea reserves. The West wants Iran’s oil on the market and Europe wants pipeline alternatives to those owned by Russia. This is an economic survival issue for the western economies. The American economy and dollar dominance depend on affordable oil. The political stakes are high and the forward risks are ominous.

Resource Wars cause extinction

Wooldridge 9 (Frosty Wooldridge, Free lance writer @ Cornell University, 2009, http://www.australia.to/index.php?option=com\_content&view=article&id=10042:humanity-galloping-toward-its-greatest-crisis-in-the-21st-century&catid=125:frosty-wooldridge&Itemid=244, accessed 6-26-11, JG)

Without transitioning away from use of fossil fuels, humanity will move further into an era of resource wars (remember, Africom has been added to the Pentagon’s structure -- and China has noticed), clearly with intent to protect US “interests” in petroleum reserves. The consequences of more resource wars, many likely triggered over water supplies stressed by climate disruption, are likely to include increased unrest in poor nations, a proliferation of weapons of mass destruction, widening inequity within and between nations, and in the worst (and not unlikely) case, a nuclear war ending civilization.

Impact – Warming

Solar energy does not lead to global warming – it stops it

Chow 11 (Darren, Environmental Activist, 6-20, http://www.contour2002.org/article/help-stop-global-warming-with-a-solar-power-system, accessed 6-25, JG)

But if you are seeking to be more active in this endeavor you can take a step farther and install a solar power system in your home. It runs the electricity in a more efficient and eco-friendly way. Sounds impossible? Even if you think that this is not doable, I know that it has caught your attention. Read the rest of the article and become familiar with this technology. The thing is that the environment-friendly feature is not the only striking benefit that solar panels can promise you and your family. It is also developed to help people like you save a lot of money. A simple solar panel has the ability to harness the energy of the sun so that it can be used to power certain machines. In this sense, the sun's energy can create electricity when you have developed a consolidated solar power system. Science recognizes this technology, but you will not find a lot of solar panels out in the market. While some people are doubtful against its effectiveness, companies do produce them because of reduced returns. A technology as good as this must not kept from the public, especially when it can help alleviate the global warming phenomenon. With this, I advice you to consult a useful manual that can help you create a solar power system in your home.

Warming causes extinction

Henderson 6 (Bill, Environmental Scientist, 8-19-06, http://www.countercurrents.org/cc-henderson190806.htm, accessed 6-25-11, JG)

The scientific debate about human induced global warming is over but policy makers - let alone the happily shopping general public - still seem to not understand the scope of the impending tragedy. Global warming isn't just warmer temperatures, heat waves, melting ice and threatened polar bears. Scientific understanding increasingly points to runaway global warming leading to human extinction. If impossibly Draconian security measures are not immediately put in place to keep further emissions of greenhouse gases out of the atmosphere we are looking at the death of billions, the end of civilization as we know it and in all probability the end of man's several million year old existence, along with the extinction of most flora and fauna beloved to man in the world we share.

AT – Cadmium

Cadmium isn’t key to solar energy – rarely used at all

Solar Power 10 (Solar Industry Website, 12-29, http://www.solarpower.org/News/800316207-chinas-export-cuts-of-rare-earths-should-have-minimal-short-term-effects-on-solar.aspx, accessed 6-26, JG)

Recently, China's commerce ministry announced that it would cut its exports of rare earth metals in the early months of next year as the country moves to increase its domestic stockpiles of the metals,used in the production of many consumer products, including automobiles and electronics. However, while the export cut rattled the nerves of executives in many industries that rely on rare earths, the solar power industry is not as concerned. While some reports claim that rare earths are vital to the production of solar panels, they are actually not, according to the Solar Home & Business Journal. In fact, solar panels are mostly constructed using crystalline silicon, one of the most widely available substances on the planet. Currently, the U.S. produces myriad amounts of crystalline silicon, and many new factories are being built to process it. Moreover, thin-film solar panels are not made with rare earths, but with tellurium, indium and gallium - substances the U.S. does not rely on China to produce. Even so, the U.S. is increasing its production capacity of certain elements as it moves to wean itself from its dependence on Chinese exports. Some mines in the U.S. - including one in Colorado - are expanding manufacturing capacity to meet the demands of solar panel producers. For now, however, "the basic availability" of the metals "appears more than adequate," the U.S. Department of Energy asserts.

Cadmium doesn’t spread globally – their author concedes

UN 8 (United Nations Environment Program, http://www.chem.unep.ch/pb\_and\_cd/SR/Files/2008/UNEP\_Cadmium\_review\_Interim-APPENDIX-MAR2008.pdf, accessed 6-26, JG)

Specific evidence of cadmium intercontinental transport is very scarce. Due to the relatively short residence time of cadmium in the atmosphere (days or weeks), the airborne dispersion of cadmium has a pronounced local or regional character. However, data from ice core measurements in Greenland indicate that cadmium can be transported over distances of up to thousands of kilometres. Analysis of cadmium in aerosols in a few regions also illustrates long-range transport. Some small portion of anthropogenic cadmium from North America has been noted in the Russian Arctic. Further, aerosol measurements in Taiwan show that a portion of airborne cadmium can be transported over a thousand kilometres from developing areas of China

\*\*\*Solar Inflation DA\*\*\*

Solar Inflation 1NC (1/3)

Solar cells for space development increase demand and prices

Brito 2k (Dagobert, Rice Univ., 11-2k, http://bakerinstitute.org/publications/faculty\_brito1.pdf, accessed 6-25-11, JG)

The cost of solar cells has roughly been dropping by a factor of 2 every 5 years. This has occurred in the environment where support for photovoltaic research has not been very aggressive and demand has been limited. Federal funding of photovoltaic research has been on the order of 60 million dollars a year. This signiﬁcantly less than what has been spent on to a more exotic forms of power is such as fusion. The cost of photovoltaic power has been above $3 per peak watt so demand for solar cells has been limited to remote applications and other exotic uses. Figure 8 below is a schedule that gives the potential demand for photovoltaic electricity. It is not a demand curve in the traditional sense, but rather is a schedule of the demand for electricity in various applications and various prices based on Table 4 in Ogden and Williams. A pictorial representation of this table is very illustrative At very high prices the market is for exotic uses such as space satellites, buoys, corrosion protection.

Huge demand for solar cell production inflates prices of rare toxic materials – makes them unavailable

Flux Energy 11 (Flux Energy, Solar Industry, 06-08, http://sundial365.com/pdfs/EnvironmentalMyths\_final.pdf, accessed 6-25-11, JG)

Operators of solar installations are currently under fire to find ways to reverse the negative environmental impact their systems deliver. One issue of great concern is the production of PV panels utilizing the newer thin-film technology. Thinfilm technology reduces the amount of material required in creating a solar cell. Thus, it is quickly becoming a preferred manufacturing process due to cost, flexibility, lighter weight and ease of integration compared to wafer silicon cells. The thin-layer production of panels, however, involves the mining of rare earth minerals such as cadmium and selenium. These minerals are so rare that the yield per truckload of ore is very small, implying that many truckloads are required to feed the global need for these elements. As more and more solar installation operators elect to center their production on thin-layer PV elements, the industry will respond. As with many rare elements, when demand goes up, price goes up. These minerals also possess a level of toxicity that can be dangerous to the environment as well as to humans. They are considered hazardous materials. Assuming a 30- to 40-year life for most PV panels, there are grave concerns over the proper disposal of thin-film panels to keep these minerals from leaking into waste and water streams. Additionally, the mining processes for these elements are very invasive and pollutive. China is the primary global producer due to the lower standards for invasive mining. The mining of cadmium and other toxic elements is allowed in the U.S. as a by-product of other mining efforts such as the extraction of zinc. However, following in the standards set by the European Union to ban the use of some of these elements from all products, regulations and cleanup mandates continue to limit the production of cadmium and other minerals in the U.S. The manufacturers of solar panels and other energy industry lobbyists continue to push for more relaxed regulations. While the production and disposal of thin-film PV panels is certainly one issue attracting a lot of environmentalist opposition in the industry, there are many others.

Solar Inflation 1NC (2/3)

No access to scarce earth materials stop worldwide solar panel production

FOE 10 (Friends of Earth, Environmental Organ., http://www.foe.org/sites/default/files/Nanotechnology-climate-and-energy.pdf, accessed 6-25-11, JG)

Nanomaterials used in nano solar, including silver, cadmium and other heavy metals, pose toxicity risks for human health and the environment. End of life recovery of nanomaterials and recycling is uneconomic, requiring government intervention to prevent irresponsible disposal of panels and to recover rare metals and rare earths. The scarcity of metals such as indium and gallium may be a near term constraint to the widespread development of some thin film nano solar… Proponents of thin film nano solar argue that the sector has years of growth before it has to worry about running out of raw materials (Edwards 2010). However, scarcity analysts have warned that the growth of nano solar may be imminently curtailed due to its reliance on scarce minerals such as indium and gallium, and rare earths such as selenium and telluride. The reserves of both indium and gallium are disputed. However, German researchers suggest that we have less than ten years before we run out of indium (Cohen 2007). Dutch researchers argue that because thin film nano solar based on cadmium telluride and CIGS is reliant on scare minerals such as indium and gallium, these technologies will never be able to contribute more than 2 percent of global energy demand, due to resource constraints (Kleijn and van der Voet 2010). They caution that governments should require careful resource constraints assessment before further funding of these thin film technologies: “Large scale government funding for technologies that will remain marginal is not an efficient way to tackle the energy and climate crisis” (Kleijn and van der Voet 2010, section 4.2). The United Nations Environment Programme (UNEP) has warned that despite concern within the high tech sector over scarcity and high prices of minerals such as indium and gallium, only around one percent of these crucial high-tech metals are recycled, with the rest discarded and thrown away at the end of a product’s life (UNEP 2010a). UNEP commissioned a report that found that unless end-of-life recycling rates are increased dramatically, specialty and rare earth metals could become “essentially unavailable” for use in high tech products.

Solar panels key to stop global warming

Chow 11 (Darren, Environmental Activist, 6-20, http://www.contour2002.org/article/help-stop-global-warming-with-a-solar-power-system, accessed 6-25, JG)

But if you are seeking to be more active in this endeavor you can take a step farther and install a solar power system in your home. It runs the electricity in a more efficient and eco-friendly way. Sounds impossible? Even if you think that this is not doable, I know that it has caught your attention. Read the rest of the article and become familiar with this technology. The thing is that the environment-friendly feature is not the only striking benefit that solar panels can promise you and your family. It is also developed to help people like you save a lot of money. A simple solar panel has the ability to harness the energy of the sun so that it can be used to power certain machines. In this sense, the sun's energy can create electricity when you have developed a consolidated solar power system. Science recognizes this technology, but you will not find a lot of solar panels out in the market. While some people are doubtful against its effectiveness, companies do produce them because of reduced returns. A technology as good as this must not kept from the public, especially when it can help alleviate the global warming phenomenon. With this, I advice you to consult a useful manual that can help you create a solar power system in your home.

Solar Inflation 1NC (3/3)

Warming causes extinction

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The scientific debate about human induced global warming is over but policy makers - let alone the happily shopping general public - still seem to not understand the scope of the impending tragedy. Global warming isn't just warmer temperatures, heat waves, melting ice and threatened polar bears. Scientific understanding increasingly points to runaway global warming leading to human extinction. If impossibly Draconian security measures are not immediately put in place to keep further emissions of greenhouse gases out of the atmosphere we are looking at the death of billions, the end of civilization as we know it and in all probability the end of man's several million year old existence, along with the extinction of most flora and fauna beloved to man in the world we share.

Uniq – Sustainable Now

Decreasing solar prices ensure sustainability of solar power commerce

Stryi-Hipp 8 (Gerhard, Director @ German Solar Industry, 10-14, http://www.renewableenergyworld.com/rea/news/article/2008/10/industry-in-upheaval-plotting-the-future-for-pv-53851, accessed 6-25, JG)

The fundamental factors for the development of photovoltaic markets in many states are for the most part positive, considering the increasing dependence on energy imports, increasing energy costs, and climate change. At the same time, in the coming years photovoltaics will become economically attractive in more and more regions of the world without support programmes, particularly in those locations where high levels of solar radiation and high energy costs come together. Therefore, in the mid-term an increased demand for photovoltaics is to be expected, especially when prices decrease significantly.

Current solar cell production sustainable

Iles 94 (P.A., Applied Solar Energy Corporation, “Technology Challenges For Space Solar Cells”, pg. 1961, accessed 6-25-11, JG)

Current space cell production can accommodate most of the missions. The major exceptions are the high radiation orbits and these may be addressed by extensions of the III-V Cell technology for InP-based cells. Thin film cells must be adapted for space use, to realize their advantages of lighter weight, easier stowability and deployment, and lower costs. A business problem is maintaining a balanced Production base, to supply required quantities of Si cells, GaAs/Ge cells and cascade cells. Despite the advantages of higher efficiency cells, there will be continued demand for Si cells, with possible use of advanced Si cells in specific missions. The GaAs/Ge and cascade cells will coexist, and will be used in larger quantities.

Link – Solar Sails

Solar sails use a large demand of solar materials

Herbeck 2 (Lars, German Aerospace Center, June, http://www.dlr.de/fa/Portaldata/17/Resources/dokumente/publikationen/2002/06\_herbeck.pdf, accessed 6-24-11, JG)

The hardware of a Solar Sail is faced with tremendous challenges. High residual velocities can only be reached with this propulsion concept if the specific ratio of spacecraft weight and sail size (sail area density) is very small. In most proposed Solar Sail concepts [4], this results in the need for very large sail surfaces, which can easily reach the size of 100,000 m 2 , see Figure 1. The result is the requirement that the sail must be automatically deployable in orbit. A look at the required sail area density of 1 – 10 g/m 2 shows that this challenge is hard to meet with the sail material and stiffening structures that are commercially available today. Figure 2 shows the boom area density that can be attained by means of a diagonally-stiffened DLR / ESA Solar Sail concept. In an initial deployment experiment with a boom weight of approx. 14 g/m 2, specific densities of approx. 2.5 g/m 2 can be reached depending on the sail size and new boom concept.

Impact – Oil Reserves

The plan causes the U.S. to tap into their strategic oil reserves to compensate for the solar industry crashing

Boyd 11 (James, CEO Tierra Verde Solar Inc., 6-7, http://www.renewableenergyworld.com/rea/news/article/2011/06/can-solar-survive-without-incentives, accessed 6-26, JG)

In closing, let’s look at the worst case scenario. Let’s assume our decision makers kill incentives at the federal level as part of their budget cutting efforts. They also cut other programs that support budgets in each of the fifty states. Since the states, who are today in a financial crisis, cannot afford more federal spending cuts, local solar energy incentives may need to be cut to avoid severe cuts in essential services. Now let’s assume the solar industry eventually withers and dies (like renewables did after it’s false start in the 1970’s) and Middle Eastern oil stops flowing. Assuming domestic oil production won’t have time to offset our demand for foreign oil, we must then either tap our strategic oil reserves, risking our ability to defend ourselves or ration energy nationwide. I truly believe — and again this in my personal opinion — that we shouldn’t be choosing between oil production and renewables. What we should be focusing on is energy, regardless of the source. Put another way, our energy independence will only come from aggressive support for all types of domestic energy, so rather than cutting incentives to any sector of the energy industry, we should be spending more.

Tapping strategic oil reserves causes worldwide panic – buoys prices to all time high

Levi 11 (Michael, Council on Foreign Relations, 3-4, http://blogs.cfr.org/levi/2011/03/04/its-too-early-to-use-the-strategic-petroleum-reserve/, accessed 6-26, JG)

Indeed policymakers should be concerned that it would do precisely the opposite. Tapping the reserves right now could validate fears in the market – after all, it would signal that the United States government was worried. That could simply induce more precautionary buying, thus buoying prices, rather than depressing them. Such an outcome would be doubly dangerous, since, since it would undermine the psychological value of the reserves.

Worldwide panic and buoyed prices ignite resource wars

Gleason Report 10 (Investing Company, April, http://www.gleasonreport.com/documents/The%20Real%20Gold%20Standard.pdf, accessed 6-26, JG)

That price level implies gold will be $1500 (10x) to $2400 (16x) and possibly higher by 2015. The market is not psychologically ready for a higher multiple but it could happen during war or political upheaval. High oil prices will incite resource wars. The Iraq/Afghan wars are about energy. War with Iran is likely. Iran has 9% of the world’s remaining oil reserves and borders the coveted Caspian Sea reserves. The West wants Iran’s oil on the market and Europe wants pipeline alternatives to those owned by Russia. This is an economic survival issue for the western economies. The American economy and dollar dominance depend on affordable oil. The political stakes are high and the forward risks are ominous.

Resource Wars cause extinction

Wooldridge 9 (Frosty Wooldridge, Free lance writer @ Cornell University, 2009, http://www.australia.to/index.php?option=com\_content&view=article&id=10042:humanity-galloping-toward-its-greatest-crisis-in-the-21st-century&catid=125:frosty-wooldridge&Itemid=244, accessed 6-26-11, JG)

Without transitioning away from use of fossil fuels, humanity will move further into an era of resource wars (remember, Africom has been added to the Pentagon’s structure -- and China has noticed), clearly with intent to protect US “interests” in petroleum reserves. The consequences of more resource wars, many likely triggered over water supplies stressed by climate disruption, are likely to include increased unrest in poor nations, a proliferation of weapons of mass destruction, widening inequity within and between nations, and in the worst (and not unlikely) case, a nuclear war ending civilization.

\*\*\*Solar Inflation Aff\*\*\*

Uniq – Demand Now

Huge demand now and increasing prices – should trigger link

Mints 11 (Paula, Energy at Navigant Consulting, 2-9, http://www.renewableenergyworld.com/rea/news/article/2011/02/2011-all-the-makings-of-an-interesting-year, accessed 6-26, JG)

The PV industry, (the entire solar industry, really), is made up of talented, hungry people who believe in something, and 2000 through 2010 was a magic decade for solar. Industry demand moved from megawatts to gigawatts, surging rapidly in the second half of the decade to multi-gigawatt level. The photovoltaic industry’s compound annual growth rate from 2000 through the end of 2010 will be >50%, while the CAGR from 2005 through 2010 will be >61%. In 2010 over 2009, industry demand will grow >100%. It’s been a giddy ride filled with polysilicon shortages, surges in feed-in-tariff driven demand, technology achievements, increases in system sizes from kilowatts to multi-megawatts, shortages, over supplies, and an increase in announcements of the impossible to boggle a mind. Prices went up and then prices came down. Feed in tariff incentives stimulated significant market growth and then had to be reined-in as the bill came due. The important issues facing the PV industry in 2011 are not new, but as with demand over the past five years, they are accelerating. These issues are: increasing prices for polysilicon accompanied by constrained supplies of crystalline technology, rapidly decreasing FiT rates accompanied by downward pressure on prices and margins, and political obstacles (particularly in the US).

Production costs high now

CalFinder 11 (Solar Power Contractors, http://solar.calfinder.com/ask/why-are-solar-2, accessed 6-26-11, JG)

Yet solar cells are still expensive, and that has much to do with the production costs. Silicon is expensive to process from raw material to solar cell semiconductor. For that reason, streamlining the production process has become a top goal for solar industrialists, and while advancements have certainly been made, production costs remain high.

**Link Answer– Inevitable**

Link will be inevitably triggered – solar energy will eventually be in high demand

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\*\*\*MISCELLANEOUS\*\*\*

Xenon Propulsion Bad

The supply and desirability of xenon propellants are diminishing – alternative chemicals face daunting technical barriers and even greater cost.

Hillier 11 (Adam C., Second Lieutenant, USAF, Air Force Institute of Technology, March, p. 1-2, http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA540018&Location=U2&doc=GetTRDoc.pdf, JM)

Typically in a Hall-effect thruster, propellants are gaseous at room temperature because no heating or cooling is required before the fuel is converted to plasma inside the thruster. In addition, these propellants are often inert. This is advantageous as they do not interfere with the thruster itself. The optimal gaseous propellant for most applications has a high molecular weight in order to increase both thrust and electrical efficiency. This leaves a short list of propellant choices, usually resulting in one of the heavier noble gases like xenon. However, non-gaseous elements will typically ionize more readily than the noble gases. The ionization potential is a measure of how easily a species ionizes. Not limiting choices to the stereotypical noble gases results in a myriad of interesting propellant choices, many of which can outperform xenon in nearly every category. Iodine is a particularly interesting choice as a propellant since it is almost as heavy as xenon, the heaviest of the stable noble gases, and it is easier to ionize than xenon. Other alternatives to the noble gases are metals. When these metals are ionized and ejected from a Hall thruster, they sometimes return to the spacecraft. This can result in plating of important hardware. Iodine, a non-metal, does not introduce the plating problems present in a metal propellant fueled Hall thruster. However, iodine introduces an oxidation issue. Iodine, being more fairly electronegative, may oxidize certain materials. This can be more or less of a problem than plating, depending on the hardware of the spacecraft. Iodine can be vaporized using less power than most other propellants. 5 Several prospective propellants have significantly high melting points, which would need to be overcome before it can be flowed through a feed system and converted to plasma. The melting point of iodine is one of the lowest of the alternate propellant options. Finally, cost is another important factor. Xenon is a very expensive substance and is not produced in high quantity. As of 2001, roughly ten tons per year of xenon was produced [3]. This could not sustain terrestrial industry and future space systems. The future of space depends on a more readily available propellant and one that is not going to dominate costs. Iodine is much cheaper than its noble gas counterpart xenon. This is mainly because iodine is 25,000 times more abundant in the Earth’s crust [4]. Iodine is a good alternative, but using it has its own technical barriers. One major barrier is its state of matter at room temperature. Iodine, being a solid at room temperature, cannot be simply injected into the combustion chamber. The complexity in designing thrusters to use Iodine as a fuel acts as a barrier to this technology moving forward. The technology has been developed to adequately vaporize and pump solid propellants. However, integration is not fully tested to the point of confidently operating iodine propellant Hall thrusters while maintaining the proper storage temperature. This is an engineering issue for operating these thrusters. Although iodine may produce favorable theoretical results, the amount of power needed to sustain the gaseous iodine must be considered. Including this in the power to thrust calculations more accurately relates current systems with possible iodine replacements [4]. An additional technical barrier is that iodine is not ideal in terms of ionization. Other species have better ionization characteristics. Metals typically will be influenced 6 by a colliding electron to release an electron of their own and become positively charged ions. Because iodine is more commonly a negative ion, at least in the monatomic state, it is possible that an interaction with an electron could influence the diatomic iodine to disassociate and create a negative ion. This would hurt the performance and efficiency of the thruster as the electric field is meant to accelerate positive charges to produce thrust [4]. Since iodine injected thrusters are more difficult to build, operate, and maintain, the profiles of these thrusters is not yet well understood. The exhaust profile needs to be well characterized before an iodine fueled system can be flown in actual missions. More data must be collected to prove iodine as a viable option as a fuel. Unfortunately, there are complications to testing the iodine propellant. The iodine plasma is more difficult to measure as it is more likely to corrode intrusive measuring devices. Many intrusive probes would be preferable to get the best experimental data possible, but their degradation can skew results and ruin equipment. Other types of instrumentation must be used in order to adequately characterize the entire exhaust profile [4].

Ionic Propulsion Bad

Ionic propulsion poisons emitters, takes up too much space, and interferes with equipment.

Rotter 9 (John E., Lieutenant Commander, USN, Air Force Institute of Technology, March, p. 18, http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA496727&Location=U2&doc=GetTRDoc.pdf, JM)

Most hollow cathode designs for space propulsion in use today utilize a tungsten-based impregnated emitter which is highly susceptible to poisoning. Poisoning from water vapor or oxygen can seriously degrade the performance of these types of emitters. Another limiting factor for impregnated emitters is their lifetime, governed by the rate at which the impregnate evaporates. In a high-current application, the lifetime of an emitter is considerably shorter than in low-current applications. Both the SPT-100 and BHT-200 mentioned above utilize an external cathode for electron production. Since both of these thrusters are relatively compact, this generally poses no major integration issues. As Hall thrusters increase in size, however, the overall form factor of the thruster becomes increasingly important. Any real estate on a satellite bus utilized by a Hall thruster system cannot be used for other necessary subsystems such as thermal, power, or communications. The Hall thruster’s plume divergence is another 19 issue that must be carefully evaluated when a Hall thruster system is being integrated into a satellite. It is highly undesirable to have high energy particles from the thruster’s exhaust plume striking solar arrays, communications antennas, or the satellite bus itself. Thruster plume symmetry and divergence need to be evaluated as the scale of the thruster increases.

Water Coach Bad

Water propulsion is unstable – varies wildly

Hou et al 11 (Lingyun, PhD in propulsion theory, *IEEE Transactions on Plasma Science* 39, 1, January, JM)

There was serious instability observed in the previous experiments [12]. The phenomena include three aspects shown as follows. 1) The plume plasma presents obviously alternative variations of strong and weak visible light (shown in Fig. 1). There are almost no plumes in the eighth frame and fifteenth frame. The strongest plumes are shown in the fifth and twelfth frames. If the eighth frame and fifteenth frame represent the start and end of a period, it is found that there are about two periodic variations in 15 frame pictures. The period of plume variation is nearly 0.1 s. 2) Fig. 2 shows the strong fluctuation of arc voltage when the flow rate of water is 15 mg/s and the current is 8 A. The low-frequency fluctuation has the same period of 0.1 s as that for the plume, for example, the high amplitude noise of the signal occurs repeatedly in a second from 0.55 to 0.65 s. 3) It is also easy to quench the arc, and then, there is frequent arc-restarting or discharge between the places of nonelectrode in the vacuum chamber. This phenomenon is also caused by the pressure fluctuation of the supply pipe, which changes the flow rate of water frequently. The fluctuation maximum of voltage will exceed the power threshold of 100 V, and the program of generating the arc is started. If the condition is appropriate for starting the arc, the thruster continues to work. Otherwise, the arc restarting fails, and the discharge outside the thruster occurs. It can be solved through increasing the threshold to 150 V by adjusting the design point of power. However, it is difficult for water arcjet to remove the oscillation of plume and arc voltage. There are two possible reasons for the unstable plume and voltage. One is inappropriate working parameters. In general, arcjet has a stable range for working parameters. When argon is used as a propellant at the same specific power as water in the identical arcjet, a stable plume appears at the outlet [13]. Thus, the design of thruster seems reasonable. Another is the oscillation of liquid propellant flow rate. There is no low-frequency fluctuation for gas propellant in the arcjet. However, in instability research for a liquid rocket, it is found that the low-frequency vibration results from the oscillation of propellant supply system [14]. In the previous design of water arcjet thruster, the vaporization is realized by the heat absorbed from the radiation of anode in the steel pipe, which twists outside the high-temperature region of anode. It is shown in Fig. 3 that the twisted steel pipe forms a coil. There is a small gap between the anode and the water tube coil. The phase change is unstable because of the uneven heating, which results in the variation of water vapor’s flow rate at the exit of steel pipe.

Water Coach Bad

Water propulsion fails – vaporization difficulties

Morren et al 87 (W. Earl, Scientist @ Lewis Research Center, “Preliminary Performance Characterizations of an Engineering Model Multipropellant Resistojet for Space Station Application,” June 29, http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19870014388\_1987014388.pdf, JM)

The use of water as a propellant for the engineering model resistojet poses problems not encountered with the other propellants tested. Water is most conveniently stored as a liquid and requires significant input of energy to vaporize. This raises questions about the best manner in which to vaporize the liquid so that it may be superheated and expelled through the nozzle. One could envision two systems: the first of these employs a separate water vapor­izer upstream of the thruster with the thruster serving only to superheat the steam (ref. 13); the second would combine the vaporizing and superheating func­tions into a single unit (ref. 16). Since the engineering model thruster was originally envisioned to operate on steam in combination with a separate steam generator, it was never optimized to perform as a water vaporizer. However, it was decided during the performance testing program to make minor modifica­tions to the engineering model to facilitate operation as a liquid water-fed thruster. The decoupled system (i.e., the system employing the separate boiler) appeared to operate in a manner very similar to the seven gaseous propellant systems discussed earlier, since the fluid entering the heat exchanger was already a vapor and required only superheating. Since the range of operating capabilities of the boiler was limited, only one propellant inlet pressure setting was tested (0.21 MPa), although four total power levels ranging from 780 to 1160 W were examined. The decoupled system demonstrated a maximum spe­cific impulse of 184/sec at a thrust level of 230 mN while consuming 466 W in the water vaporizer and 692 W 1n the thruster. The heater temperature near the nozzle under these conditions was measured to be about 1140 °C. The coupled system required the thruster to act as a boiler and super­heater. Therefore the thruster operated at high temperatures to perform the superheating, causing a large temperature difference between the incoming liquid and the heat exchanger walls. This was an undesirable condition accord­ing to traditional boiler design practice, which calls for a thin layer of liquid in contact with the heat exchanger wall. Such a condition would require a liquid-to-wall temperature difference on the order of 50 °C. However, the room-temperature liquid fed directly into the thruster encountered wall temper­atures as high as 700 °C, which would cause the Incoming liquid stream to flash to a mixture of superheated vapor and liquid droplets. The range of stable operation was narrower for the coupled system than for the decoupled system, so the power levels and thrust levels tested were highly interdependent. Four power levels ranging from 200 to 500 W, each at a unique thrust level, were tested. Figure 6 shows the relation between specific Impulse and the ratio of input electric power to propellant mass flow rate for all of the operating con­ditions tested using water propellant. The coupled system demonstrated a maxi­mum specific Impulse of 159/sec at a thrust level of 84 mN while consuming 289 W. The heater temperature near the nozzle under these conditions was approximately 600 °C. The large variations in the data obtained from the coupled system as compared to the data from the decoupled system are due to the relatively low flow rates experienced with the coupled system. These were typically only one-third the flow rates of the decoupled system, so the result­ing uncertainty 1n mass flow rate was much larger for the coupled system. Figure 6 shows that no significant performance advantages exist for either water-feeding scheme over its alternative.

Water coaches won’t be launched from earth, can’t land, and don’t travel fast

McConnell and Tolley 10 (Brian S. and Alex, Freelance Scientists, published in *Journal of the British Interplanetary Society*, http://spacecoach.org/for-ship-designers/, JM)

Spacecoaches never enter a planetary atmosphere. Any craft that do, such as landers, are separate vehicles that will be designed independently. Electrothermal propulsion systems produce small amounts of thrust for a long period of time. The craft is not subjected to extreme forces or vibration as an Earth launched craft would be. Solar power, provided by large, lightweight solar arrays is the primary power source for the ship and its engines. Nuclear powerplants, such as those developed in the 1960s [NERVA program](http://en.wikipedia.org/wiki/NERVA), are not necessary, except perhaps for future missions beyond Jupiter. Water is reused extensively. Water may be initially frozen into pykrete shells to shield part of the ship, then melted off to irrigate crops and recycled many times before being sent to the engines for use as propellant later in the flight. Any ship fueled for a long duration trip (e.g. Martian moons) will be fueled with many tons of water. The ship can be viewed as an organic structure, almost like a cell, where the design goal is to minimize the amount of non-aqueous or non-organic mass. The ship itself is mostly an empty membrane or shell that protects the plants, animals and people within, and may be home to extensive plant growth (for life support, food production, and to create a comfortable, natural environment for its inhabitants). Large, complex structures can be built simply by interconnecting smaller units, with no upward limit on their size or form.

Water Coach Chemical Launch Link

Water coach forces reliance on chemical propulsion for landing and launch

McConnell and Tolley 10 (Brian S. and Alex, Freelance Scientists, published in *Journal of the British Interplanetary Society*, http://spacecoach.org/water-rockets/, JM)

Water can not only be used for environmental purposes, but it can also be used to supply high thrust steam and/or hydrogen peroxide thrusters that will be useful in ascent and landing maneuvers to higher gravity sites, such as the Martian moon Phobos, where electric propulsion systems will not be able to produce enough thrust. Steam rockets are the simplest type of rocket motor available. A steam rocket works by superheating water above its normal boiling point in a pressure vessel, and then venting the exhaust out through a standard rocket nozzle. While steam rockets are not very efficient, with a specific impulse of only 45 seconds, they can be used to land and ascent from low gravity sites such as the Martian moons, Ceres and small moons of Jupiter and Saturn, as well as large asteroids and comets. Hydrogen peroxide is also an interesting propellant which can be generated from water and oxygen using an electrolytic process that has already been developed for wastewater treatment. Hydrogen peroxide rockets work by pumping concentrated hydrogen peroxide through a catalyst that decomposes it into superheated steam and oxygen. When used as a monopropellant, hydrogen peroxide motors run at a specific impulse of 160 seconds, and when the exhaust is mixed with kerosene or alcohol, specific impulse can be boosted to 265 seconds. In either case, this is sufficient to land and ascend from larger moons, and even small planets such as Mercury.

Antimatter Bad- Cost

The costs of antimatter propulsion are prohibitive

Schmidt et al 2k (G. R., Deputy Manager, Propulsion Research Center, AIAA, http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19990110316\_1999165769.pdf, JM)

The costs of producing batches of antimatter on demand are not well characterized, since the facilities do not yet provide this function as an actual service. FNAL is beginning to recognize the existence of an incipient demand outside the high-energy physics community. Although less experienced than FNAL, Brookhaven National Laboratory has recently expressed interest in "going into the antimatter business"; however, Brookhaven's facilities are much less developed than those at FNAL. From our previous analysis, the current cost of producing 1 ug of antimatter is $6.4 billion. Assuming present production levels, the antimatter needed to support highly ambitious ACMF or AIM missions (- 100 pg) would cost $640 billion, much too high for practical considerations. In addition, the extremely low production rate would require an unreasonably long fill time on the order of 100's of years. The situation looks discouraging until we account for the anticipated improvements to the current production capacity. In this case the costs would go down by at least 2 orders of magnitude to $64 million per/.tg or $6.4 billion for a 100 pg mission. This is too expensive to support even occasional missions, and is certainly prohibitive for anything above the 10 pg level. However, this cost certainly" permits ground-based testing and demonstration of antimatter-assisted fusion/fission propulsion technology, which would require quantities of only 1 pg or less.

Antimatter Bad- Weaponization

Antimatter research will be used to develop weapons

Gsponer and Hurni 87 (Andre and Jean-Pierrre, Independent Sci. Res. Inst., Oxford & Author, *The Physical Principles of Thermonuclear Explosives*, *Bulletin of Peace Proposals* 19, pp.444-450, JM)

In view of its considerable strategic potential (for instance, antimatter seems to be a particularly interesting pump source for the Star War's X-ray lasers), it's not at all surprising that Soviet and American Scientists interested by the eventual applications of antimatter are eager to come to CERN, which at present has at least a five year lead in antimatter technology. In this context, it also wouldn't be surprising if a blunder was made... In effect, for the teams of American physicists coming from weapons laboratories, the official justification for their coming to CERN, is to carry-out fundamental research, pure scientific research. In the beginning of July 1986, these same Americans were supposed to go to Madrid, where a full session of the Fourth International Conference on Emerging Nuclear Systems was dedicated to antimatter energy concepts. At this same conference we were to present the point of view that the only realistic applications for annihilation energy were in the military domain [13]. To everyone's surprise, the Americans didn't come. Ten days before the conference, they announced their withdrawal without giving any convincing explanations. The participants quickly realized that the American Authorities had undoubtly reevaluated the military importance of antimatter, and had probably prevented the Los Alamos Scientists from coming to Madrid [14]. Thus exposing that scientists working at CERN, and coming from a non-European weapons laboratory, had other than fundamental research interests, that were obviously militarily sensitive.

Antimatter weapon development guarantees H-bomb proliferation

Gsponer and Hurni 87 (Andre and Jean-Pierrre, Independent Sci. Res. Inst., Oxford & Author, *The Physical Principles of Thermonuclear Explosives*, *Bulletin of Peace Proposals* 19, pp.444-450, JM)

Whether antimatter triggered thermonuclear weapons are realizable or not, or whether other weapons using annihilation energy are feasible or not, the fact that a relatively small quantity of antimatter can set off a very powerful thermonuclear explosion creates serious problems for the future of the strategic balance. In fact, the arms control treaties presently in force deal only with fission related devices and materials [16]: atomic bombs, nuclear reactors and fissile materials. By removing the fission fuse from thermonuclear weapons, antimatter triggered H-bombs and neutron bombs could be constructed freely by any country possessing the capacity, and be placed anywhere, including outer-space. Then again, even if technical obstacles prevented, for example, the actual construction of battle-field antimatter weapons, antimatter triggered microexplosions would still allow small and middle sized thermonuclear explosions to be made in the laboratory. This possibility would considerably reduce the need for underground nuclear explosions, thus rendering ineffective any attempt to slow the arms race by an eventual comprehensive nuclear test-ban treaty [16]. A nuclear test laboratory of this type could be based around a large heavy-ion accelerator [16], which would provide a means of massive antimatter production, as well as a driver to study the compression and explosion of thermonuclear fuel pellets.

Antimatter Bad- Solvency

Radiation from antimatter threatens equipment and personnel

McMahon 2k (Patrick B., UWisconsin, “AIM Propulsion,” May 8, http://fti.neep.wisc.edu/neep602/SPRING00/TERMPAPERS/mcmahon.pdf, JM)

Safety from radiation is another topic that must be addressed when considering space travel. Both manned and unmanned missions involve radiation shielding considerations. While electronics are much more susceptible to radiation that humans, they still have exposure limits which necessitate shielding for unmanned missions. An AIM engine running with D-T fuel will have the approximately the same radiation shielding requirements as any other fusion scheme. But an AIM engine operating with D-3He as fuel will have additional shielding requirements compared to most other fusion propulsion methods. This is due to the payload of antiprotons necessary and the potential radiation hazard that is associated with them. If a fuel payload of 100 ug of antiprotons were to suddenly annihilate with its confinement structure there would be a nearly instantaneous flux of 4.2 x 1020 gamma rays. 57% of those gamma rays would have an energy of approximately 200 MeV, while the others would be 0.511 MeV gammas. The gamma rays account for only 43% of the energy released from the annihilation. The rest is released in the form of neutrinos. Neutrinos interact very little with matter, therefore the gamma flux accounts for the vast majority of the radiation risk. This potential radiation hazard adds much unwanted mass to the system design and may offset the lightweight advantages originally assumed. Another risk involves the regulation and supervision of antimatter fuel for fear that one would use antiprotons as a weapon of mass destruction. However, the fact that all end products of proton-antiproton annihilation are all neutral forms of radiation make it a poor choice of weaponry.

Space Elevator Bad- Radiation

Space elevators expose passengers to lethal radiation

Young 6 (Kelly, Staff, *New Scientist*, “Space elevators:’First floor, deadly radiation!’” November 13, http://www.newscientist.com/article/dn10520, JM)

Space elevators are touted as a novel and cheap way to get cargo, and possibly people, into space one day. So far, they have barely left the drawing board, but ultimately robots could climb a cable stretching 100,000 kilometres from Earth's surface into space. But there is a hitch: humans might not survive thanks to the whopping dose of ionising radiation they would receive travelling through the core of the Van Allen radiation belts around Earth. These are two concentric rings of charged particles trapped by Earth's magnetic fields. "They would die on the way through the radiation belts if they were unshielded," says Anders Jorgensen, author of a new study on the subject and a technical staff member at Los Alamos National Laboratory, New Mexico, US. Space elevators had been planned to be anchored on an ocean platform near the equator, with the other end tied to a counterweight in space. At the equator, the most dangerous part of the radiation belts extends from about 1000 to 20,000 kilometres in altitude. The region did not hurt the Apollo astronauts in the 1960s and 1970s because their rockets delivered them swiftly through it. For a space elevator travelling at the current proposed speed of 200 kilometres per hour, however, passengers might spend half a week in the belts. That would hit them with 200 times the radiation experienced by the Apollo astronauts.

Space elevator transportation is lethal and harmful to equipment

Hoffman 6 (Michael, Contributor, *DailyTech*, November 15, http://www.dailytech.com/Radiation+May+Kill+Travelers+on+Space+Elevator/article4953.htm, JM)

Although [technology](http://www.dailytech.com/Radiation%2BMay%2BKill%2BTravelers%2Bon%2BSpace%2BElevator/article4953.htm) designated for the creation and implementation of space elevators has been [increasing in popularity](http://www.dailytech.com/Second%2BRound%2Bof%2BSpace%2BElevator%2BTechnology%2BCompleted/article827.htm) ([even at NASA](http://www.dailytech.com/NASA%2BWants%2BElevator%2Bto%2BSpace/article4046.htm)), a recent article in New Scientist claims that space elevators [may inadvertently kill travelers](http://space.newscientist.com/article/dn10520-space-elevators-first-floor-deadly-radiation.html) due to a high levels of ionising radiation.  The Van Allen radiation belts, two rings of charged particles trapped in the Earth's magnetic field, would ultimately kill any humans on the space elevator.  Astronauts who traveled through the belt in a spacecraft went relatively unharmed because they do so at a fast pace -- people on the elevator, however, may spend a half week in the belts.  Even at short intervals, the Van Allen radiation belts have been responsible for damaging shuttle and satellite [integrated](http://www.dailytech.com/Radiation%2BMay%2BKill%2BTravelers%2Bon%2BSpace%2BElevator/article4953.htm) circuits and sensors. Researchers are looking into several different ways they would be able to protect space travelers from the high level of radiation.  The first way is to move the elevator away from the equator so that the more intense parts of the belts can be avoided.  Some scientists have been quick to point out that even a relocation to the north or south might not be enough to reduce the amount of radiation exposure.  Another idea being discussed is to create some sort of radiation shield to help block radiation when the [travelers](http://www.dailytech.com/Radiation%2BMay%2BKill%2BTravelers%2Bon%2BSpace%2BElevator/article4953.htm) enter the Van Allen belts.  But the shield would ultimately weigh down the elevator line enough to disrupt the motion of the cable and/or add unwanted stress on the line. The [idea](http://www.dailytech.com/Radiation%2BMay%2BKill%2BTravelers%2Bon%2BSpace%2BElevator/article4953.htm) of creating a 62,000-mile elevator to carry supplies and humans into space has been met with a bit of interest and optimism from researchers.  Even though there was no [winner](http://www.dailytech.com/Radiation%2BMay%2BKill%2BTravelers%2Bon%2BSpace%2BElevator/article4953.htm) in the [recent Space Elevator Games competition](http://www.dailytech.com/No%2BWinner%2Bin%2BSpace%2BElevator%2BCompetition/article4664.htm) held in a New Mexico desert, contest organizers believe someone has the ability to win next year.  The University of Saskatchewan Space Design Team, however, was close but ended up being disqualified after going over the time limit by two seconds. Needless to say, humans might still be using the good old rocket ship for some time to come even when, or if, a space elevator is built.

Space Elevator Bad- Radiation

Radiation exposure kills travelers on the space elevator – mitigating tactics decrease its usefulness

Jorgensen et al 6 (A. M., Space Instrumentation and System Engineering, Los Alamos National Laboratory, *Acta Astronautica* 60, 3, pp. 198-209, JM)

The Earth's natural van Allen radiation belts present a serious hazard to space travel in general, and to travel on the space elevator in particular. The average radiation level is sufficiently high that it can cause radiation sickness, and perhaps death, for humans spending more than a brief period of time in the belts without shielding. The exact dose and the level of the related hazard depends on the type or radiation, the intensity of the radiation, the length of exposure, and on any shielding introduced. For the space elevator the radiation concern is particularly critical since it passes through the most intense regions of the radiation belts. The only humans who have ever traveled through the radiation belts have been the Apollo astronauts. They received radiation doses up to approximately 1 rem over a time interval less than an hour. A vehicle climbing the space elevator travels approximately 200 times slower than the moon rockets did, which would result in an extremely high dose up to approximately 200 rem under similar conditions, in a timespan of a few days. Technological systems on the space elevator, which spend prolonged periods of time in the radiation belts, may also be affected by the high radiation levels. In this paper we will give an overview of the radiation belts in terms relevant to space elevator studies. We will then compute the expected radiation doses, and evaluate the required level of shielding. We concentrate on passive shielding using aluminum, but also look briefly at active shielding using magnetic fields. We also look at the effect of moving the space elevator anchor point and increasing the speed of the climber. Each of these mitigation mechanisms will result in a performance decrease, cost increase, and technical complications for the space elevator.

Efforts to reduce radiation from the space elevator moot its solvency

Young 6 (Kelly, Staff, *New Scientist*, “Space elevators:’First floor, deadly radiation!’” November 13, http://www.newscientist.com/article/dn10520, JM)

There are several possibilities for dealing with the radiation - all of which come with drawbacks. One option would be to move the elevator off the equator. By shifting the elevator north or south, the most intense part of the radiation belts could be avoided. "Basically what we found was that by moving off the equator by the largest amount you can, you reduce the radiation by a small factor - but probably not enough," says study co-author Blaise Gassend of MIT in the US. In addition, if the elevator was located at a latitude of 45° north, roughly the same latitude as MIT, the cable would veer south, pulled towards the equator by centrifugal forces. So it would run nearly horizontally through Earth's atmosphere for thousands of kilometres, putting weather-related stresses on the cable that could weaken it. Another option would be to have some sort of radiation shield stationed along the cable so the elevator could pick it up when it is about to reach the belts. But such a shield would weigh down the whole apparatus, disrupting the natural motion of the cable.

Space Elevator Bad- Solvency

Space elevators will inevitably face wind and stability issues

Shiga 8 (David, Staff, *New Scientist*, March 28, http://www.newscientist.com/article/dn13552?feedId=online-news\_rss20, JM)

If an elevator stretching from Earth into space could ever be built, it could slash the cost of space travel. But a controversial new study suggests that building and maintaining one would be an even bigger challenge than previously thought, because it would need to include built-in thrusters to stabilise itself against dangerous vibrations. The idea behind a space elevator is simple. Deploy a cable stretching from the ground near Earth's equator far enough into space, and centrifugal forces due to Earth's spin will keep the cable taut. Vehicles could then climb up the cable, also called a tether or ribbon, to get into space, powered by lasers on the ground or other Earth-based power sources. The idea could dispense with expensive rocket launches, making access to space much cheaper. But the concept has been stuck on the ground floor for decades, not least because constructing a tether strong enough for the job is beyond current technology. [Nanotubes](http://www.newscientist.com/blog/space/2007/10/nanotube-cable-proves-bust.html) might be up to the task, but they would have to be made longer and with fewer defects than any that can be fabricated today. A new study makes the prospects appear even gloomier. Even if a space elevator could be built, it will need thrusters attached to it to prevent potentially dangerous amounts of wobbling, says Lubos Perek of the Czech Academy of Sciences' Astronomical Institute in Prague. The addition would increase the difficulty and cost of building and maintaining the elevator. Previous studies have noted that gravitational tugs from the Moon and Sun, as well as pressure from gusts of solar wind, would shake the tether. That could potentially make it veer into space traffic, including satellites and bits of space debris. A collision could cut the tether and wreck the space elevator.

Nuclear Pulse/Project Orion- EMP

Nuclear pulse damages electronics - EMP

Pearson 2 (Ben, Associate of Science, “Electromagnetic Pulse as a Result of Nuclear Pulse Propulsion,” http://www.u.arizona.edu/~tuvas/Project\_orion\_mini.htm, JM)

Another of my large objections to Project Orion was in the Electromagnetic Pulse shockwave that would result from the use of such a bomb. Electromagnetic Pulse is the effect of nuclear weapons that has a tendency to destroy electronics for a large area. It is caused by radiation ionizing the atoms in a band around the earth approximately 20-30 km high. It is extremely damaging. A 1.4 Megaton bomb launched about 400 kilometers above Kansas would destroy most of the electronics that were not protected in the entire Continental United States. That is a large area. However, Electromagnetic Pulse remains almost untested for small nuclear bombs. Electromagnetic Pulse was a theory of nuclear weapons that was not tested until the early 1960’s. This was the same time period that Orion was under development; so little research was done on the Electromagnetic Pulse effects of Orion. In fact, George Dyson informed me that he read 6000 pages worth of information on Project Orion to write his book, largely in the form of declassified reports, and that Electromagnetic Pulse was not mentioned on a single page of these papers. I asked about this question in many message boards on the Internet. However, the best response I could get was “EMP is not significant for less than 1 megaton bombs” from the Yahoo Project Orion club. I believed it was significant, but I was largely been unable to find out a way to test my hypothesis. However, I did get some information, mostly on using a very commonly used and applied physics formula known as the Inverse Squared law, which states that the power of a field or charge or many other things varies inversely squared with its distance.

EMP crushes US leadership, infrastructure, and readiness

Foster et al 4 (John S., Special Commission to Assess the Threat to the US as a Result of EMP, http://www.globalsecurity.org/wmd/library/congress/2004\_r/04-07-22emp.pdf, JM)

Several potential adversaries have or can acquire the capability to attack the United States with a high-altitude nuclear weapon-generated electromagnetic pulse (EMP). A determined adversary can achieve an EMP attack capability without having a high level of sophistication. EMP is one of a small number of threats that can hold our society at risk of catastrophic consequences. EMP will cover the wide geographic region within line of sight to the nuclear weapon. It has the capability to produce significant damage to critical infrastructures and thus to the very fabric of US society, as well as to the ability of the United States and Western nations to project influence and military power. The common element that can produce such an impact from EMP is primarily electronics, so pervasive in all aspects of our society and military, coupled through critical infrastructures. Our vulnerability is increasing daily as our use of and dependence on electronics continues to grow. The impact of EMP is asymmetric in relation to potential protagonists who are not as dependent on modern electronics. The current vulnerability of our critical infrastructures can both invite and reward attack if not corrected. Correction is feasible and well within the Nation's means and resources to accomplish.

Nuclear Pulse/Project Orion EMP Impact extensions

EMP makes us vulnerable to nuclear, biological, and cyber attack

Foster et al 4 (John S., Special Commission to Assess the Threat to the US as a Result of EMP, http://www.globalsecurity.org/wmd/library/congress/2004\_r/04-07-22emp.pdf, JM)

An EMP attack is one way for a terrorist activity to use a small amount of nuclear weaponry—potentially just one weapon—in an effort to produce a catastrophic impact on our society, but it is not the only way. In addition, there are potential applications of surface-burst nuclear weaponry, biological and chemical warfare agents, and cyber attacks that might cause damage that could reach large-scale, long-term levels. The first order of business is to prevent any of these attacks from occurring. The US must establish a global environment that will profoundly discourage such attacks. We must persuade nations to forgo obtaining nuclear weapons or to provide acceptable assurance that these weapons will neither threaten the vital interests of the United States nor fall into threatening hands.

EMP destroys the economy

Foster et al 4 (John S., Special Commission to Assess the Threat to the US as a Result of EMP, http://www.globalsecurity.org/wmd/library/congress/2004\_r/04-07-22emp.pdf, JM)

The financial services industry comprises a network of organizations and attendant systems that process instruments of monetary value in the form of deposits, loans, funds transfers, savings, and other financial transactions. It includes banks and other depository institutions, including the Federal Reserve System; investment-related companies such as underwriters, brokerages, and mutual funds; industry utilities such as the New York Stock Exchange, the Automated Clearing House, and the Society for Worldwide Interbank Financial Telecommunications; and third party processors that provide electronic processing services to financial institutions, including data and network management and check processing. Virtually all American economic activity depends upon the functioning of the financial services industry. Today, most financial transactions that express National wealth are performed and recorded electronically. Virtually all transactions involving banks and other financial institutions happen electronically. Essentially all record-keeping of financial transactions involves information stored electronically. The financial services industry has evolved to the point that it would be impossible to operate without the efficiencies, speeds, and processing and storage capabilities of electronic information technology. The terrorist attacks of September 11, 2001, demonstrated the vulnerabilities arising from the significant interdependencies of the Nation’s critical infrastructures. The attacks disrupted all critical infrastructures in New York City, including power, transportation, and telecommunications. Consequently, operations in key financial markets were interrupted, increasing liquidity risks for the United States financial system.11

EMP disrupts the food supply system

Foster et al 4 (John S., Special Commission to Assess the Threat to the US as a Result of EMP, http://www.globalsecurity.org/wmd/library/congress/2004\_r/04-07-22emp.pdf, JM)

EMP can damage or disrupt the infrastructure that supplies food to the population of the United States. Recent federal efforts to better protect the food infrastructure from terrorist attack tend to focus on preventing small-scale disruption of the food infrastructure, such as would result from terrorists poisoning some food. Yet an EMP attack could potentially disrupt the food infrastructure over a large region encompassing many cities for a protracted period of weeks to months. Technology has made possible a dramatic revolution in US agricultural productivity. The transformation of the United States from a nation of farmers to a nation where less than 2 percent of the population is able to feed the other 98 percent and supply export markets is made possible only by technological advancements that, since 1900, have increased the productivity of the modern farmer by more than 50-fold. Technology, in the form of knowledge, machines, modern fertilizers and pesticides, high-yield crops and feeds, is the key to this revolution in food production. Much of the technology for food production directly or indirectly depends upon electricity, transportation, and other infrastructures. The distribution system is a chokepoint in the US food infrastructure. Supermarkets typically carry only enough food to provision the local population for 1 to 3 days. Supermarkets replenish their stocks on virtually a daily basis from regional warehouses that usually carry enough food to supply a multi-county area for about one month. The large quantities of food kept in regional warehouses will do little to alleviate a crisis if it cannot be distributed to the population in a timely manner. Distribution depends largely on a functioning transportation system.

Nuclear Pulse/Project Orion Bad- EMP extensions

EMP disrupts space systems

Foster et al 4 (John S., Special Commission to Assess the Threat to the US as a Result of EMP, http://www.globalsecurity.org/wmd/library/congress/2004\_r/04-07-22emp.pdf, JM)

Over the past few years, there has been increased focus on US space systems in low Earth orbits and their unique vulnerabilities, among which is their susceptibility to nuclear detonations at high altitudes—the same events that produce EMP. It is also important to include, for the protection of a satellite-based system in any orbit, its control system and ground infrastructure, including up-link and down-link facilities. Commercial satellites support many significant services for the Federal government, including communications, remote sensing, weather forecasting, and imaging. The national security and homeland security communities use commercial satellites for critical activities, including direct and backup communications, emergency response services, and continuity of operations during emergencies. Satellite services are important for national security and emergency preparedness telecommunications because of their ubiquity and separation from other communications infrastructures. The Commission to Assess United States National Security Space Management and Organization conducted an assessment of space activities that support US national security interests, and concluded that space systems are vulnerable to a range of attacks due to their political, economic, and military value.19 Satellites in low Earth orbit generally are at very considerable risk of severe lifetime degradation or outright failure from collateral radiation effects arising from an EMP attack on ground targets.

Nuclear Pulse/Project Orion Bad - Satellites

Nuclear pulse threatens key satellites

Pearson 2 (Ben, Associate of Science, “Electromagnetic Pulse as a Result of Nuclear Pulse Propulsion,” http://www.u.arizona.edu/~tuvas/Project\_orion\_mini.htm, JM)

Closely related to Electromagnetic Pulse is an unnamed effect of nuclear weapons that has a tendency to destroy satellites, especially those in low orbits. Henceforth I will refer to this effect of nuclear weapons as Space Electromagnetic Pulse. Although the two subjects are not completely related, they are close enough to share that kind of a name. Most military satellites are protected against Space Electromagnetic Pulse, but most civilian satellites are not. Note that Space Electromagnetic primarily affects spacecraft in low Earth orbits. That means your phone services/cable TV would probably. However, there are still a great many satellites that are very important if not critical in low Earth orbit, not the least of which is the International Space Station. There are several thousands of satellites that would be affected by this devastating effect of nuclear weapons. To do some kind of testing on this, I tested for bombs blowing up in the Van Allen belts. To my surprise, none did. So while space Electromagnetic Pulse may damage something, it would not be a critical blow to the space industry.

Bifrost Bridge Bad

Plans like Savage’s ignore the economic realities of space travel

Almond 9 (Paul, Freelance writer, November 1, http://www.paul-almond.com/LaunchingAnythingIsGood.pdf, JM)

In his book The High Frontier: Human Colonies in Space, Gerard O’Neill envisioned the future expansion of humanity into space on a massive scale, with our civilization becoming a spacefaring civilization.1 O’Neill’s plan was for material to be mined from the moon and sent to the L5 point in Earth orbit where it would be used to build huge space colonies. (See Figure 1, below.) These would not rely on government money to sustain them. Instead, space would be developed and exploited by industry that would pay for itself. Similar proposals have been made by Thomas Heppenheimer.2 More recently, Marshall Savage proposed a long range plan for space colonization.3 Proposals on this sort of scale cannot become reality with the existing economics of spaceflight in which a space shuttle launch costs $450 million.4 Space activity needs economy of scale: It can be a lot cheaper if a lot more of it is done. This is necessary if humanity is to expand into the solar system in any significant way.

Mass driver operations like bifrost bridge don’t avoid massive costs

Combs 10 (Mike, Freelance Writer, “The Space Settlement FAQ,” January, http://space.mike-combs.com/spacsetl.htm, JM)

Zubrin says even assuming a lunar mass-driver could deliver ores to GEO at 1/10,000th of current launch prices, launching the raw material for building an O'Neill habitat would cost $4 trillion. He then considers it a "reasonable guess" that factoring in the costs of refining, processing, manufacturing, and construction would justify multiplying this price tag 10 times over. But this latter calculation may gain unfair leverage from the current high costs of rocket launch into orbit, when the issues are the costs of refining ores in a region where solar energy is continuously available, and of construction in a region with access to zero gravity. Launch costs 1/10,000th current prices certainly sounds like a generous assumption. But is there in fact any basis for comparison between rocketry and launch via electromagnetic forces? A M.I.T. study concluded that a lunar mass-driver could launch ore into space for a cost of around 10 cents/kilogram. For Zubrin to successfully dispute this, he must identify the calculation errors in these previous studies, and not merely throw out a number of his own, no matter how generous-sounding. Zubrin says that, "...the size and complexity of the O'Neill operation...boggles the mind". Certainly all can agree on this point. But it seems inescapable that building self-sufficient settlements on the surface of Mars of comparable capacity would require at least an equivalent amount of infrastructure not only be launched into Earth orbit, but propelled the additional distance to Mars, and then soft-landed on the surface. Zubrin is well known as an advocate of the position that this is within our capabilities.