# Round 3 NDT – ASU RV vs. Wake BM (Aff)

## 1AC

### Inherency

#### Observation One: Inherency

#### Obama pushing nuclear incentives now.

Northey 13 (Hannah, E&E reporter, 3-13-13, “Obama admin placing big bet on small reactors”, <http://www.eenews.net/public/Greenwire/2013/03/13/1>, RSR)

The Obama administration is promoting a bold, long-range plan for building dozens of small, factory-built reactors capable of replacing coal-fired power plants that are expected to be retired in the coming decades, a Department of Energy official said yesterday.¶ DOE's effort is aimed at establishing an industry that would manufacture as many as 50 small modular reactors (SMRs) a year by 2040 or sooner, said Rebecca Smith-Kevern, the director of light water reactor technology at the department's Office of Nuclear Energy, which oversees the licensing of tiny nuclear plants.¶ "We have a vision of having a whole fleet of [small modular reactors] produced in factories," Smith-Kevern told a regulatory conference in Bethesda, Md. "We envision the U.S. government to be the first users."¶ DOE this week announced a second wave of million-dollar cost-share grants to help the industry design and license the modular reactors, which the administration defines as factory-built plants of less than 300 megawatts that are shipped by truck, barge or rail to construction sites for assembly.¶ The department awarded the first grants under its $452 million cost-share program to veteran reactor designer Babcock & Wilcox, which is building two small units at the Clinch River site in Oak Ridge, Tenn. (Greenwire, Nov. 11, 2012).

#### Global nuclear renaissance now

Marketwire 12 (5/3/12, – Part of the Paragon Report on uranium ore stock future

<http://finance.yahoo.com/news/nuclear-renaissance-back-track-122000381.html>)

NEW YORK, NY--(Marketwire -05/03/12)- Last year the Fukushima disaster in Japan started a downward spiral for companies in the Uranium Industry. Approximately one year later the industry looks to be finally recovering as the Global X Uranium ETF (URA) is up nearly 12 percent year-to-date. "Fukushima put a speed bump on the road to the nuclear renaissance," Ganpat Mani, president of Converdyn, said at a nuclear industry summit. "It's not going to delay the programs around the world." The Paragon Report examines investing opportunities in the Uranium Industry and provides equity research on Cameco Corporation (CCJ - News) and Uranium One, Inc. (UUU.TO - News). Approximately 650 million people in China and India currently are living without electricity. With the high costs of fossil fuel the most viable options for these countries would be nuclear power. Indonesia, Egypt, and Chile are among some of the nations that have plans to build their first nuclear power station, the list of countries operating atomic plants currently stands at 30. According to numbers released by the World Nuclear Association there are 61 reactors that are presently under construction, and plans to build another 162. "In two years, there will be very strong demand on the market, as new reactors start operating, and as new contracts with the existing fleet kick in," Areva SA's Chief Commercial Officer Ruben Lazo said in a previous interview.

#### But, the US is not reversing course on reprocessing.

Saillan 10 (Charles, attorney with the New Mexico Environment Department, Harvard Environmental Law Review, 2010, “DISPOSAL OF SPENT NUCLEAR FUEL IN THE UNITED STATES AND EUROPE: A PERSISTENT ENVIRONMENTAL PROBLEM”, Vol. 34, RSR)

The U.S. government’s position on reprocessing changed in 1974 when India exploded a nuclear weapon in the state of Rajasthan. 150 The weapon’s plutonium was isolated with reprocessing equipment imported for “peaceful purposes.” 151 Rightly concerned about the dangers of nuclear proliferation, President Ford announced that the United States would no longer view reprocessing as a necessary step in the nuclear fuel cycle. He called on other nations to place a three-year moratorium on the export of reprocessing technology. 152 In 1977, President Carter indefinitely deferred domestic efforts at reprocessing and continued the export embargo. 153 Although President Reagan reversed the ban on domestic reprocessing in 1981, 154 the nuclear industry has not taken the opportunity to invest in the technology. In 2006, the George W. Bush Administration proposed a Global Nuclear Energy Partner ship (“GNEP”) for expanded worldwide nuclear power production. 155 As a key component of the GNEP proposal, the United States would provide other nations with a reliable supply of nuclear fuel, and it would take back the spent fuel for reprocessing at a commercial facility in the United States, thus avoiding the spread of reprocessing technology. 156 However, the Obama Administration substantially curtailed GNEP in 2009, and is “no longer pursuing domestic commercial reprocessing.” 157

### Observation 2

#### Observation Two: Helium

**HE-3 shortage now – low tritium production is causing a supply crisis**

Veen-Hincke ’12(Kristin V, Political Focus: Helium-3 Supply Dwindles while Demand Increases, May/June 2012, http://wellservicingmagazine.com/political-focus/2012/05/political-focus-helium-3-supply-dwindles-while-demand-increases/)

**For** more than **50 years**, the Department of Energy (**DOE) has supplied** isotopes and isotope-related services to not only companies in the U.S., but also those working in **the global market**. The Isotope Program, which was within the realm of the Office of Science until 2009, oversees the sale of distribution of these isotopes including Helium-3 (He-3) which is a rare, non-radioactive, and non-hazardous isotope. Helium-3 is used for neutron detection in the areas of national security, oil and gas exploration, nuclear safeguards measurements, and in scientific experimentation, and due to its non-reactive and non-corrosive nature, it is the preferred detector material.¶ Without He-3 gas, the wireline and well logging companies have no effective commercial alternatives for neutron detectors meaning they have a limited ability to generate a neutron porosity log for either open or cased hole operations.¶ “The U.S. government is the sole source of He-3 in this country because of the national security issues associated with this isotope,” said Elena Melchert, senior program manager for the Department of Energy’s Oil and Gas Research Program. **“Helium-3 results from the natural decay of tritium** which is a radioactive isotope. This process occurs during refurbishment and dismantling of nuclear weapons. **With a lessening supply of nuclear weapons, the stock of He-3 has been gradually dwindling while demand has increased,”** she continued. **“Finding an alternative source** for Helium-3 **is of** the **utmost importance.”** Distribution ¶ The distribution of Helium-3 for commercial use began in 1980. Helium-3 is a rare find on Earth so **natural recovery has not been financially feasible**.¶ The sole production of Helium-3 in the United States has come from the dismantling of nuclear weapons. Currently, the U.S. supply of Helium-3 is stored at the National Nuclear Security Administration’s (NNSA) Savannah River Site in South Carolina. The only other source of commercially-available Helium-3 is from the former Soviet Union’s nuclear weapons program. With the end of the Cold War and a lessening need for nuclear weapons, the **supply** of Helium-3 **is dwindling while demand is increasing**. **This is creating a problem for DOE as well as companies relying on the government’s supply** of this important component **for** their business **success**.¶ “Because **the primary, current source of He**lium-**3 is** the decay of **tritium, current supplies** of this important gas **are limited by** the **quantities of tritium** on hand and being **produced,” said** Dr. William **Brinkman**, **director of the Office of Science for** the U.S. **D**epartment **o**f **E**nergy at a House subcommittee meeting on this issue in April 2010. “**Without development of alternative sources** for Helium-3, **use** of this gas **will be constrained seriously in the foreseeable future** as accumulated stockpiles are drawn down.” Dr. Brinkman went on to say that the U.S. Government ended reactor-based production of tritium in 1988. This downsizing and an increase in demand have now created what he termed a “critical shortage in the global supply of Helium-3.”

**Helium shortages undermines nuclear detection capabilities – key to prevent prolif and nuclear terrorism.**

Homeland Security News Wire ’11(Helium-3 shortage endangers nuclear detection capabilities

2/28/11, http://www.homelandsecuritynewswire.com/helium-3-shortage-endangers-nuclear-detection-capabilities)

**Demand for radiation detectors has surged as a result of increased efforts to stop nuclear proliferation and terrorism, but production of he**lium-**3**, **a critical element in** nuclear **detection** **tech**nology, has not kept pace and existing stockpiles **are quickly dwindling**; in 2010 demand for helium-3 was projected to be 76,000 liters per year; the United States only produces 8,000 liters of helum-3 a year; last year the U.S. stockpile of helium-3 was at less than 48,000 liters; alternatives are currently in the early stages of development and researchers have found several promising leads; when an alternative is found, current radiation detection equipment will have to be replaced with the new technology¶ Demand for radiation detectors has surged as a result of increased efforts to stop nuclear proliferation and terrorism, but production of helium-3, a critical element in nuclear detection technology, has not kept pace and existing stockpiles are quickly dwindling.¶ Helium-3 is primarily used in security applications as it is highly sensitive to the neutrons that are emitted by plutonium. **Roughly 80 percent of helium-3 supplies are used for national security.**¶ According to Wired’s Danger Room, helium-3 does not naturally occur in large quantities and it represents less than 0.0002 percent of all helium.¶ **He**lium-**3 is** currently **produced by harvesting tritium**, a heavy isotope of hydrogen that is used to enhance the yield of nuclear weapons. **Tritium has not been produced since 1988 and led to reduced** helium-3 **production** levels. Helium-3 is now primarily obtained from dismantled or refurbished nuclear weapons.¶ **Since 9/11 demand for radiation detectors increased sharply, however production failed to increase.**¶ In 2010 demand for helium-3 was projected to be 76,000 liters per year, but the United States only produces 8,000 liters of it a year. Moreover, last year the U.S. stockpile of helium-3 was at less than 48,000 liters.¶ The United States has stopped exporting the gas and the International Atomic Energy Agency was informed that it must diversify its sources for helium-3.¶ Other countries have also followed suit and reduced its exports. From 2004 to 2008, the United States imported roughly 25,000 liters of helium-3 each year from Russia, but in August of 2008 Russia declared that it was “reserving its supplies for domestic use.” Dr. William K. **Hagan,** the acting **director of the Domestic Nuclear Detection Office at DHS, said** that **the shortage** of helium-3 **could affect** the handheld and backpack **detectors used by the U.S. Coast Guard, Customs and Border Protection, and T**ransportation **S**ecurity **A**dministration.¶ After the shortage was first noticed by government officials in 2008, the Domestic Nuclear Detection Office (DNDO) formed the Helium-3 Interagency Integrated Product Team (IPT) to manage the use of existing stockpiles of helium-3, investigate alternatives, and explore technologies to recycle helium-3 and extend current supplies.¶

#### Nuclear terrorism is extremely likely

Jaspal 12– Associate Professor at the School of Politics and International Relations, Quaid-i-Azam University, Islamabad, Pakistan

(Zafar Nawaz, “Nuclear/Radiological Terrorism: Myth or Reality?”, Journal of Political Studies, Vol. 19, Issue - 1, 2012, 91:111, dml)

The **misperception, miscalculation and** above all **ignorance** of the ruling elite **about security puzzles are perilous for the national security of a state**. Indeed, **in an age of transnational terrorism and unprecedented dissemination of dualuse nuclear technology, ignoring nuclear terrorism threat is an** imprudent policy choice. The **incapability** of terrorist organizations **to engineer fissile material does not eliminate** completely **the possibility of nuclear terrorism**. At the same time, **the absence of an example** or precedent of a nuclear/ radiological terrorism **does not qualify the assertion that the** nuclear/radiological **terrorism ought to be remained a myth**. Farsighted rationality obligates that one should not miscalculate **transnational terrorist groups — whose behavior suggests that they have a death wish — of acquiring nuclear**, radiological, chemical and biological **material producing capabilities**. In addition, one could be sensible about the published information that **huge amount of nuclear material is spread around the globe**. According to estimate **it is enough to build more than** 120,000 **Hiroshima-sized nuclear bombs** (Fissile Material Working Group, 2010, April 1). The alarming fact is that **a few storage sites** of nuclear/radiological materials **are inadequately secured and continue to be accumulated in unstable regions** (Sambaiew, 2010, February). Attempts at stealing fissile material had already been discovered (Din & Zhiwei, 2003: 18). Numerous evidences confirm **that terrorist groups had aspired to acquire fissile material for their terrorist acts**. Late Osama **bin Laden**, the founder of al Qaeda **stated that acquiring nuclear weapons was a“religious duty**” (Yusufzai, 1999, January 11). The IAEA also reported that “al-Qaeda was actively seeking an atomic bomb.” Jamal Ahmad al-Fadl, a dissenter of Al Qaeda, in his trial testimony had “revealed his extensive but unsuccessful efforts to acquire enriched uranium for al-Qaeda” (Allison, 2010, January: 11). On November 9, 2001, Osama bin Laden claimed that “we have chemical and nuclear weapons as a deterrent and if America used them against us we reserve the right to use them (Mir, 2001, November 10).” On May 28, 2010, Sultan Bashiruddin Mahmood, a Pakistani nuclear scientist confessed that he met Osama bin Laden. He claimed that “I met Osama bin Laden before 9/11 not to give him nuclear know-how, but to seek funds for establishing a technical college in Kabul (Syed, 2010, May 29).” He was arrested in 2003 and after extensive interrogation by American and Pakistani intelligence agencies he was released (Syed, 2010, May 29). Agreed, Mr. Mahmood did not share nuclear know-how with **Al Qaeda**, but his meeting with Osama establishes the fact that the terrorist organization **was in contact with nuclear scientists**. Second, **the terrorist group has sympathizers in the nuclear scientific bureaucracies**. It also authenticates bin Laden’s Deputy Ayman Zawahiri’s claim which he made in December 2001: “If you have $30 million, go to the black market in the central Asia, contact any disgruntled Soviet scientist and a lot of dozens of smart briefcase bombs are available (Allison, 2010, January: 2).” **The covert meetings between nuclear scientists and al Qaeda members could not be interpreted as idle threats** and thereby the threat of nuclear/radiological terrorism is real. The 33Defense Secretary Robert Gates admitted in 2008 that “what keeps every senior government leader awake at night is the thought of a terrorist ending up with a weapon of mass destruction, especially nuclear (Mueller, 2011, August 2).” Indeed, **the nuclear deterrence strategy** cannot deter **the transnational terrorist syndicate from** **nuclear**/radiological terrorist **attacks**. Daniel Whiteneck pointed out: “**Evidence suggests**, for example, **that al Qaeda** might not only use WMD simply to demonstrate the magnitude of its capability but that it might actually welcome **the escalation of a strong U.S. response, especially if it included** catalytic effects **on governments** and societies in the Muslim world. **An adversary that prefers escalation regardless of the consequences** cannot be deterred” (Whiteneck, 2005, Summer: 187) Since taking office, President Obama has been reiterating that “nuclear weapons represent the ‘gravest threat’ to United States and international security.” While realizing that the US could not prevent nuclear/radiological terrorist attacks singlehandedly, he launched 47an international campaign to convince the international community about the increasing threat of nuclear/ radiological terrorism. He stated on April 5, 2009: “**Black market trade in nuclear secrets and nuclear materials abound**. The technology to build a bomb has spread. Terrorists are determined to buy, build or steal one. **Our efforts to contain these dangers are centered on a global non-proliferation regime, but as more** people and nations **break the rules, we could reach the point where the center cannot hold** (Remarks by President Barack Obama, 2009, April 5).” He added: “**One terrorist with one nuclear weapon could unleash massive destruction**. Al Qaeda has said it seeks a bomb and that it would have no problem with using it. And we know that there is unsecured nuclear material across the globe” (Remarks by President Barack Obama, 2009, April 5). In July 2009, at the G-8 Summit, President Obama announced the convening of a Nuclear Security Summit in 2010 to deliberate on the mechanism to “secure nuclear materials, combat nuclear smuggling, and prevent nuclear terrorism” (Luongo, 2009, November 10). President Obama’s nuclear/radiological threat perceptions were also accentuated by the United Nations Security Council (UNSC) Resolution 1887 (2009). The UNSC expressed its grave concern regarding ‘the threat of nuclear terrorism.” It also recognized the need for all States “to take effective measures to prevent nuclear material or technical assistance becoming available to terrorists.” The UNSC Resolution called “for universal adherence to the Convention on Physical Protection of Nuclear Materials and its 2005 Amendment, and the Convention for the Suppression of Acts of Nuclear Terrorism.” (UNSC Resolution, 2009) The United States Nuclear Posture Review (NPR) document revealed on April 6, 2010 declared that “**terrorism and proliferation are** far greater threats **to the United States and international stability**.” (Security of Defence, 2010, April 6: i). **The United States declared that it reserved the right to“hold fully accountable” any state or group “that supports or enables terrorist efforts to obtain** or use **weapons of mass destruction**, whether by facilitating, financing, or providing expertise or safe haven for such efforts (Nuclear Posture Review Report, 2010, April: 12)”. This declaration underscores the possibility that terrorist groups could acquire fissile material from the rogue states.

#### An attack breaks the nuclear taboo – leads to nuclear war.

Bin ‘9 (5-22-09 About the Authors Prof. Li Bin is a leading Chinese expert on arms control and is currently the director of Arms Control Program at the Institute of International Studies, Tsinghua University. He received his Bachelor and Master Degrees in Physics from Peking University before joining China Academy of Engineering Physics (CAEP) to pursue a doctorate in the technical aspects of arms control. He served as a part-time assistant on arms control for the Committee of Science, Technology and Industry for National Defense (COSTIND).Upon graduation Dr. Li entered the Institute of Applied Physics and Computational Mathematics (IAPCM) as a research fellow and joined the COSTIND technical group supporting Chinese negotiation team on Comprehensive Test Ban Treaty (CTBT). He attended the final round of CTBT negotiations as a technical advisor to the Chinese negotiating team. Nie Hongyi is an officer in the People’s Liberation Army with an MA from China’s National Defense University and a Ph.D. in International Studies from Tsinghua University, which he completed in 2009 under Prof. Li Bin. )

**The nuclear taboo is a** kind **of international norm and this type of norm is supported by the promotion of the norm through international social exchange.** **But at present the increased threat of nuclear terrorism has lowered people’s confidence that nuclear weapons will not be used**. **China and the United States have a broad common interest in combating nuclear terrorism.** **Using technical and institutional measures to break the foundation of nuclear terrorism and lessen the possibility of a nuclear terrorist attack can not only weaken the danger of nuclear terrorism itself but also** strengthen people’s confidence in the nuclear taboo**, and in this way preserve an international environment beneficial to both China and the United States.** **In this way even if there is crisis in China-U.S. relations caused by conflict, the nuclear taboo can also help both countries reduce suspicions about the nuclear weapons problem, avoid miscalculation and thereby reduce the** danger of a nuclear war**.**

#### That causes extinction via retal.

Ayson 10 (Robert, Professor of Strategic Studies, Director of Strategic Studies: New Zealand, Senior Research Associate with Oxford’s Centre for International Studies. “After a Terrorist Nuclear Attack: Envisaging Catalytic Effects. Studies in Conflict and Terrorism, Volume 33, Issue 7, July 2010, pages 571-593)

**Washington's early response to a terrorist nuclear attack on its own soil might also raise** the possibility of an unwanted (and **nuclear** aided) **confrontation with Russia and/or China.** For example, **in the noise and confusion during the immediate aftermath of the terrorist nuclear attack, the U.S. president might be expected to place** the country's armed forces, including **its nuclear arsenal, on a higher stage of alert. In such a tense environment**, when careful planning runs up against the friction of reality, it is just possible that **Moscow and**/or **China might mistakenly read this as a sign of U.S. intentions to use** force (and possibly **nuclear force) against them**. In that situation, the **temptations to preempt such actions might grow**, although it must be admitted that **any preemption would** probably still **meet** with **a devastating response. As part of its initial response to the act of nuclear terrorism** (as discussed earlier) **Washington might decide to order a** significant conventional (or **nuclear) retaliatory** or disarming **attack** **against the leadership of the terrorist group and/or states** seen to support that group. Depending on the identity and especially the location of these targets, **Russia and/or China might interpret such action as being far too close for their comfort, and** potentially as an **infringement on their spheres of influence and even on their sovereignty.** One far-fetched but perhaps not impossible scenario might stem from a judgment in Washington that some of the main aiders and abetters of the terrorist action resided somewhere such as Chechnya, perhaps in connection with what Allison claims is the “Chechen insurgents' … long-standing interest in all things nuclear.”42 **American pressure** on that part of the world **would** almost **certainly raise alarms in Moscow** that …might require a degree of advanced consultation from Washington that the latter found itself unable or unwilling to provide.

**Detection technology is uniquely key to solve terrorism**

Levi ‘8(Michael A. David M. Rubenstein senior fellow for energy and environment at the Council on Foreign Relations, “Deterring State of Sponsorship of Nuclear Terrorism”, Council of Foreign Relations Special Report No. 39, September 2008)

**Nuclear detection tech**nology **has a dual role in thwarting a terrorist nuclear attack—deterrence** ¶ **and defense.** Deterrence means dissuasion from an action by threat of unacceptable consequences. ¶ **Terrorists may be deterred from a nuclear strike by** one of the few consequences unacceptable to ¶ them: **failure**. **Detection systems would raise that risk.** These **systems** could also **make** **a** terrorist ¶ **nuclear strike too complex to succeed.** But **other factors** would also have these effects: the ¶ difficulty of fabricating a bomb, the chance that law enforcement or intelligence would detect ¶ efforts to obtain a bomb, the possible inability to detonate a purloined bomb, and the risk that ¶ ¶ scientists recruited for the plot would defect. Such risks would **disappear,** however, **if terrorists**  **were given a bomb and operating instructions. They would then only need to mount a smuggling operation. In that case, the role of nuclear detection systems** would change: they would **become the main defense.**

#### Reprocessing is best the method for producing tritium and HEU – Savannah River proves.

IEER, No Date

[Institute for Energy and Environmental Research, “Reprocessing and Spent Nuclear Fuel Management at the Savannah River Site”, RSR]

The primary mission of SRS throughout the Cold War was to produce tritium, a radioactive element used in nuclear weapons. This was done by placing fuel into one or more of the site’s five production reactors. Targets made of lithium were also placed inside the reactors. During the chain reaction, some of the neutrons coming off the U-235 were absorbed in the target rather than bumping into another atom of U-235. This created tritium inside the lithium target rod.¶ When the SRS reactors were not being used to make tritium, they were often used to make plutonium for nuclear weapons (Pu-239). This was done in a very similar way using depleted uranium targets instead of lithium ones. Depleted uranium is what’s left when most U-235 has been removed from natural uranium during the enrichment process. Sometimes other target materials were used to produce different radioisotopes. For example, neptunium-237 was used to produce Pu-238 for heat sources and special batteries for space exploration, as well as military and intelligence missions. The last SRS reactor operated in 1988.¶ Nuclear weapons are not made of irradiated targets. The tritium or plutonium first has to be separated from everything else in the target — the metal cladding and the other radioactive elements. The separation process for plutonium is called reprocessing. Reprocessing was also used at SRS to recover HEU from spent fuel to be made into new fuel. Some of this fuel came from SRS reactors, and spent fuel containing HEU was also sent to SRS from research and test reactors in the U.S. and other countries. Continued reprocessing is one of the options in the Draft EIS for managing SNF in the future

### Observation 3

#### Observation Three: Warming

#### Warming is real and anthropogenic – carbon dioxide increase, polar ice records, melting glaciers, sea level rise all prove.

Prothero 12 (Donald, Lecturer in Geobiology at Cal Tech and Professor of Geology at Occidental College, 3-1-12, “How We Know Global Warming is Real and Human Caused," Skeptic, vol 17 no 2, EBSCO)

Converging Lines of Evidence¶ How do we know that global warming is real and primarily human caused? There are numerous lines of evidence that converge toward this conclusion.¶ 1. Carbon Dioxide Increase.¶ Carbon dioxide in our atmosphere has increased at an unprecedented rate in the past 200 years. Not one data set collected over a long enough span of time shows otherwise. Mann et al. (1999) compiled the past 900 years' worth of temperature data from tree rings, ice cores, corals, and direct measurements in the past few centuries, and the sudden increase of temperature of the past century stands out like a sore thumb. This famous graph is now known as the "hockey stick" because it is long and straight through most of its length, then bends sharply upward at the end like the blade of a hockey stick. Other graphs show that climate was very stable within a narrow range of variation through the past 1000, 2000, or even 10,000 years since the end of the last Ice Age. There were minor warming events during the Climatic Optimum about 7000 years ago, the Medieval Warm Period, and the slight cooling of the Little Ice Age in die 1700s and 1800s. But the magnitude and rapidity of the warming represented by the last 200 years is simply unmatched in all of human history. More revealing, die timing of this warming coincides with the Industrial Revolution, when humans first began massive deforestation and released carbon dioxide into the atmosphere by burning an unprecedented amount of coal, gas, and oil.¶ 2. Melting Polar Ice Caps.¶ The polar icecaps are thinning and breaking up at an alarming rate. In 2000, my former graduate advisor Malcolm McKenna was one of the first humans to fly over the North Pole in summer time and see no ice, just open water. The Arctic ice cap has been frozen solid for at least the past 3 million years (and maybe longer),4 but now the entire ice sheet is breaking up so fast that by 2030 (and possibly sooner) less than half of the Arctic will be ice covered in the summer.5 As one can see from watching the news, this is an ecological disaster for everything that lives up there, from the polar bears to the seals and walruses to the animals they feed upon, to the 4 million people whose world is melting beneath their feet. The Antarctic is thawing even faster. In February-March 2002, the Larsen B ice shelf - over 3000 square km (the size of Rhode Island) and 220 m (700 feet) thick- broke up in just a few months, a story typical of nearly all the ice shelves in Antarctica. The Larsen B shelf had survived all the previous ice ages and interglacial warming episodes over the past 3 million years, and even the warmest periods of the last 10,000 years- yet it and nearly all the other thick ice sheets on the Arctic, Greenland, and Antarctic are vanishing at a rate never before seen in geologic history.¶ 3. Melting Glaciers.¶ Glaciers are all retreating at the highest rates ever documented. Many of those glaciers, along with snow melt, especially in the Himalayas, Andes, Alps, and Sierras, provide most of the freshwater that the populations below the mountains depend upon - yet this fresh water supply is vanishing. Just think about the percentage of world's population in southern Asia (especially India) that depend on Himalayan snowmelt for their fresh water. The implications are staggering. The permafrost that once remained solidly frozen even in the summer has now Üiawed, damaging the Inuit villages on the Arctic coast and threatening all our pipelines to die North Slope of Alaska. This is catastrophic not only for life on the permafrost, but as it thaws, the permafrost releases huge amounts of greenhouse gases which are one of the major contributors to global warming. Not only is the ice vanishing, but we have seen record heat waves over and over again, killing thousands of people, as each year joins the list of the hottest years on record. (2010 just topped that list as the hottest year, surpassing the previous record in 2009, and we shall know about 2011 soon enough). Natural animal and plant populations are being devastated all over the globe as their environments change.6 Many animals respond by moving their ranges to formerly cold climates, so now places that once did not have to worry about disease-bearing mosquitoes are infested as the climate warms and allows them to breed further north.¶ 4. Sea Level Rise.¶ All that melted ice eventually ends up in the ocean, causing sea levels to rise, as it has many times in the geologic past. At present, the sea level is rising about 3-4 mm per year, more than ten times the rate of 0.10.2 mm/year that has occurred over the past 3000 years. Geological data show Üiat ttie sea level was virtually unchanged over the past 10,000 years since the present interglacial began. A few mm here or there doesn't impress people, until you consider that the rate is accelerating and that most scientists predict sea levels will rise 80-130 cm in just the next century. A sea level rise of 1.3 m (almost 4 feet) would drown many of the world's low-elevation cities, such as Venice and New Orleans, and low-lying countries such as the Netherlands or Bangladesh. A number of tiny island nations such as Vanuatu and the Maldives, which barely poke out above the ocean now, are already vanishing beneath the waves. Eventually their entire population will have to move someplace else.7 Even a small sea level rise might not drown all these areas, but they are much more vulnerable to the large waves of a storm surge (as happened with Hurricane Katrina), which could do much more damage than sea level rise alone. If sea level rose by 6 m (20 feet), most of die world's coastal plains and low-lying areas (such as the Louisiana bayous, Florida, and most of the world's river deltas) would be drowned.¶ Most of the world's population lives in lowelevation coastal cities such as New York, Boston, Philadelphia, Baltimore, Washington, D.C., Miami, and Shanghai. All of those cities would be partially or completely under water with such a sea level rise. If all the glacial ice caps melted completely (as they have several times before during past greenhouse episodes in the geologic past), sea level would rise by 65 m (215 feet)! The entire Mississippi Valley would flood, so you could dock an ocean liner in Cairo, Illinois. Such a sea level rise would drown nearly every coastal region under hundreds of feet of water, and inundate New York City, London and Paris. All that would remain would be the tall landmarks such as the Empire State Building, Big Ben, and the Eiffel Tower. You could tie your boats to these pinnacles, but the rest of these drowned cities would lie deep underwater.

#### Scientific consensus goes aff – 97% of the most qualified scientists in the field agree

Anderegg, et al. 10 (William (Department of Biology, Stanford University); James Prall (Electrical and Computer Engineering, University of Toronto); Jacob Harold (William and Flora Hewlett Foundation); and Stephen Schneider (Department of Biology, Stanford University and Woods Institute for the Environment, Stanford University), “Expert credibility in climate change”, PNAS, Vol. 17, No. 27, July 6, 2010, RSR

\*\*Note: ACC = Anthropogenic Climate Change, UE = those unconvinced by evidence and CE = those convinced by evidence.)

The UE group comprises only 2% of the top 50 climate researchers as ranked by expertise (number of climate publications), 3% of researchers of the top 100, and 2.5% of the top 200, excluding researchers present in both groups (Materials and Methods). This result closely agrees with expert surveys, indicating that ≈97% of self-identiﬁed actively publishing climate scientists agree with the tenets of ACC (2). Furthermore, this ﬁnding complements direct polling of the climate researcher community, which yields qualitative and self-reported researcher expertise (2). Our ﬁndings capture the added dimension of the distribution of researcher expertise, quantify agreement among the highest expertise climate researchers, and provide an independent assessment of level of scientiﬁc consensus concerning ACC. In addition to the striking difference in number of expert researchers between CE and UE groups, the distribution of expertise of the UE group is far below that of the CE group (Fig. 1). Mean expertise of the UE group was around half (60 publications) that of the CE group (119 publications; Mann–Whitney U test: W = 57,020; P < 10 −14 ), as was median expertise (UE = 34 publications; CE = 84 publications). Furthermore, researchers with fewer than 20 climate publications comprise ≈80% the UE group, as opposed to less than 10% of the CE group. This indicates that the bulk of UE researchers on the most prominent multisignatory statements about climate change have not published extensively in the peer-reviewed climate literature. We examined a subsample of the 50 most-published (highestexpertise) researchers from each group. Such subsampling facilitates comparison of relative expertise between groups (normalizing differences between absolute numbers). This method reveals large differences in relative expertise between CE and UE groups (Fig. 2). Though the top-published researchers in the CE group have an average of 408 climate publications (median = 344), the top UE researchers average only 89 publications (median = 68; Mann– Whitney U test: W = 2,455; P < 10 −15 ). Thus, this suggests that not all experts are equal, and top CE researchers have much stronger expertise in climate science than those in the top UE group. Finally, our prominence criterion provides an independent and approximate estimate of the relative scientiﬁc signiﬁcance of CE and UE publications. Citation analysis complements publication analysis because it can, in general terms, capture the quality and impact of a researcher’s contribution—a critical component to overall scientiﬁc credibility—as opposed to measuring a researcher’s involvement in a ﬁeld, or expertise (Materials and Methods). The citation analysis conducted here further complements the publication analysis because it does not examine solely climaterelevant publications and thus captures highly prominent researchers who may not be directly involved with the climate ﬁeld. We examined the top four most-cited papers for each CE and UE researcher with 20 or more climate publications and found immense disparity in scientiﬁc prominence between CE and UE communities (Mann–Whitney U test: W = 50,710; P < 10 −6 ; Fig. 3). CE researchers’ top papers were cited an average of 172 times, compared with 105 times for UE researchers. Because a single, highly cited paper does not establish a highly credible reputation but might instead reﬂect the controversial nature of that paper (often called the single-paper effect), we also considered the average the citation count of the second through fourth most-highly cited papers of each researcher. Results were robust when only these papers were considered (CE mean: 133; UE mean: 84; Mann–Whitney U test: W = 50,492; P < 10 −6 ). Results were robust when all 1,372 researchers, including those with fewer than 20 climate publications, were considered (CE mean: 126; UE mean: 59; Mann–Whitney U test: W = 3.5 × 10 5 ; P < 10 −15 ). Number of citations is an imperfect but useful benchmark for a group’s scientiﬁc prominence (Materials and Methods), and we show here that even considering all (e.g., climate and nonclimate) publications, the UE researcher group has substantially lower prominence than the CE group. We provide a large-scale quantitative assessment of the relative level of agreement, expertise, and prominence in the climate researcher community. We show that the expertise and prominence, two integral components of overall expert credibility, of climate researchers convinced by the evidence of ACC vastly overshadows that of the climate change skeptics and contrarians. This divide is even starker when considering the top researchers in each group. Despite media tendencies to present both sides in ACC debates (9), which can contribute to continued public misunderstanding regarding ACC (7, 11, 12, 14), not all climate researchers are equal in scientiﬁc credibility and expertise in the climate system. This extensive analysis of the mainstream versus skeptical/contrarian researchers suggests a strong role for considering expert credibility in the relative weight of and attention to these groups of researchers in future discussions in media, policy, and public forums regarding anthropogenic climate change.

#### We must act quickly with long term technological innovation to avoid the irreversible climate change triggered by 2°C.

Peters, et al. 12(Glen (Center for International Climate and Environmental Research – Oslo); Robbie Andrew (Center for International Climate and Environmental Research – Oslo); Tom Boden (Carbon Dioxide Information Analysis Center (CDIAC), Oak Ridge National Laboratory); Josep Canadell (Global Carbon Project, CSIRO Marine and Atmospheric Research, Canberra, Australia); Philippe Ciais (Laboratoire des Sciences du Climat et de l’Environnement, Gif sur Yvette, France); Corinne Le Quéré (Tyndall Centre for Climate Change Research, University of East Anglia, Norwich, UK); Gregg Marland (Research Institute for Environment, Energy, and Economics, Appalachian State University); Michael R. Raupach (Global Carbon Project, CSIRO Marine and Atmospheric Research, Canberra, Australia); and Charlie Wilson (Tyndall Centre for Climate Change Research, University of East Anglia, Norwich, UK), “The challenge to keep global warming below 2 °C”, Nature Climate Change, 12-2-12, RSR)

It is important to regularly re-assess the relevance of emissions scenarios in light of changing global circumstances3,8. In the past, decadal trends in CO2 emissions have responded slowly to changes in the underlying emission drivers because of inertia and path dependence in technical, social and political systems9. Inertia and path dependence are unlikely to be affected by short-term fluctuations2,3,9 — such as financial crises10 — and it is probable that emissions will continue to rise for a period even after global mitigation has started11. Thermal inertia and vertical mixing in the ocean, also delay the temperature response to CO2 emissions12. Because of inertia, path dependence and changing global circumstances, there is value in comparing observed decadal emission trends with emission scenarios to help inform the prospect of different futures being realized, explore the feasibility of desired changes in the current emission trajectory and help to identify whether new scenarios may be needed. Global CO2 emissions have increased from 6.1±0.3 Pg C in 1990 to 9.5±0.5 Pg C in 2011 (3% over 2010), with average annual growth rates of 1.9% per year in the 1980s, 1.0% per year in the 1990s, and 3.1% per year since 2000. We estimate that emissions in 2012 will be 9.7±0.5 Pg C or 2.6% above 2011 (range of 1.9–3.5%) and 58% greater than 1990 (Supplementary Information and ref. 13). The observed growth rates are at the top end of all four generations of emissions scenarios (Figs 1 and 2). Of the previous illustrative IPCC scenarios, only IS92-E, IS92-F and SRES A1B exceed the observed emissions (Fig. 1) or their rates of growth (Fig. 2), with RCP8.5 lower but within uncertainty bounds of observed emissions. Observed emission trends are in line with SA90-A, IS92-E and IS92-F, SRES A1FI, A1B and A2, and RCP8.5 (Fig. 2). The SRES scenarios A1FI and A2 and RCP8.5 lead to the highest temperature projections among the scenarios, with a mean temperature increase of 4.2–5.0 °C in 2100 (range of 3.5–6.2 °C)14, whereas the SRES A1B scenario has decreasing emissions after 2050 leading to a lower temperature increase of 3.5 °C (range 2.9–4.4°C)14. Earlier research has noted that observed emissions have tracked the upper SRES scenarios15,16 and Fig. 1 confirms this for all four scenario generations. This indicates that the space of possible pathways could be extended above the top-end scenarios to accommodate the possibility of even higher emission rates in the future. The new RCPs are particularly relevant because, in contrast to the earlier scenarios, mitigation efforts consistent with longterm policy objectives are included among the pathways2,. RCP3-PD (peak and decline in concentration) leads to a mean temperature increase of 1.5 °C in 2100 (range of 1.3–1.9 °C)14. RCP3–PD requires net negative emissions (for example, bioenergy with carbon capture and storage) from 2070, but some scenarios suggest it is possible to stay below 2 °C without negative emissions17–19. RCP4.5 and RCP6 — which lie between RCP3–PD and RCP8.5 in the longer term — lead to a mean temperature increase of 2.4 °C (range of 1.0–3.0 °C) and 3.0 °C (range of 2.6–3.7 °C) in 2100, respectively14. For RCP4.5, RCP6 and RCP8.5, temperatures will continue to increase after 2100 due to on-going emissions14 and inertia in the climate system12. Current emissions are tracking slightly above RCP8.5, and given the growing gap between the other RCPs (Fig. 1), significant emission reductions are needed by 2020 to keep 2 °C as a feasible goal18–20. To follow an emission trend that can keep the temperature increase below 2 °C (RCP3-PD) requires sustained global CO2 mitigation rates of around 3% per year, if global emissions peak before 202011,19. A delay in starting mitigation activities will lead to higher mitigation rates11, higher costs21,22, and the target of remaining below 2 °C may become unfeasible18,20. If participation is low, then higher rates of mitigation are needed in individual countries, and this may even increase mitigation costs for all countries22. Many of these rates assume that negative emissions will be possible and affordable later this century11,17,18,20. Reliance on negative emissions has high risks because of potential delays or failure in the development and large-scale deployment of emerging technologies such as carbon capture and storage, particularly those connected to bioenergy17,18. Although current emissions are tracking the higher scenarios, it is still possible to transition towards pathways consistent with keeping temperatures below 2 °C (refs 17,19,20). The historical record shows that some countries have reduced CO2 emissions over 10-year periods, through a combination of (non-climate) policy intervention and economic adjustments to changing resource availability. The oil crisis of 1973 led to new policies on energy supply and energy savings, which produced a decrease in the share of fossil fuels (oil shifted to nuclear) in the energy supply of Belgium, France and Sweden, with emission reductions of 4–5% per year sustained over 10 or more years (Supplementary Figs S17–19). A continuous shift to natural gas — partially substituting coal and oil — led to sustained mitigation rates of 1–2% per year in the UK in the 1970s and again in the 2000s, 2% per year in Denmark in the 1990–2000s, and 1.4% per year since 2005 in the USA (Supplementary Figs S10–12). These examples highlight the practical feasibility of emission reductions through fuel substitution and efficiency improvements, but additional factors such as carbon leakage23 need to be considered. These types of emission reduction can help initiate a transition towards trajectories consistent with keeping temperatures below 2 °C, but further mitigation measures are needed to complete and sustain the reductions. Similar energy transitions could be encouraged and co-ordinated across countries in the next 10 years using available technologies19, but well-targeted technological innovations24 are required to sustain the mitigation rates for longer periods17. To move below the RCP8.5 scenario — avoiding the worst climate impacts — requires early action17,18,21 and sustained mitigation from the largest emitters22 such as China, the United States, the European Union and India. These four regions together account for over half of global CO2 emissions, and have strong and centralized governing bodies capable of co-ordinating such actions. If similar energy transitions are repeated over many decades in a broader range of developed and emerging economies, the current emission trend could be pulled down to make RCP3‑PD, RCP4.5 and RCP6 all feasible futures. A shift to a pathway with the highest likelihood to remain below 2 °C above preindustrial levels (for example, RCP3-PD), requires high levels of technological, social and political innovations, and an increasing need to rely on net negative emissions in the future11,17,18. The timing of mitigation efforts needs to account for delayed responses in both CO2 emissions9 (because of inertia in technical, social and political systems) and also in global temperature12 (because of inertia in the climate system). Unless large and concerted global mitigation efforts are initiated soon, the goal of remaining below 2 °C will very soon become unachievable.

#### Scenario one is corals

#### Increased CO2 emissions kill coral diversity – newest research shows.

Fabricius, et al. 11

[Katharina (Australian Institute of Marine Science); Chris Langdon (University of Miami Rosenstiel School of Marine and Atmospheric Science); Sven Uthicke (Australian Institute of Marine Science); Craig Humphrey (Australian Institute of Marine Science); Sam Noonan (Australian Institute of Marine Science); Remy Okazaki (University of Miami Rosenstiel School of Marine and Atmospheric Science); Nancy Muehllehner (University of Miami Rosenstiel School of Marine and Atmospheric Science); Martin S. Glas (Max-Planck Institute for Marine Microbiology, Department of Biogeochemistry); and Janice M. Lough (Australian Institute of Marine Science), “Losers and winners in coral reefs acclimatized to elevated carbon dioxide concentrations”, Nature Climate Change, Vol. 1, June 2011, RSR]

Rising atmospheric CO2 from the burning of fossil fuels and deforestation affects marine systems in several ways. Through its effect on the global climate, it increases sea surface temperatures (now 0:7 C higher than in pre-industrial times) and intensifies storm and rainfall variability, altering salinity and the terrestrial runoff of nutrients and sediments8. It also causes profound changes in sea water chemistry. Atmospheric CO2 concentrations of 390 ppm already exceed by 50100% the historic envelope of 200300 ppm in the past >2 million years9. The resulting increased partial pressure of carbon dioxide (pCO2) in sea water has already reduced mean surface seawater pH by 0.1, thus lowering carbonate ion concentrations by 30 mol kg􀀀1, and the saturation state of sea water for calcium carbonate minerals ( ) by 15%, although the magnitude of these effects varies regionally and with latitude1,5,10,11. The declining pH, termed `ocean acidification', is predicted to have profound implications for marine ecosystems because carbonate ions are an essential substrate for biotic calcification. Coral reefs are of particular concern because their many tens of thousands of species ultimately depend on the structural complexity derived from the corals' carbonate skeletons5,6. However, specific knowledge about the capacity of reef ecosystems to acclimatize and/or adapt to long-term exposure to lowered pH (increased pCO2 and reduced ) remains inadequate. Much of our understanding stems from short-term laboratory perturbation experiments of individual organisms or from deterministic models. Perturbation experiments report variable and sometimes severe responses in many marine plants, invertebrates and vertebrates at lowered pH, such as declining calcification, altered physiologies and some effects on survival24. Although laboratory experiments are indispensable, most are too brief for full organism acclimatization to occur, and co-limiting factors (for example nutrients, currents and irradiance) are difficult to simulate ex situ12,13. Experiments also provide little information about processes leading to ecosystem adaptation, such as altered reproduction, competition, food webs and disease susceptibility, or genetic adaptation. There is therefore a great need for empirical data documenting the long-term effects of ocean acidification on marine ecosystems acclimatized to high pCO2, as found around submarine CO2 vents. Recently, changes in shallow-water marine rocky shore ecosystems have been investigated at volcanic CO2 vents in the Mediterranean, documenting major declines in many calcifying and non-calcifying organisms and increases in macroalgae and seagrasses at reduced seawater pH (refs 7,14). Here we report the effects of natural in situ exposure to elevated seawater pCO2 on tropical coral reef communities, coral growth, recruitment, seagrasses and sedimentary properties. The study is based on field investigations of clear-water coral reefs and seagrass communities around three cool volcanic seeps of 99% CO2 gas, and at three adjacent control sites with similar geomorphology, seawater temperature and salinity, that fringe the D'Entrecastraux Islands, Milne Bay Province, Papua New Guinea (Supplementary Figs S1, S2, Table S1). Coral communities at 3mdepth were compared between control sites (`low pCO2': bubble streams >5m from the transect lines, medians per site 7.978.14 pH at total scale, 296494 ppm pCO2) and reef sections with moderate seep activity (`high pCO2': bubble streams <5m from the transect lines, pH 7.738.00, 444953 ppm pCO2; Fig. 1a,b, Supplementary Fig. S3, Table S2). The median saturation state of sea water for the calcium carbonate mineral aragonite ( arag) was 3.5 at the control sites and 2.9 at the seeps. The zones of most vigorous venting were covered by sand or rocks with individual coral colonies, macroalgae or dense seagrass (Fig. 1c, Supplementary Fig. S4). No reef development was found at a pH less than 7.70 (>1,000 ppm CO2), and hence the most intensely venting zones were excluded from the reef assessment. The field surveys showed that at high compared with low pCO2 sites, hard coral cover was similar (33% versus 31%; Fig. 2a, Supplementary Table S3). However, the cover of massive Poritescorals doubled, whereas the cover of structurally complex corals (with branching, foliose, and tabulate growth forms, that is, excluding massive, submassive and encrusting growth forms) was reduced three fold. The taxonomic richness of hard corals was reduced by 39%. The cover of fleshy non-calcareous macroalgae doubled and seagrass increased eight fold, whereas the cover of crustose coralline algae (important calcareous substrata for coral settlement) and of other red calcareous algae was reduced seven fold. Cover and richness of soft corals and sponge cover were also significantly reduced. The density and taxonomic richness of hard coral juveniles were reduced 2.8- and 2-fold, respectively, and of soft coral juveniles 18- and 12-fold, at the high pCO2 sites (Fig. 2b). Even juvenile densities of massive Porites declined >fourfold at high pCO2, despite the high representation of this taxon in the adult community. The pH for each 10-m section along the study transects at the largest seep site (Upa-Upasina) was spatially predicted from the observed pH data (Supplementary Fig. S3). As seawater pH declined from 8.1 to 7.8, reef communities gradually changed, without a clear threshold (Fig. 3, Supplementary Table S4). In particular, hard coral richness, coral juveniles, and crustose coralline algae progressively declined with declining pH. Differences in rates of calcification and tissue thickness in massive Porites between the high and low pCO2 sites were small (Fig. 2c, Supplementary Table S3). However, massive Porites colonies were paler at high pCO2, and had almost twice the density of externally visible macrobioeroders in their living surfaces compared to low pCO2 sites. Similarly, in situ growth measurements found small differences in linear extension in the ubiquitous coral Pocillopora damicornis. Clades of endosymbiotic dinoflagellate algae did not change in response to high pCO2 in P. damicornis (90% with clade D1, 10% with C1 at both seeps and controls) and Acropora millepora (100% with clade C3). At both the high and low pCO2 sites in Milne Bay, mean calcification rates of massive Porites over the past 12 years were 30% lower than expected given their latitude15 (Fig. 4). This finding is in agreement with an increasing body of data that show that rates of calcification in massive Porites, P. damicornis and other corals have declined by 1430% over the past 2 decades in large geographic regions around the world, with the two global factors, temperature stress and/or ocean acidification, considered the most likely cause(s)16,17. Milne Bay summer maximum sea surface temperatures have exceeded the long-term averages in 9 of these last 12 years18. Severe coral bleaching occurred in the region in 1996, followed by minor bleaching in 1998 and 20002001 (Supplementary Information). The similar and low calcification rates at the high and low pCO2 sites suggest that calcification in massive Porites is relatively insensitive to a reduction to pH 7.8, and that another factor (possibly temperature stress) has had a stronger effect on calcification. Nevertheless, even massive Porites were infrequent near the most intense vents where seawater pH was <7:7, in agreement with experiments showing a 5575% reduction in Porites calcification at pH 7.49 and 7.19 compared to that at ambient pH (ref. 19). Seagrass communities at the intense seeps (>500 ppm pCO2) had three to four times higher shoot densities and below-ground biomass compared with those at the control site, but reduced diversity (Fig. 2d). On seagrass blades, calcareous epiphyte cover and densities of the large foraminifera Marginopora vertebralis were both nearly zero near the seeps. The increases in seagrass and macroalgal cover and reductions in epiphytes and carbonate organisms are similar to the findings reported from volcanic CO2 vents in the Mediterranean7. Surface sediments at high pCO2 sites were almost free of inorganic carbon, calcareous biota and their remains (foraminifera, small gastropods and calcareous spicules; Fig. 2e), whereas organic carbon, nitrogen and siliceous spicules did not change along the pH gradient. Indeed, across the high pCO2 sites, total seawater alkalinity was elevated by 50 Equiv kg􀀀1 sea water (Supplementary Table S2), suggesting continued net carbonate dissolution. The more sparsely seeping Esa'Ala high pCO2 site sediments still contained 5% inorganic carbon (controls: 610%), however many foraminifera tests were corroded or pitted. The implications of the observed ecological changes for the future of coral reefs are severe. The decline in structurally complex framework-forming corals at lowered pH is likely to reduce habitat availability and quality for juvenile fish and many invertebrates20. The low coral juvenile densities (including those of Porites) probably slows coral recovery after disturbance, suggesting reduced community resilience. The loss of crustose coralline algae that serve as settlement substratum for coral larvae probably impedes larval recruitment, and the doubling of non-calcareous macroalgae reduces the available space for larvae to settle. Susceptibility to storm breakage would also increase, if internal macrobioeroder densities in massive Porites are indicative of borer densities in other coral taxa and reef substrata. Indeed, high bioerosion rates have been reported from reefs where deepwater upwelling reduces arag (ref. 21). However, the causal mechanisms and implications of these and many other of the observed changes, such as increased macroalgal cover and bioeroder densities, and declines in sponges, soft corals and numerous other taxa at lowered pH remain poorly understood. Natural limitations exist in using the Milne Bay CO2 seeps as proxies to assess the future of coral reefs. The seeps are surrounded by areas with ambient pH, supplying larvae of sensitive taxa for recolonization, and hence partly offsetting the negative effects of ocean acidification on recruitment. As a result of wave mixing, pCO2 approaches background values during windy periods, providing respite from low pH, especially during the trade-wind seasons. The Milne Bay seeps are located within the coral triangle at 9 latitude, where conditions for reef development are ideal; reefs at higher latitudes with low arag may be more susceptible to ocean acidification. Reefs around the seeps are also under relatively low anthropogenic pressures (Supplementary Information), and it is likely that ocean acidification may affect reefs more severely if they are already stressed from terrestrial runoff or overfishing. Bearing in mind these caveats, our data nevertheless suggest that tropical coral reefs with high coral cover can still exist at seawater pH of 7.8 (750 ppm pCO2, 150 mol kg􀀀1 carbonate ions, or arag 2.5), albeit with severe losses in biodiversity, structural complexity and resilience. As pH declines from 8.1 to 7.8 units, the loss of the stenotopic fast-growing structurally complex corals progressively shifts reef communities to those dominated by slow-growing, longlived and structurally simple eurytopic massive Porites (Fig. 1a,b). As a result of this shift in species composition, coral cover seems to be unaltered during the transition from 8.1 to 7:8 pH units. Reef development ceases at 7.7 pH units (980 ppm pCO2, 125 mol kg􀀀1 carbonate ions, 2:0 arag), suggesting these values are terminal thresholds for any form of coral reef development. This threshold is higher than those previously derived from global spatial correlations between aragonite saturation state and reef development5, possibly because the high latitude reefs and upwelling sites where low aragonite saturation states are naturally found are also exposed to very low or fluctuating temperatures, which is not the case at the Milne Bay seep sites. The threshold is also higher than those derived from deterministic model predictions, possibly because these models assess pH changes and projected increases in temperature stress simultaneously6 (the seeps are not yet subjected to the projected warming of>2 C). The rate of atmospheric CO2 increase continues to accelerate, with emission scenarios predicting CO2 concentrations of 540970 ppm and a decline in seawater pH by 0.140.35 units globally (to 7.97.7 units, arag D3:02:1) for 2100 (refs 8,22). The range of exposures of the seep sites are therefore comparable to end-of-century pCO2 projections (however, without the additional stress due to the predicted warming). Our study demonstrates that many ecological properties in coral reefs will gradually change as pH declines to 7.8, and that it would be catastrophic for coral reefs if seawater pH dropped below 7.8 (at 750 ppm pCO2). We have shown here that large differences in sensitivity between organisms to declining pH result in complex changes in tropical ecosystems, with a few taxa and processes winning, but many more losing prominence. Temperature stress leading to reduced coral calcification (for example in massive Porites) has the potential to further accelerate and exacerbate the losses. Our data add to the mounting body of evidence that shows a rapid transition to a lowCO2 emissions future is necessary to minimize the risk of profound losses of coral reef ecosystem functions and services, not only due to climate change, but also due to ocean acidification.

#### Coral loss risks massive biodiversity loss – maintain most of marine biodiversity.

Veron et al. 9

[J.E.N (Coral Reef Research – Australia); O. Hoegh-Guldberg (Centre of Excellence for Coral Reef Studies, University of Queensland); T.M. Lenton (School of Environmental Sciences, University of East Anglia); J.M. Lough (Australian Institute of Marine Science); D.O. Obura (IUCN Coral Specialist Grou); P. Pearce-Kelly (Zoological Society of London); C.R.C. Sheppard (Dept. of Biological Sciences, University of Warwick); M. Spalding (The Nature Conservancy - UK); M.G. Stafford-Smith (Coral Reef Research – Australia); and A.D. Rogers (nternational Programme on State of the Ocean and Zoological Society of London), “The coral reef crisis: The critical importance of <350 ppm CO2”, Marine Pollution Bulletin, Vol. 58, 2009, pg. 1428-1429, RSR]

Although they make up only 0.2% in area of the marine environment, coral reefs are the most biodiverse ecosystems of the ocean, estimated to harbour around one third of all described marine species (Reaka-Kudla, 1997, 2001), most of which are found nowhere else. Their intricate three-dimensional landscapes promote elaborate adaptation, richly complex species interdependencies, and a fertile source of medically active compounds (Fenical, 2002; Bruckner, 2007). The extensive ramparts formed by reefs shield thousands of kilometres of coastline from wave erosion, protecting essential lagoon and mangrove habitat for vulnerable life stages of a wide range of commercial and non-commercial species (Johnson and Marshall, 2007). More than 100 countries have coastlines with coral reefs (Moberg and Folke, 1999) and almost 500 million people (8% of the world’s population) live within 100 km of a reef (Bryant et al., 1998). Consequently, tens of millions of people depend on reef ecosystems for protein and other services (Costanza et al., 1997). Resulting exploitation, combined with lack of regulation, has resulted in severe depletion of many reef resources and has caused widespread reef degradation particularly in highly populated regions (Pet-Soede et al., 1999). Despite these impacts, human dependence on reefs continues to increase. The values of goods and services provided by reefs have not been accurately determined, but estimates range from $172 billion to $375 billion per year (Moore and Best, 2001; Wilkinson, 2002; Fischlin et al., 2007; Martínez et al., 2007). This is probably underestimated given that many of the beneﬁts of coral reefs pass through non-market economies (Donner and Potere, 2007) or involve intangible ecosystem services such as sand production and gas exchange. Importantly, the consequences of coral reef destruction would not be limited to the loss of the value of these goods and services, for the demise of reefs would also mean the extinction of a large part of the Earth’s total biodiversity – something never experienced before in human history.

#### The impact is extinction – relative probability means err aff.

Kunich 5 [John, Professor of Law at Roger Williams University School of Law, ARTICLE: Losing Nemo: The Mass Extinction Now Threatening the World's Ocean Hotspots,” Columbia Journal of Environmental Law, 2005, 30 Colum. J. Envtl. L. 1]

On the other hand, there is an unimaginable cost from failing to preserve the marine hotspots if they contain numerous species of high value at great risk of extinction. We could cost ourselves and our posterity untold advancements in medicine, therapies, genetic resources, nutrients, ecosystem services, and other areas, including perhaps a cure to a global health threat that might not materialize until centuries from now...truly a "grave error" of the first order. [\*128] But if we sit on the sidelines and fail to invest in hotspots preservation, and we "get lucky" (few species, low value, small extinction risk), our only gain is in the form of saving the money and effort we could have spent on the hotspots. Even if this amounts to several billion dollars a year, it is a small benefit compared to the incalculably catastrophic losses we could suffer if we guess wrong in betting on the inaction option.¶ The Decision Matrix actually under-represents the extent to which the rational decision is to invest in hotspots preservation. Because the Decision Matrix, in tabular form, devotes equal space to each of the sixteen possible combinations of extreme variable values, it can mislead readers into thinking that each of the sixteen outcomes is equally probable. This is most emphatically not the case. Some of these results are far more probable than others. This problem of apparent equality of disparate results is of the same type as a chart that depicts a person's chances of being fatally injured by a plummeting comet on the way home from work on any given day. There are only two possible results in such a table (survives another day, or killed by meteor), and they would occupy an equal amount of tabular space on the printed page, but the probability of the former outcome is, thankfully, much higher than the likelihood of the latter tragic event.¶ As explained in this Article, it is much more likely that there are numerous, even millions, of unidentified species currently living in the marine hotspots than that these hotspots are really not centers of profuse biodiversity. It is also very probable that the extinction threat in our oceans is real, and significant, given what we know about the horrific effects wrought on coral reefs and other known marine population centers by overfishing, pollution, sedimentation, and other human-made stressors. n525 Recent discoveries have revealed very high rates of endemism in small areas such as seamounts, which are extremely vulnerable to trawl damage. n526 Even in the deep ocean areas, there is evidence that new technologies are making it both a possibility and a reality to exploit the previously unexploitable biodiversity in these waters via [\*129] demersal fishing/trawling, to devastating effect. n527 Only a truly Orwellian brand of doublethink could label as progress the development of fishing methods that do to the benthic habitats what modern clearcutting has done to so many forests, only on a scale 150 times as severe, but it is this "progress" that has brought mass extinction to the seas. n528 However, there is also the positive side, in light of the large numbers of marine species and habitat types, including life forms adapted to extraordinary niches such as hydrothermal vents and the abyss. That is, it would be surprising if there were not highly valuable genetic resources, natural medicines, potential sources of food, and other boons waiting to be discovered there.¶ Therefore, the results that are linked to high, rather than low, values of each of the three variables are far more probable than the converse outcomes. In terms of probabilities, it is much more likely that either a "first order grave error" or "first order jackpot" will occur than a "lucky wager" or an "unused insurance" result. In fact, all of the combinations with either two or three "high" values of the variables are significantly more probable that any of the combinations with two or three "low" variable values. This means that the tilt in favor of betting on the hotspots is much more pronounced than is apparent from a cursory glance at the Decision Matrix. The extreme results are far likelier to fall in favor of hotspots preservation than the opposite**.**

#### **Scenario two is agriculture**

#### Despite CO2 fertilization, massive rise of temperature due to warming causes food shortages —the result is extinction.

Strom 7 (Robert, Professor Emeritus of planetary sciences in the Department of Planetary Sciences at the University of Arizona, studied climate change for 15 years, the former Director of the Space Imagery Center, a NASA Regional Planetary Image Facility, “Hot House”, SpringerLink, p. 211-216)

THE future consequences of global warming are the least known aspect of the problem. They are based on highly complex computer models that rely on inputs that are sometimes not well known or factors that may be completely unforeseen. Most models assume certain scenarios concerning the rise in greenhouse gases. Some assume that we continue to release them at the current rate of increase while others assume that we curtail greenhouse gas release to one degree or another. Furthermore, we are in completely unknown territory. The current greenhouse gas content of the atmosphere has not been as high in at least the past 650,000 years, and the rise in temperature has not been as rapid since civilization began some 10,000 years ago. What lies ahead for us is not completely understood, but it certainly will not be good, and it could be catastrophic. We know that relatively minor climatic events have had strong adverse effects on humanity, and some of these were mentioned in previous chapters. A recent example is the strong El Nin~o event of 1997-1998 that caused weather damage around the world totaling $100 billion: major flooding events in China, massive fires in Borneo and the Amazon jungle, and extreme drought in Mexico and Central America. That event was nothing compared to what lies in store for us in the future if we do nothing to curb global warming. We currently face the greatest threat to humanity since civilization began. This is the crucial, central question, but it is very difficult to answer (Mastrandea and Schneider, 2004). An even more important question is: "At what temperature and environmental conditions is a threshold crossed that leads to an abrupt and catastrophic climate change?'' It is not possible to answer that question now, but we must be aware that in our ignorance it could happen in the not too distant future. At least the question of a critical temperature is possible to estimate from studies in the current science literature. This has been done by the Potsdam Institute for Climate Impact Research, Germany's leading climate change research institute (Hare, 2005). According to this study, global warming impacts multiply and accelerate rapidly as the average global temperature rises. We are certainly beginning to see that now. According to the study, as the average global temperature anomaly rises to 1 °C within the next 25 years (it is already 0.6'C in the Northern Hemisphere), some specialized ecosystems become very stressed, and in some developing countries food production will begin a serious decline, water shortage problems will worsen, and there will be net losses in the gross domestic product (GDP). At least one study finds that because of the time lags between changes in radiative forcing we are in for a 1 °C increase before equilibrating even if the radiative forcing is fixed at today's level (Wetherald et al., 2001). It is apparently when the temperature anomaly reaches 2 °C that serious effects will start to come rapidly and with brute force (International Climate Change Taskforce, 2005). At the current rate of increase this is expected to happen sometime in the middle of this century. At that point there is nothing to do but try to adapt to the changes. Besides the loss of animal and plant species and the rapid exacerbation of our present problems, there are likely to be large numbers of hungry, diseased and starving people, and at least 1.5 billion people facing severe water shortages. GDP losses will be significant and the spread of diseases will be widespread (see below). We are only about 30 years away from the 440 ppm CO2 level where the eventual 2'C global average temperature is probable. When the temperature reaches 3 'C above today's level, the effects appear to become absolutely critical. At the current rate of greenhouse gas emission, that point is expected to be reached in the second half of the century. For example, it is expected that the Amazon rainforest will become irreversibly damaged leading to its collapse, and that the complete destruction of coral reefs will be widespread. As these things are already happening, this picture may be optimistic. As for humans, there will be widespread hunger and starvation with up to 5.5 billion people living in regions with large crop losses and another 3 billion people with serious water shortages. If the Amazon rainforest collapses due to severe drought it would result in decreased uptake of CO2 from the soil and vegetation of about 270 billion tons, resulting in an enormous increase in the atmospheric level of CO2. This, of course, would lead to even hotter temperatures with catastrophic results for civilization. A Regional Climate Change Index has been established that estimates the impact of global warming on various regions of the world (Giorgi, 2006). The index is based on four variables that include changes in surface temperature and precipitation in 2080-2099 compared to the period 1960-1979. All regions of the world are affected significantly, but some regions are much more vulnerable than others. The biggest impacts occur in the Mediterranean and northeastern European regions, followed by high-latitude Northern Hemisphere regions and Central America. Central America is the most affected tropical region followed by southern equatorial Africa and southeast Asia. Other prominent mid-latitude regions very vulnerable to global warming are eastern North America and central Asia. It is entirely obvious that we must start curtailing greenhouse gas emissions now, not 5 or 10 or 20 years from now. Keeping the global average temperature anomaly under 2'C will not be easy according to a recent report (Scientific Expert Group Report on Climate Change, 2007). It will require a rapid worldwide reduction in methane, and global CO2 emissions must level off to a concentration not much greater than the present amount by about 2020. Emissions would then have to decline to about a third of that level by 2100. Delaying action will only insure a grim future for our children and grandchildren. If the current generation does not drastically reduce its greenhouse gas emission, then, unfortunately, our grandchildren will get what we deserve. There are three consequences that have not been discussed in previous chapters but could have devastating impacts on humans: food production, health, and the economy. In a sense, all of these topics are interrelated, because they affect each other. Food Production Agriculture is critical to the survival of civilization. Crops feed not only us but also the domestic animals we use for food. Any disruption in food production means a disruption of the economy, government, and health. The increase in CO2 will result in some growth of crops, and rising temperatures will open new areas to crop production at higher latitudes and over longer growing seasons; however, the overall result will be decreased crop production in most parts of the world. A 1993 study of the effects of a doubling of CO2 (550 ppm) above pre-industrial levels shows that there will be substantial decreases in the world food supply (Rosenzweig et al., 1993). In their research they studied the effects of global warming on four crops (wheat, rice, protein feed, and coarse grain) using four scenarios involving various adaptations of crops to temperature change and CO2 abundance. They found that the amount of world food reduction ranged from 1 to 27%. However, the optimistic value of 1% is almost certainly much too low, because it assumed that the amount of degradation would be offset by more growth from "CO2 fertilization." We now know that this is not the case, as explained below and in Chapter 7. The most probable value is a worldwide food reduction between 16 and 27%. These scenarios are based on temperature and CO2 rises that may be too low, as discussed in Chapter 7. However, even a decrease in world food production of 16% would lead to large-scale starvation in many regions of the world. Large-scale experiments called Free-Air Concentration Enrichment have shown that the effects of higher CO2 levels on crop growth is about 50% less than experiments in enclosure studies (Long et al., 2006). This shows that the projections that conclude that rising CO2 will fully offset the losses due to higher temperatures are wrong. The downside of climate change will far outweigh the benefits of increased CO2 and longer growing seasons. One researcher (Prof. Long) from the University of Illinois put it this way: Growing crops much closer to real conditions has shown that increased levels of carbon dioxide in the atmosphere will have roughly half the beneficial effects previously hoped for in the event of climate change. In addition, ground-level ozone, which is also predicted to rise but has not been extensively studied before, has been shown to result in a loss of photosynthesis and 20 per cent reduction in crop yield. Both these results show that we need to seriously re-examine our predictions for future global food production, as they are likely to be far lower than previously estimated. Also, studies in Britain and Denmark show that only a few days of hot temperatures can severely reduce the yield of major food crops such as wheat, soy beans, rice, and groundnuts if they coincide with the flowering of these crops. This suggests that there are certain thresholds above which crops become very vulnerable to climate change. The European heat wave in the summer of 2003 provided a large-scale experiment on the behavior of crops to increased temperatures. Scientists from several European research institutes and universities found that the growth of plants during the heat wave was reduced by nearly a third (Ciais et al., 2005). In Italy, the growth of corn dropped by about 36% while oak and pine had a growth reduction of 30%. In the affected areas of the mid- west and California the summer heat wave of 2006 resulted in a 35% loss of crops, and in California a 15% decline in dairy production due to the heat-caused death of dairy cattle. It has been projected that a 2 °C rise in local temperature will result in a $92 million loss to agriculture in the Yakima Valley of Washington due to the reduction of the snow pack. A 4'C increase will result in a loss of about $163 million. For the first time, the world's grain harvests have fallen below the consumption level for the past four years according to the Earth Policy Institute (Brown, 2003). Furthermore, the shortfall in grain production increased each year, from 16 million tons in 2000 to 93 million tons in 2003. These studies were done in industrialized nations where agricultural practices are the best in the world. In developing nations the impact will be much more severe. It is here that the impact of global warming on crops and domestic animals will be most felt. In general, the world's most crucial staple food crops could fall by as much as one-third because of resistance to flowering and setting of seeds due to rising temperatures. Crop ecologists believe that many crops grown in the tropics are near, or at, their thermal limits. Already research in the Philippines has linked higher night-time temperatures to a reduction in rice yield. It is estimated that for rice, wheat, and corn, the grain yields are likely to decline by 10% for every local 1 °C increase in temperature. With a decreasing availability of food, malnutrition will become more frequent accompanied by damage to the immune system. This will result in a greater susceptibility to spreading diseases. For an extreme rise in global temperature (> 6 'C), it is likely that worldwide crop failures will lead to mass starvation, and political and economic chaos with all their ramifications for civilization.

#### Reprocessing solves warming in two ways:

#### First, reprocessing is key to a revived U.S. clean energy program that provides leadership to win agreements to cut emissions and solve warming.

Roberts 4 (Paul, Energy Expert and Writer for Harpers, The End of Oil, pg. 325-326)

Politically, a new U.S. energy policy would send a powerful message to the rest of the players in the global energy economy. Just as a carbon tax would signal the markets that a new competition had begun, so a progressive, aggressive American energy policy would give a warning to international businesses, many of which now regard the United States as a lucrative dumping ground for older high-carbon technology. It would signal energy producers — companies and states — that they would need to start making investments for a new energy business, with differing demands and product requirements. Above all, a progressive energy policy would not only show trade partners in Japan and Europe that the United States is serious about climate but would give the United States the leverage it needs to force much-needed changes in the Kyoto treaty. With a carbon program and a serious commitment to improve efficiency and develop clean-energy technologies, says one U.S. climate expert, “the United States could really shape a global climate policy. We could basically say to Europe, ‘Here is an American answer to climate that is far better than Kyoto. Here are the practical steps we’re going to take to reduce emissions, far more effectively than your cockamamie Kyoto protocol.”’ Similarly, the United States would finally have the moral credibility to win promises of cooperation from India and China. As James MacKenzie, the former White House energy analyst who now works on climate issues for the Washington-based World Resources Institute, told me, Chinese climate researchers and policymakers know precisely what China must do to begin to deal with emissions but have thus far been able to use U.S. intransigence as an excuse for their own inaction. “Whenever you bring up the question of what the Chinese should be doing about climate, they just smile. They ask, ‘Why should we in China listen to the United States and take all these steps to protect the climate, when the United States won’t take the same steps itself? With a nudge from the United States, argues Chris Flavin, the renewables optimist at World Watch Institute, China could move away from its “destiny” as a dirty coal energy economy. Indeed, given China’s urgent air quality problems, a growing middle class that will demand environmental quality, and a strategic desire to become a high- tech economy, Flavin says, Beijing is essentially already under great domestic pressure to look beyond coal and is already turning toward alternatives — gas, which is in short supply, but also renewables, especially wind, a resource China has in abundance. Once China’s growing expertise in technology and manufacturing and its cheap labor costs are factored in, Flavin says, it has the basis for a large-scale wind industry — something the right push from the West could set in motion. “As China moves forward,” asks Flavin, “is it really likely to do something that no other country has ever done: run a modern, hightech, postindustrial economy on a hundred-year-old energy source?” Flavin, for one, thinks not. During a visit two years ago to lobby reluctant Chinese government officials to invest in renewable energy, Flavin was pleasantly surprised to find in his hotel parking lot a truck owned by NEG Micon, a Danish company that is one of the world’s largest wind turbine manufacturers. Flavin was elated: “At least one leading renewable-energy company, located halfway around the world, is confident enough of its business prospects in China that it now has its own vehicles in Beijing.”

#### Second, only allowing for reprocessing allows for nuclear power to transition to a carbon free economy fast enough to avoid catastrophic warming – best modeling flows aff.

Chakravorty et al. 12 (Ujjayant (Professor and Canada Research Chair, Alberta School of Business and Department of Economics); Bertrand Magne (OECD Environment Directorate, Paris, France); Michel Moreaux (Emeritus Professor and IDEI Researcher, Toulouse School of Economics, University of Toulouse), “RESOURCE USE UNDER CLIMATE STABILIZATION: CAN NUCLEAR POWER PROVIDE CLEAN ENERGY?”, Journal of Public Economic Theory, Vol. 14, Issue 2, 2012, RSR)

This paper applies a model with price-induced substitution across resources to examine the role of nuclear power in achieving a climate stabilization target, such as that advocated by the Intergovernmental Panel on Climate Change (IPCC). It asks an important policy question: is nuclear power a viable carbon-free energy source for the future? If so, then at what cost? The main insight is that nuclear power can help us switch quickly to carbon free energy, and if historical growth rates of nuclear capacity are preserved, the costs of reaching climate stabilization goals decline signiﬁcantly and may therefore be at the lower end of cost estimates that are reported by many studies. However, it is also clear from our results that nuclear is economical anyway, even without environmental regulation. Regulation only plays a major part when fast breeders are available and that too, in the somewhat distant future, towards the end of the century. To some extent, recent increases in efﬁciency in U.S. nuclear power attest to its economic advantages, even in a market with no environmental regulation (Davis and Wolfram 2011). The climate goal of 550 ppm of carbon can be achieved at a surplus cost of about 800 billion dollars, or about 1.3% of current world GDP, if no nuclear expansion is undertaken. Achieving this goal using nuclear power will result in a tripling of the share of world nuclear electricity generation by mid century with welfare gains of about half a trillion dollars (in discounted terms). The cost of providing energy will decrease by about $1.3 trillion or 2% of current world GDP, compared to the case in which the level of nuclear generation is frozen. These estimates of cost savings from nuclear power are signiﬁcant, and unlike in previous studies, are derived from an economic model with an explicit nuclear fuel cycle. However, nuclear power can be cost-effective for about 50 years or so, beyond which period, other technologies are likely to take over, including renewables, clean coal and next generation nuclear technologies that are much more efﬁcient in recycling waste materials. Ultimately, large-scale adoption of nuclear power will be hindered by the rising cost of uranium and the problem of waste disposal. Only signiﬁcant new developments such as the availability of new generation nuclear technology that is able to recycle nuclear waste may lead to a steady state where nuclear energy plays an important role. 31

#### US leadership on nuclear reprocessing leads to a spillover of the technology internationally.

Acton 9 (James, J. associate in the Nonproliferation Program at the Carnegie Endowment for International Peace, Survival, Vol. 51, No. 4, “Nuclear Power, Disarmament and Technological Restraint”, RSR)

Thus, not only does reprocessing clearly not help with facilitating take back, but if advanced nuclear states adopt it as a tool for waste management, it will be virtually impossible for them to argue against others doing likewise. Today, waste management is probably the most important driver for reprocessing. Indeed, the Bush administration’s interest in this technology was born out of a desire to stretch the capacity of Yucca Mountain as far as possible. If the United States and others reprocess they will hand a powerful argument to lobbies within a state – typically the nuclear R&D community – that support the development of reprocessing.

### Plan Text

#### Thus the plan: The United States Federal Government should provide a twenty-percent investment tax credit for the deployment of domestic nuclear fuel recycling.

### Solvency

#### Observation Four: Solvency

#### Tax incentives would solve for reprocessing – makes it commercially more desirable

Lagus 5 (Todd, 2005 WISE Intern, University of Minnesota, WISE, “Reprocessing of Spent Nuclear Fuel: A Policy Analysis” <http://www.wise-intern.org/journal/2005/lagus.pdf>, RSR)

The economic analysis shows that the reprocessing or even the once through nuclear cycle is not yet economically desirable to investors. However, changes in government policies, including environmental regulations already mentioned and economic policies, could improve the competitiveness of both technologies. The University of Chicago nuclear power study analyzes the effects of government involvement in the future of the once through cycle using several different forms of support: loan guarantees, accelerated depreciation, and investment tax credits. Loan guarantees in this case refer to the obligation of the government to repay part of the loan should a utility company not be able to repay. The 2005 Energy Bill, which passed in July 2005, would make advanced nuclear power plants eligible for federal loan guarantees and provide a tax credit for nuclear power production. This would lessen the risks associated with capital costs for investors, and according to the Chicago study, reduce the LCOE for a nuclear reactor by 4 mills/kWh to 6 mills/kWh. The next financial subject, accelerated depreciation, refers to the ability of an investor to utilize the investment tax deductions early on in the lifetime of the payment rather than receive the same deduction each year in a linear fashion. Accelerated depreciation helps investors absorb capital costs, which for nuclear power generation are large. The University of Chicago study calculates a reduction in the LCOE for a 7 year depreciation policy of 3 mills/kWh to 4 mills/kWh. Tax incentives for nuclear power production are the final policies that could make nuclear power and reprocessing more desirable. An investment tax credit of 10 percent would create an LCOE reduction between 6 mills/kWh and 8 mills/kWh, while a 20 percent credit could create cost reductions between 9 mills/kWh and 13 mills/kWh. 39 Production tax credits on a per kWh basis may also be used. Since reprocessing and the once through cycle are not appreciably different for the price, it is sufficient to assume 12 that similar effects for all three of these government policies would occur with policies applied to reprocessing. While it is no secret that monetary incentives would help the nuclear reprocessing investments, there is still the question of whether or not the government should provide economic support to the industry. As with any government funding, it is politically important not to be viewed by other energy generation industries, i.e. gas and coal, as favoring nuclear power over other sources. Given the recent concerns for global warming, tax incentives and loan guarantees for nuclear technologies seem like a realistic option especially in the absence of emission regulations. Accelerated depreciation also is an unobtrusive option that could help the industry by easing capital costs.

#### Government investment key – necessary to mitigate risks from government regulations.

Selyukh 10 (Alina, Staff Writer, “Nuclear waste issue could be solved, if...”, 8-17-10, Reuters,

<http://www.reuters.com/article/2010/08/17/us-nuclear-waste-recycling-idUSTRE67G0NM20100817>, RSR)

Since the U.S. agency declared spent fuel reprocessing too costly, U.S. research into new technologies has slowed. President George W. Bush offered federal backing for nuclear waste management alternatives, but over the years the policy has meandered and had few incentives to lure companies, said Steven Kraft, senior director of used-fuel management at the Nuclear Energy Institute, the industry's trade organization. Being able to burn through rather inexpensive uranium to produce energy, companies are wary of investing millions into recycling technology that may go against the national policy. Still, industry support for the ideas is strong, if not for the procedure itself then for allowing the market -- not the government -- to determine its cost-effectiveness and fate. Duke Energy, which operates seven nuclear plants, would support nuclear recycling if there was a cost-effective national policy, spokeswoman Rita Sipe said. GE Hitachi has proposed a new generation of fast reactors that, they say, could return to the grid up to 99 percent of energy contained in the uranium, compared to recovering 2 or 3 percent from a common light water reactor. But they want federal support for more research and, ultimately, commercialization of the technology, said chief consulting engineer Erik Loewen. That support, in essence, would have to come in a form of subsidies such as cost sharing or loan guarantees, said Jack Spencer, nuclear energy policy research fellow at the Heritage Foundation think tank. "What the industry needs... is something to mitigate government-imposed risks," he said of the regulatory regime.

#### Government investment necessary – provides appropriate risk mitigation and shortens the timeframe for completion.

IAEA 8 (International Atomic Energy Agency, “Spent Fuel Reprocessing Options”, August 2008, RSR)

With the expected high costs and significant risks involved in constructing new nuclear facilities, e.g., reprocessing facilities, the impact of various ownership options need to be considered. These options include government funding, regulated funding, private funding, and combinations of public and private funding. These different funding approaches may significantly impact the costs of fuel cycle services. Given the very long time frames associated with building reprocessing facilities, there exist risks other than technological or economic, which need to be dealt with. These include evolving government policy, public and political acceptance, and licensing risks. As a result, private investors are unlikely to provide capital unless the initial high risks factors are mitigated through appropriate risk sharing agreements (e.g., loan guarantees, equity protection plans, tax credits, etc.) with government entities.

## 2AC

### T

#### We meet: Nuclear fuel recycling is energy production.

World Nuclear Association 12 [Processing of Used Nuclear Fuel, http://www.world-nuclear.org/info/inf69.html]

Used nuclear fuel has long been reprocessed to extract fissile materials for recycling and to reduce the volume of high-level wastes. ¶ New reprocessing technologies are being developed to be deployed in conjunction with fast neutron reactors which will burn all long-lived actinides. ¶ A significant amount of plutonium recovered from used fuel is currently recycled into MOX fuel; a small amount of recovered uranium is recycled. ¶ A key, nearly unique, characteristic of nuclear energy is that used fuel may be reprocessed to recover fissile and fertile materials in order to provide fresh fuel for existing and future nuclear power plants. Several European countries, Russia and Japan have had a policy to reprocess used nuclear fuel, although government policies in many other countries have not yet addressed the various aspects of reprocessing.¶ Over the last 50 years the principal reason for reprocessing used fuel has been to recover unused uranium and plutonium in the used fuel elements and thereby close the fuel cycle, gaining some 25% more energy from the original uranium in the process and thus contributing to energy security. A secondary reason is to reduce the volume of material to be disposed of as high-level waste to about one fifth. In addition, the level of radioactivity in the waste from reprocessing is much smaller and after about 100 years falls much more rapidly than in used fuel itself.¶

#### Counter interpretation:

#### The aff has to affect both resource extraction and conversion into energy

Australian Government, Department of Climate Change and Energy Efficiency 2011 [“Energy Production and Consumption,” http://www.climatechange.gov.au/government/initiatives/national-greenhouse-energy-reporting/publications/supplementary-guidelines/energy-production-consumption.aspx]

Production of energy: in relation to a facility, means the:

1. extraction or capture of energy from natural sources for final consumption by or from the operation of the facility or for use other than in the operation of the facility
2. manufacture of energy by the conversion of energy from one form to another form for final consumption by or from the operation of the facility, or for use other than in the operation of the facility (regulation 2.23(3) NGER Regulations).

#### We meet the counter-interpretation: recycling involves both the act of reprocessing the used fuel and using it to create new nuclear energy.

#### Our interp good:

A. Predictability – Only our interpretation guarantees link arguments to both extraction and the burning of resources to produce energy. This is crucial link ground for pollution DAs and domestic/foreign energy tradeoff DAs.

B. Limits: Requiring the aff to both extract and convert the energy is necessary to eliminate affs that only extract, like capture carbon or methane or stockpile oil as a strategic military reserve with heg advantages. Also key to prevent affs that only burn fuels like Bataille-style affs that encourage rapid consumption or R&D affs that incentivize new ways to burn the same resources.

#### Their interp bad:

#### They get rid of all uranium extraction affs because extraction from waste is identical to extraction from the ground. This means they get rid of oil and natural gas extraction affs which is literally half the topic.

#### Competing interpretations are bad: Race to the bottom: they’re just trying to limit out one more case

#### Prefer reasonability: as long as we’re reasonably topical, there’s no reason to pull the trigger. Don’t vote on potential abuse.

### Solvency

#### We can build them really quickly.

Blees et al 11

[Tom Blees1, Yoon Chang2, Robert Serafin3, Jerry Peterson4, Joe Shuster1, Charles Archambeau5, Randolph Ware3, 6, Tom Wigley3,7, Barry W. Brook7, 1Science Council for Global Initiatives, 2Argonne National Laboratory, 3National Center for Atmospheric Research, 4University of Colorado, 5Technology Research Associates, 6Cooperative Institute for Research in the Environmental Sciences, 7(climate professor) University of Adelaide, "Advanced nuclear power systems to mitigate climate change (Part III)," 2/24/11) http://bravenewclimate.com/2011/02/24/advanced-nuclear-power-systems-to-mitigate-climate-change/-http://bravenewclimate.com/2011/02/24/advanced-nuclear-power-systems-to-mitigate-climate-change/]

How Fast Can We Build Them?¶ During France’s nuclear building boom they built an average of six nuclear power plants per year, culminating in a situation that provides them with about 80% of their electrical needs while making electricity their fourth-largest export earner. Gross Domestic Product (GDP) can be used as a rough guide to what a given country can financially bear for such a project, keeping in mind that France proceeded without the sense of urgency that the world today should certainly be ready to muster. There are six countries with higher GDPs than France, all of whom already possess the technology to build fast reactors: USA, China, Japan, India (they’re building one now), Germany, and the United Kingdom. Add Canada and Russia (which already has a commercial fast reactor running and is planning more), then tally up the GDP of these eight countries. At the rate of 6 plants per year (~ 1GW each) at the equivalent of France’s GDP, these countries alone could afford to build about 117 power plants per year, even without any greater urgency than the French brought to bear on their road to energy independence.¶ Consider that there are about 400 nuclear power plants in the world today. At this entirely feasible rate of construction we could more than double the planet’s nuclear capacity in just four years. Remember, the French accomplished their transformation with non-modular, albeit standardized, Gen II designs. Modular construction, passive safety systems, and factory fabrication, divided among companies all over the planet, could realistically convert the planet’s electricity production to virtually all nuclear in a couple decades, with abundant surplus electricity for ancillary uses such as desalination and the production of liquid fuels such as ammonia.

#### No defaults.

Hamilton, Editor-in-chief of Corporate Knights Magazine and a business columnist for the Toronto Star, ‘12

[Tyler, "NO BUBBLE BURSTING FOR CLEAN ENERGY TECHNOLOGIES: THE FUTURE IS GROWTH, GROWTH, GROWTH", August 15,

www.energyboom.com/finance/no-bubble-bursting-clean-energy-technologies-future-growth-growth-growth]

The reason why clean energy isn’t a fad or a bursting bubble is that global problems such as climate change, pollution, poverty, food scarcity, crumbling legacy infrastructure, and access to clean water aren’t going away anytime soon. Renewable energy and other clean technologies may not be the only solution, but they are a big and growing part of it.¶ Will nuclear help out? Maybe, but don’t count on it. Jeff Immelt, chief executive of General Electric, a big supplier of nuclear technology, told the Financial Times this week that it’s “really hard” these days to justify the cost of nuclear. “I think some combination of gas, and either wind or solar … that’s where we see most countries around the world going.”¶ Ontario may want to reconsider plans for new nukes at Darlington.¶ Fact is, renewable energy costs are falling fast, and that’s part of the reason there are layoffs, profit warnings, bankruptcies and falling share prices in the industry. Subsidies are supposed to gradually fade away, something the fossil fuel industry hasn’t learned after 100 years of handouts.¶ There was oversupply in clean energy equipment. Weak companies are struggling and some are failing. Those intent on surviving figure out how to innovate, adjust, enter new geographic markets and come out stronger – the cycle is not unique to clean energy.¶ “Any emerging market will experience growth problems and will have winners and losers. And the losers’ problems do not necessarily indicate the absence of a long-term market,” says Craig Tighe, a partner with global law firm DLA Piper. “Were that the case, the loss of Palm and Handspring would mean that the smart phone market is not sustainable, which is manifestly not the case.”¶ Growth in clean energy is happening. What’s changing is the pace of that growth and the players who get to benefit.¶ There’s no bubble bursting here

### Advantage CP

#### Perm do both. Perm gets double solvency because it both reduces emissions and spreads aerosols to combat warming.

#### Links to politics – the GOP doesn’t believe in warming they would never foot the bill to release such a massive amount of SO2. PLUS they would hate that the CP is a BLANK CHECK to spend as much as the government wants on Warming schemes.

#### Can’t solve warming:

#### a.) No global implementation of the CP means only the plan can guarantee a solution that’s 1AC Roberts. Also, reprocessing tech spillsover and solves warming internationally. That’s 1AC Acton.

#### b.) Emissions reductions are the best way to proceed to combat warming. Long Term the CP provides a justification for people to believe that they can continue to release as much CO2 as they want, which means the warming problem will just reoccur later. Only the plan has long term tech viability and commercialization. That’s 1AC Peters.

#### Doesn’t solve CO2 BAD impacts. Only emissions reductions guarantee this. CO2 poisons important ecological networks, leads to deadzones and kills corals. That’s 1AC Verne. Impact is extinction. That’s 1AC Kinitsch.

#### Can’t solve helium. Doesn’t boost the supply of tritium.

#### SO2 aerosols are bad – leads to drought, acid rain, ozone depletion and can’t solve for ocean acidification, which kills biodiversity.

MIT, ‘9

[Massachusetts Institute of Technology: Department of Civil and Environmental Engineering, “The Unintended Consequences of Sulfate Aerosols in the Troposphere and Lower Stratosphere”, 11-29-9, RSR]

In order to understand what may happen when sulfate aerosols are injected into the atmosphere, and therefore predict the unintended consequences of such a geoengineering scheme, we can analyze large scale volcanic eruptions. For example, the Mount Pinatubo eruption decreased air temperatures and reduced the total amount of water vapor present in the atmosphere (Trenberth & Dai, 2007). In 1992, following the eruption of Pinatubo, a significant percentage of the world experienced drought conditions, a fact attributed to the eruption (Dai et al., 2004). In addition, precipitation changes in 1992 were much larger than for other years, indicating a relationship between the increase in sulfate aerosols in the atmosphere and the hydrological cycle (Trenberth & Dai, 2007). Moreover, volcanic eruptions in the tropics have been shown to cause warming in Northern Hemisphere summers while eruptions at high latitudes cause warming in Northern Hemisphere winters (Oman et al., 2006). The seasonal temperature changes are due to changes in atmospheric circulation. Sulphate aerosols have the potential to cause global changes in precipitation, temperature and water vapor, even if released from a singular location. Stratospheric aerosol injection could also cause an increase in acid rain. Some aerosols find their way to the troposphere and hydrate to form sulfuric acid, leading to an increase in acid deposition in a variety of ecosystems (Kravitz et al., 2009). These increases will be most noticed in pristine as opposed to urban areas and areas with significant rainfall will be the most affected (Kravitz et al., 2009). Although sulfur is a necessary nutrient in some ecosystems, for other ecosystems it can be extremely harmful in excess quantities. Acid rain has led to a decrease in biodiversity in aquatic ecosystems and acidic soils can limit the amount of nutrients available to trees (Kannan & James, 2009). It is not possible to control the areas affected by acid rain because sulfate aerosols cause changes in cloud chemistry across the globe. Another significant potential consequence of this scheme is an increase in ozone depletion. The seasonal ozone hole over Antarctica is caused by chemical reactions on the surface of water and nitric acid particles, and injecting sulfate aerosols would increase the surface area on which these chemical reactions can occur (Robock, 2008). As a result, the ozone hole would become larger, causing even more ultraviolet radiation to reach the Earth. UV radiation has negative effects and can cause skin cancer in humans as well as damage to DNA and photosensitizers in plants (Stapleton, 1992). Finally, combating the rise in global temperature with stratospheric aerosols does not address continued carbon emissions, a significant side effect of global warming. The continued build up of greenhouse gases in the atmosphere leads to ocean acidification. The ocean uptakes a significant portion of excess carbon dioxide in the atmosphere (Robock, 2008) because when CO2 is dissolved it forms dissolved carbon dioxide, carbonic acid, bicarbonate and carbonate. Ocean acidification significantly affects marine ecosystems such as coral reefs, and would have repercussions through the entire biological chain (Robock, 2008). These are only a few of the consequences that may stem from a sulfate aerosol geoengineering scheme. The breadth and severity of their effects need to be considered along with the potential benefits from any scheme.

#### Independently, Ozone depletion causes extinction.

Williams, Author of Tetron Natural Unified Field Theory, ‘96

[David Crockett, “THE SCIENTIFIC SPIRITUAL REVOLUTION”, 2-7-96,

http://www.angelfire.com/on/GEAR2000/video96.htmls]

Today all life on earth is threatened by many problems associated with the materialistic and shortsighted human activities out of harmony with nature that have led to an oxygen crisis from massive deforestation and fossil fuel combustion which has created global warming responsible for increased weather extremes, flooding, droughts, disease vectors, etc., and an ozone layer depletion that threatens all life on earth by the imminent destruction of the ocean's phytoplankton which produce over half of earth's oxygen and form the beginning of the oceanic food chain. Nuclear testing has caused lasting increases in seismic and volcanic activity, explainable by free energy science, which threatens cataclysmic earth changes. The danger of nuclear conflagration still exists. All these conditions have been predicted independently by many different religious prophecies since many hundreds of years ago. How can this be understood and resolved?

#### Ocean fertilization backfires – kills marine biodiversity.

Hume, Contributor, ‘12

[Mark, “Ocean fertilization experiment alarms marine scientists”, The Globe and Mail, 10-19-12,

<http://www.theglobeandmail.com/news/national/ocean-fertilization-experiment-alarms-marine-scientists/article4625695/>, RSR]

Russ George, a California businessman who designed the project, believes massive clouds of plankton can suck enough carbon dioxide out of the atmosphere to blunt global warming and provide rich nutrients to marine animals and reduce ocean acidification. But scientists say the experiment poses huge risks. “Scientists from the U.S. have contacted me. They are really alarmed by this. They are worried. And I personally think it’s scary,” said Maite Maldonado, an associate professor in earth, ocean and atmospheric sciences at the University of British Columbia. “The consequences of this kind of disturbance to the marine ecosystem can be atrocious . . . and we have to be very careful,” said Ms. Maldonado, who attended the press conference. “I think they should be stopped.” Evgeny Pakhomov, an associate professor of biological and fisheries oceanography at UBC, said he shares those concerns. “I don’t like what they’ve done,” he said, noting that while the experiment might show short-term gain in surface blooms, it could cause long-term oxygen depletion at greater depth. In an e-mail, David Keith, an expert on climate science at Harvard University, questioned the credibility of the project. “This is hype masquerading as science,” he said. The Council of the Haida Nation, a separate political body from the Old Massett village council, distanced itself from the project, saying the “consequences of tampering with nature at this scale are not predictable and pose unacceptable risks to the marine environment.”

### Nat Gas DA

#### Natural gas prices will stay low and plenty of shale now

Philips ‘13 (Matthew, Bloomberg Businessweek, “Why Natural Gas Will Stay Cheap in 2013,” 2013, http://www.businessweek.com/articles/2013-01-10/why-natural-gas-will-stay-cheap-in-2013)

Six weeks ago, natural gas bulls were riding high. By Thanksgiving, prices had more than doubled since hitting a decade low of $1.90 per million BTUs in April. Heading into what was supposed to be a cold winter for the U.S.—at least compared with last year—the consensus view was that natural gas prices would be higher in 2013, since about half of all U.S. households heat their homes with natural gas. By the end of December, the median forecast of 22 analysts surveyed by Bloomberg was that natural gas would average $3.75 for 2013. A few weeks of warm weather later, and a lot of those forecasts look way too optimistic. Prices have fallen more than 20 percent since peaking at $3.90 per million BTUs in late November. With the National Weather Service predicting above-normal temperatures over the next 10 days for the eastern third of the U.S., that downward pressure is likely to continue. “We’re going to see a lot of guys coming in and changing their forecasts,” says Laurent Key, an energy analyst at Societe Generale (SCGLY) in New York. Key expects prices to bottom out around an average of $3.16 in the second quarter before climbing. “If we end up repeating 2012, those expectations need to come down by about a buck,” says Scott Hanold, an energy analyst at RBC Capital Markets (RY) in Minneapolis. Goldman Sachs (GS) just lowered its 2013 price target by 50 cents, from $4.25 per million BTUs, to $3.75, still above the current price of $3.12. Natural gas is notoriously volatile, so prices could surge if the weather turns cold and people crank up their heat, but it’s hard to see that demand making up for what’s already been lost. Even if there is a February freeze across the country, that cold snap probably wouldn’t be sufficient to compensate for a mild December, Goldman analyst Johan Spetz wrote in a Jan. 7 research note. Bloomberg News reported Wednesday that Mike Fitzpatrick, editor of the Energy OverView newsletter, thinks natural gas prices could drop as low as $2.20 if the weather stays mild. The more likely scenario seems to be something akin to what happened last year, when prices fell through the spring and didn’t rise appreciably until people started turning on their air conditioners in May. Part of what helped lift natural gas prices off their lows last April was increased demand from utilities switching from coal to natural gas to generate electricity. But that effect might be more muted in 2013. After getting crushed by cheap natural gas over the last few years, coal appears set to recapture some of that market share in 2013. “Coal has become more competitive against natural gas,” says Lucas Pipes, an analyst at Brean Murray, Carret & Co. Coal prices have gotten so cheap that if natural gas rises to just $3.40 this year, Pipes estimates that would cause 50 million tons of coal demand to come on the market as utilities fire up their coal plants. The Department of Energy is forecasting that coal will account for 39 percent of all electricity generated in 2013, up from 37.6 percent last year. Meanwhile, natural gas’s continued run of increasing its share of the electricity market may be over. The DOE predicts that natural gas will lose ground this year and next, falling from 30.3 percent of all electricity generated in 2012, to 27.9 percent in 2013, and 27.5 percent in 2014. On top of that, natural gas production is set to rise by 0.5 percent this year, according to the DOE. After spending the previous 15 months reducing the number of rigs drilling for natural gas, U.S. producers finally started adding to that total in November, spurred perhaps by the prospect of sustained $4 prices. While production has slowed in some places, the Marcellus Shale in western Pennsylvania is still attracting new investment. “Marcellus is an animal. There are still 1,000 wells that haven’t been put online yet,” says Hanold. “That’s going to push production even higher.” Marcellus is also more immune to lower prices. The geology is so good, and the royalty rates so low, that producers can drill profitably even at $2 natural gas prices, he says. In the end, the fundamental issue that’s kept natural gas prices so low for the last few years—too much supply, inadequate demand—appears here to stay for the foreseeable future**.** ”Natural gas prices will be dead for at least two more years,” says Fadel Gheit, a senior oil and gas analyst at Oppenheimer (OPY). By dead he means well below $4. “The industry shot itself in the foot by overdrilling,” he says. “Now anybody and their brother can get gas out of the ground and into the system.”

#### No exports now mean no spillover.

Levi, senior fellow at CFR, 2012,

[June, Michal, David M. Rubenstein Senior Fellow for Energy and the Environment. Director of the Program on Energy Security and Climate Change Council on Foreign Relations. Michael is a member of the Strategic Advisory Board for NewWorld Capital LLC, a private equity firm focused on environmental opportunities, and a member of the External Advisory Board to the Princeton University Carbon Mitigation Initiative (CMI). He holds a Bachelors of Science in mathematical physics from Queen’s University, an MA in physics from Princeton University and a Ph.D. in war studies from the

University of London. “A Strategy for U.S. Natural Gas Exports,” <http://www.hamiltonproject.org/files/downloads_and_links/06_exports_levi.pdf>]

It is far from clear that all or even most of this export volume ¶ would be used even if it were approved. A recent MIT study ¶ looked at nine scenarios for U.S. and world natural gas markets; ¶ none of them led to the emergence of significant U.S. natural ¶ gas exports, in large part because other lower cost producers ¶ undercut prices offered by the United States in distant markets ¶ (MIT 2011). Other forces, discussed in Chapter 2, could also ¶ lead global natural gas prices to converge even without U.S. ¶ exports, removing opportunities for economically attractive ¶ U.S. LNG sales.

#### Nuclear power doesn’t tradeoff with nat gas, but prices are volatile so impact is triggered anyway.

Nitikin, et al., ‘12

[Mary (Coordinator and Specialist in Nonproliferation at CRS); Anthony Andrews (Specialist in Energy and Defense Policy at the CRS; and Mark Holt (Specialist in Energy Policy at CRS), “Managing the Nuclear Fuel Cycle: Policy Implications of Expanding Global Access to Nuclear Power”, Congressional Research Service, 10-19-12, RSR]

Volatile prices for oil and natural gas are a fundamental factor in national energy policymaking. Average world prices for a barrel of oil rose from below $10 at the beginning of 1999 to above $130 in mid-2008. They then declined to around $50 in early 2009 and rose to around $100 through mid-2012. 5 U.S. natural gas prices have been similarly volatile, although falling sharply in 2012 with increased production from shale formations. 6 To reduce their vulnerability to oil and gas price swings, national governments are searching for alternative energy sources, often including nuclear power. However, only 21% of the world’s electricity generation is fueled by natural gas and 5% by oil, 7 so nuclear power’s ability to directly substitute for oil and gas is limited, at least in the near term.

#### Nuclear renaissance now. Northey says nuclear is already receiving subsidies and building plants.

#### **Global nuclear expansion now.** Over 200 reactors are going to be constructed in the next five years. That’s 1AC Marketwire.

#### Collapse of natural gas industry inevitable - overleveraged, prices too low.

Fahey, ‘12

[Jonathan Fahey, April 9, 2012, “Natural gas glut means drilling boom must slow,” Boston Globe, lexis]

The U.S. natural gas market is bursting at the seams. So much natural gas is being produced that soon there may be nowhere left to put the country's swelling surplus. After years of explosive growth, natural gas producers are retrenching. The underground salt caverns, depleted oil fields and aquifers that store natural gas are rapidly filling up after a balmy winter depressed demand for home heating. The glut has benefited businesses and homeowners that use natural gas. But with natural gas prices at a 10-year low — and falling — companies that produce the fuel are becoming victims of their drilling successes. Their stock prices are falling in anticipation of declining profits and scaled-back growth plans. Some of the nation's biggest natural gas producers, including Chesapeake Energy, ConocoPhillips and Encana Corp., have announced plans to slow down. "They've gotten way ahead of themselves, and winter got way ahead of them too," says Jen Snyder, head of North American gas for the research firm Wood Mackenzie. "There hasn't been enough demand to use up all the supply being pushed into the market." So far, efforts to limit production have barely made a dent. Unless the pace of production declines sharply or demand picks up significantly this summer, analysts say the nation's storage facilities could reach their limits by fall. That would cause the price of natural gas, which has been halved over the past year, to nosedive. Citigroup commodities analyst Anthony Yuen says the price of natural gas — now $2.08 per 1,000 cubic feet — could briefly fall below $1. "There would be no floor," he says. Since October, the number of drilling rigs exploring for natural gas has fallen by 30 percent to 658, according to the energy services company Baker Hughes. Some of the sharpest drop-offs have been in the Haynesville Shale in Northwestern Louisiana and East Texas and the Fayetteville Shale in Central Arkansas. But natural gas production is still growing, the result of a five-year drilling boom that has peppered the country with wells. The workers and rigs aren't just being sent home. They are instead being put to work drilling for oil, whose price has averaged more than $100 a barrel for months. The oil rig count in the U.S is at a 25-year high. This activity is adding to the natural gas glut because natural gas is almost always a byproduct of oil drilling. Analysts say that before long companies could have to start slowing the gas flow from existing wells or even take the rare and expensive step of capping off some wells completely. "Something is going to have to give," says Maria Sanchez, manager of energy analysis at Bentek Energy, a research firm. U.S. natural gas production has boomed in recent years as a result of new drilling techniques that allow companies to unlock fuel trapped in shale formations. Last year, the U.S. produced an average of 63 billion cubic feet of natural gas per day, a 24 percent increase from 2006. But over that period consumption has grown half as fast. The nation's storage facilities could easily handle this extra supply until recently because cold winters pushed up demand for heating and hot summers led to higher demand for air conditioning. Just over half the nation's homes are heated with natural gas, and one-quarter of its electricity is produced by gas-fired power plants. But this past winter was the fourth warmest in the last 117 years, according to the National Oceanic and Atmospheric Administration. It was the warmest March since 1950. Between November and March, daily natural gas demand fell 5 percent, on average, from a year earlier, according to Bentek Energy. Yet production grew 8 percent over the same period. "We haven't ever seen a situation like this before," says Chris McGill, Vice President for Policy Analysis at the American Gas Association, an industry group. At the end of winter, there is usually about 1.5 trillion cubic feet of gas in storage. Today there is 2.5 trillion cubic feet because utilities withdrew far less than usual this past winter. There is 4.4 trillion cubic feet of natural gas storage capacity in the U.S. If full, that would be enough fuel to supply the country for about 2 months. If current production and consumption trends were to continue, Bentek estimates that storage facilities would be full on October 10. Storage capacity, which has grown by 15 percent over the past decade, cannot be built fast enough to address the rapidly expanding glut. And analysts note there is little financial incentive to build more anyway.

### States CP

#### Perm do both. Solves GOP backlash because thirty republican governors would all back reprocessing.

#### Information distortion means the CP links to politics

**Kiely, ‘12** [2/17/12, Eugene Kiely, Washington assignment editor USA today, “Did Obama ‘Approve’ Bridge Work for Chinese Firms?” http://www.factcheck.org/2012/02/did-obama-approve-bridge-work-for-chinese-firms/]

Who’s to blame, if that’s the right word, if the project ends up using manufactured steel from China? The National Steel Bridge Alliance [blames](http://americanmanufacturing.org/blog/shameful-use-taxpayer-dollars-alaska) the state railroad agency. The Alliance for American Manufacturing [says](http://americanmanufacturing.org/blog/alaskan-manufacturers-outraged-potential-%E2%80%9Cmade-china%E2%80%9D-railroad-bridge) the federal Buy American laws have been “weakened with loopholes and various exemptions that make it easier for bureaucrats to purchase foreign-made goods instead of those made in American factories with American workers.” So, how did Obama get blamed for the decisions by state agencies and for state projects that, in at least one case, didn’t even use federal funds? The answer is a textbook lesson in how information gets distorted when emails go viral. We looked at the nearly 100 emails we received on this subject and found that Obama wasn’t mentioned at all in the first few emails. Typical of the emails we received shortly after the ABC News report aired was this one from Oct. 11, 2011: “I just got an email regarding Diane Sawyer on ABC TV stating that U. S. Bridges and roads are being built by Chinese firms when the jobs should have gone to Americans. Could this possible be true?” The answer: Yes, it’s true. End of story, right? Wrong. Days later, emails started to appear in our inbox that claimed ABC News reported that Chinese firm were receiving stimulus funds to build U.S. bridges — even though the broadcast news story didn’t mention stimulus funds at all. (The report did include a clip of Obama delivering a speech on the need to rebuild America’s bridges and put Americans to work, but said nothing about the president’s $830 billion stimulus bill.) Still, we received emails such as this one on Nov. 4, 2011, that included this erroneous claim language: “Stimulus money meant to create U.S. jobs went to Chinese firms. Unbelievable….” It didn’t take long for Obama to be blamed. That same day — Nov. 4, 2011 — we received an email that made this leap to Obama: “SOME CHINESE COMPANIES WHO ARE BUILDING ‘OUR’ BRIDGES. (3000 JOBS LOST TO THE CHINESE FIRM)…..AND NOW OBAMA WANTS ‘MORE STIMULUS MONEY’…..THIS IS NUTS ! ! ! If this doesn’t make you furious nothing will….” This year, Obama’s name started to surface in the subject line of such critical emails — raising the attack on the president to yet another level and perhaps ensuring the email will be even more widely circulated. Since Jan. 17, we have gotten more than a dozen emails with the subject line, “ABC News on Obama/USA Infrastructure,” often preceded with the word “SHOCKING” in all caps. The emails increasingly contain harsh language about the president. Since Jan. 11, 23 emails carried this added bit of Obama-bashing: “I pray all the unemployed see this and cast their votes accordingly in 2012!” One of those emails — a more recent one from Feb. 8 — contained this additional line: “Tell me again how Obama’s looking out for blue collar guys. He cancels pipelines, and lets Chinese contractors build our bridges…” And so it goes, on and on. All from a news report that blamed state officials — not Obama — for spending taxpayer money on Chinese firms to build U.S. bridges.

#### Conditionality is a voting issue – being able to kick positions at will destroys argumentative responsibility, skews the 2AC, the focal point of all aff offense, because we have to spend more time answering things than they do kicking them, and justifies aff conditionality to be reciprocal. Counter interpretation is dispositionality. Allows us to stick them to positions. Solves all their offense.

#### States CP are V/I. 1.) No comparative literature compares the action of 50 states simultaneously vs. the federal government. Kills education because it removes substantive clash about energy production. 2.) Fiat abuse – uniformity eliminates the only aff against state action, which is enforcement. Kills competitive equity.

#### CP can’t solve – federal investment is necessary to remove the perceptual ban on reprocessing.

Adams, ‘8

[Rod, “What Do You Do About the Waste? Recycle and Reuse”, Clean Technica, 5-29-2008,

<http://cleantechnica.com/2008/05/29/what-do-you-do-about-the-waste-recycle-and-reuse/>, RSR]

The US used to have a plan to recycle our fuel as well, but a great deal of marketing and pressure by people that do not like the idea of using plutonium as a source of commercial heat resulted in President Ford issuing a presidential order to temporarily halt nuclear fuel recycling in 1976. President Carter, a man who claimed to be a nuclear engineer, made that ban permanent in the hopes that forcing US companies to avoid fuel recycling would cause others to abandon the very logical idea. That effort did not work as planned, but the people who had invested large amounts of time and money into building three recycling plants in the US only to have them shut down with the stroke of a pen decided “once bitten, twice shy.” Though President Reagan removed the ban, President Clinton essentially reinstated it and no commercial company has been willing to build a facility and risk having it turn into a white elephant after an election.

#### Doesn’t solve the aff – absent the plan, companies will never believe that the federal government will allow reprocessing, so they won’t invest. That’s Selyukh 10.

### Politics

#### Obama’s pushing nuclear now – should have already triggered the link.

#### Obama’s PC is low, PC’s not key, and winners win.

The Hill 3-20 (Amie Parnes and Justin Sink, Obama honeymoon may be over, The Hill, 20 March 2013, http://thehill.com/homenews/administration/289179-obama-honeymoon-may-be-over, da 3-28-13)

The second-term honeymoon for President Obama is beginning to look like it is over.¶ Obama, who was riding high after his reelection win in November, has seen his poll numbers take a precipitous fall in recent weeks. ¶ A CNN poll released Tuesday showed Obama’s favorability rating underwater, with 47 percent approving and 50 percent disapproving of Obama’s handling of his job. ¶ Much of the president’s agenda is stuck, with climate change regulations delayed, immigration reform mired in committee negotiations and prospects for a grand bargain budget deal in limbo at best. ¶ On Tuesday, in a decision that underscored Obama’s depleting political capital, the White House watched as Senate Majority Leader Harry Reid (D-Nev.) announced only a watered-down version of Obama’s gun control proposals would be considered on the Senate floor. ¶ Republicans, sensing the sea change, are licking their chops. They point to the lack of movement on Obama’s signature issues, noting the contrast to the ambitious plans outlined in the early weeks of his second term.¶ “The president set very high goals for himself during his State of the Union, but the reality is very little of his agenda is actually moving,” Republican strategist Ron Bonjean said. “He allowed himself to get caught up in the legislative quicksand, [and] the cement is beginning to harden. “¶ History isn’t on Obama’s side. ¶ The last four presidents who won a second term all saw their poll numbers slide by mid-March with the exception of Bill Clinton, whose numbers improved in the four months following his reelection.¶ Clinton may have only been delaying the inevitable. His numbers dropped 5 points in April 1994. Even Ronald Reagan, buoyed by a dominant performance over Walter Mondale in the 1984 election, saw a double-digit erosion by this point in his second term.¶ Obama has yet to complete the first 100 days of his second term. But without a signature achievement since his reelection, he faces a crossroads that could define the remainder of his presidency. ¶ White House aides maintain that the 24-hour news cycle makes comparisons to previous presidents difficult.¶ “I think the nature of our politics now is different than Ronald Reagan’s honeymoon,” one senior administration official said. “The ebb and flow of politics doesn’t follow that model anymore.”¶ But observers say a drop in popularity is typical for second-termers.¶ “There may be some typical second-term honeymoon fade happening,” said Martin Sweet, an assistant visiting professor of political science at Northwestern University. “Honeymoon periods for incumbents are a bit more ephemeral.”¶ But like most other presidents, Sweet added, “Obama’s fate is tied to the economy.”¶ “Continuing economic progress would ultimately strengthen the president but if we are hit with a double-dip recession, then Obama’s numbers will crater,” he said.¶ The White House disputes any notion that Obama has lost any political capital in recent weeks.¶ “The president set out an ambitious agenda and he’s doing big things that are not easy, from immigration to gun control,” the senior administration official said. “Those are policies you can’t rack up easily, and no one here is naive about that.”¶ The White House is aware that the clock is ticking to push its hefty agenda, but the official added, “The clock is not ticking because of president’s political capital. The clock is ticking because there’s a timetable in achieving all of this. [Lawmakers] are not going to sign on because the president’s popular.” ¶ And administration officials believe they still have the leverage.¶ ¶ “There’s a decent amount of momentum behind all of this,” the official said. “It looks like immigration is closer [to passage] than ever before.”¶ Republican strategist Ken Lundberg argued that current budget fights “have cut short the president’s second-term honeymoon.” ¶ He said this could also hurt the president’s party, warning “the lower the president’s approval rating, the bigger the consequence for vulnerable Democrats.”¶ “Voters want solutions, and if they see the president headed down the wrong path, lockstep lawmakers will be punished in 2014,” he said.¶ Democratic strategist Chris Kofinis maintained that as long as he’s president, Obama still has the leverage.¶ “Immigration reform doesn’t get impacted by whether Obama’s poll numbers are 55 or 45,” Kofinis said. “Does it make certain things a little more difficult? Possibly. But while his numbers may have fallen, he’s still more likeable than the Republicans are on their best day.”¶ Kofinis said the real question for Obama is what kind of emphasis he’s going to place on his second term because the public will have less patience than they did during his first.¶ “The challenge in a second term is the American people look at certain things and have a higher tolerance in a second term,” he said. “When they know you’re not running for reelection again, they hold you to a higher standard.” ¶ Bonjean and other Republicans are aware that Obama could potentially bounce back from his latest slip in the polls and regain his footing.¶ “He has the opportunity to take minor legislative victories and blow them up into major accomplishments – meaning if he got something on gun control, he can tout that that was part of his agenda and the work isn’t over. If he were able to strike a grand bargain with Republicans, that’d be a legacy issue.”¶ Still, Bonjean added, “It’s not looking so good right now.”

#### Normal means is that plan is introduced at the bottom of the docket – won’t be voted on until after Immigration.

#### Plan popular and Graham shields the link.

Russell ’13 (Pam Radtke, Budget Cutters Eye Nuclear Reprocessing Plant, Roll Call, 5 February 2013, http://www.rollcall.com/news/budget\_cutters\_eye\_nuclear\_reprocessing\_plant-222173-1.html?pg=1, da 2-14-13)

The scrutiny is raising concern among the project’s supporters, especially with across-the-board spending cuts set to kick in next month unless Congress acts to postpone them or enact an alternative austerity plan.¶ “We must stay the course and create a pathway to safely and responsibly dispose of weapons grade plutonium,” Rep. Joe Wilson, R-S.C., wrote in a letter he has been circulating among his colleagues that would urge the White House to preserve the project. “If we fail to uphold our end of this agreement, dire consequences could be felt by our close allies across the globe, as Russia may choose not to honor its end of the agreement.”¶ The MOX facility has survived earlier challenges. Former Rep. David L. Hobson, R-Ohio, said his efforts to kill funding for the project when he served as Energy and Water Appropriations Subcommittee chairman were thwarted by the political clout of South Carolina lawmakers — including fiscal conservatives such as Wilson, Sen. Lindsey Graham and former Sen. Jim DeMint.¶ Hobson described the project as a jobs program for South Carolina. In addition to the 2,600 employees now working on it, the completed facility will require permanent workers to operate it for up to two decades. The plant is part of the larger Savannah River Site in South Carolina, an Energy Department-managed site that employs 12,000.¶ Hobson said one of the biggest regrets of his tenure was agreeing to back off efforts to end the project when he was told they could hurt Republican Gov. Mark Sanford’s re-election chances in 2006.¶ “I got rolled,” Hobson said.¶ Laura Peterson of Taxpayers for Common Sense, which has called for an end to the project, said conservative Republicans who otherwise might be expected to complain about cost overruns are deterred by the support it enjoys from Graham. And Hobson said DeMint — a leading champion of small government and spending cuts who now heads The Heritage Foundation — never suggested killing the MOX program.¶ “This is worse than earmarks,” Hobson said. “This is appalling.”¶ Neither Graham’s nor DeMint’s staffs responded to requests to comment on the project, but Wilson and other supporters say it is vital to fulfilling the 2000 arms deal with Russia. Failing to move ahead with the program, Wilson warned, could lead the Russians not to honor its end of the agreement.

#### Logical policy maker can do both.

#### No reason Obama would push the plan – means it doesn’t affect his political capital.

#### CIR won’t pass – interests are too divided on guest-worker wages

Murray 3-22 (Sara, Fight Over Immigrant Wages Stalls Talks on Bill, Wall Street Journal, 22 March 2013, http://online.wsj.com/article/SB10001424127887324373204578376740176273104.html?mod=googlenews\_wsj, da 3-28-13)

Negotiations between business and labor appeared to reach a breaking point Friday evening, jeopardizing the Senate's effort to finish its plan to overhaul the nation's immigration system.¶ A disagreement over how to set the minimum wages for future low-skilled workers effectively stalled immigration negotiations Friday evening. A bipartisan group of senators working on immigration legislation are expected to continue discussing the issue over the two-week recess but it appears they will fall short of their goal to reach a consensus on how to rewrite immigration laws before they leave town.¶ Even if the senators are able to reach an agreement amongst themselves, they may have to push forward without business and labor's endorsements, threatening the future of any immigration plan once the group unveils it.¶ The AFL-CIO and Chamber of Commerce have broadly agreed to create a new visa category for low-wage workers, which would allow them to come to the U.S. and work year-round. The number of workers would rise and fall, based on the state of the U.S. economy, and would have an overall cap of 200,000 a year, people familiar with the talks said.¶ Wages for those workers have proven more difficult to negotiate. The Chamber said it would support the formula government agencies currently use to calculate wages for low-skilled workers who come to the U.S. under a temporary visa program. That would ensure that immigrants were paid similar wages to their American colleagues, according to the Chamber.¶ Under that formula, employers who use guest workers are required to pay them the highest of four different rates, which include the federal and state minimum wages, as well as wages calculated based on the industry and location.¶ Organized labor was pushing for an alternate calculation that would yield higher wages. On Friday the AFL-CIO said on Friday it attempted to offer a compromise with language that said,"visas will be issued only when the employment of foreign workers will not adversely affect the wages and working conditions of similarly situated workers in the United States." It was rejected by Republicans in the bipartisan Senate group, according to a labor official.¶ As talks broke down, the Chamber took aim at the unions.¶ "The unions have jeopardized the entire immigration reform effort," over the relatively small program for future workers, Randel K. Johnson, the Chamber's senior vice president for labor, immigration and employee benefits, said in a statement. "We however remain hopeful that we can resolve this problem and still ultimately pass sound legislation that can be signed into law by the president."¶ Senators have been aiming to release legislation in April, when they return from recess, and then hold hearings and markups on the bill. The goal has been to move it to the floor by May or June at the latest. But as the deadline has neared, complications have continued to pop up.

#### CIR won’t pass – not enough support among members of the House GOP

Foley 3-27 (Elise, John Yarmuth: Immigration Group In House 'Very Close' To Deal, Huffington Post, 27 March 2013, http://www.huffingtonpost.com/2013/03/27/john-yarmuth-immigration\_n\_2963491.html, da 3-28-13)

Yarmuth said one of the biggest questions is how they ensure their bill can pass the Republican-controlled House, which will be a heavier lift than the Democratic-controlled Senate. The so-called "gang of eight" in the upper chamber plans to unveil a bill next month and has already put out a framework, but the House group still must decide whether to wait until a Senate bill passes or introduce their own legislation sooner.¶ They may be leaning toward the latter, Yarmuth hinted.¶ "I think one of the things that we're dealing with is the issue of making sure that House Republicans who are in the majority are comfortable with whatever package comes to the floor of the House," he said. "You know, just kind of the sensitivity is, would House Republicans be open to a bill that comes from a Democratic-controlled Senate or from a Democratic president? And that's why we kind of think our effort is most important because if we can get one through the House, then I think the odds of getting it signed into law improve a lot."¶ He said the contentious issues in the House group were over how to deal with undocumented immigrants already in the country, guest workers, border security and stopping employers from hiring people unauthorized to work in the United States.

#### Cantor and House Republicans support nuclear power

Politico 11 (Cantor: nuclear power 'essential' for U.S. energy needs, http://www.politico.com/blogs/glennthrush/0311/Cantor\_nuclear\_power\_essential\_for\_US\_energy\_needs.html)

House Majority Leader Eric Cantor defended nuclear energy production Monday, after a series of explosions at a nuclear reactor in Japan, calling it “essential” to meeting American energy needs. The problems at the Fukushima plant 150 miles north of Tokyo have reignited the debate over the safety of nuclear energy production. Cantor told reporters Monday that the tsunami that ravaged Japan last week is to blame, not the reactor itself. “As far as we know, this is the result of a tsunami,” he said. “Nuclear power is an essential mix of the energy economy in this country.” The tsunami caused technical problems at the Japanese plant, which left nuclear rods exposed, raising the specter of Chernobyl-style meltdown. The timing couldn’t have been worse for House Republican leaders, who demanded last week that President Barack Obama speed up approval of new nuclear energy facilities.

#### Obama is the kiss of death.

Altman, 3-20

[Alex, “Four Hurdles That Could Block Immigration Reform”, Time, 3-20-13,

<http://swampland.time.com/2013/03/20/four-hurdles-that-could-block-immigration-reform/>, RSR]

Little discussed but also looming is the possibility that Democrats drag their feet on reform. Liberals will balk if the path to citizenship is too long or too onerous, or if enforcement provisions are too rigid. Many conservatives also suspect that Democratic power brokers, despite their daily hammering of Republicans to get moving on immigration reform, would privately prefer to keep the issue as a cudgel than actually pass a law. Barack Obama “wants to make a bill come out of the Senate that is so far out there that it would never pass, so that he can blame us for not being compassionate and use the issue to take back the House in 2014,” says a House Republican. Even some liberals see this as a plausible scenario. “There’s always a lingering doubt in my mind,” admits one House Democrat. Obama knows that putting his fingerprints on the deal is an easy way to kill it; when a draft of his proposal leaked in the press, he called Republican negotiators individually to apologize. But if negotiations in Congress bog down, he may not be so hands off.

## 1AR

### Politics

#### Warming is the most probable for extinction --- absent multipliers, nuclear war won’t happen.

The New York End Times 6 The New York End Times is a non-partisan, non-religious, non-ideological, free news filter. We monitor world trends and events as they pertain to two vital threats - war and extinction. We use a proprietary methodology to quantify movements between the extremes of war and peace, harmony and extinction. http://newyorkendtimes.com/extinctionscale.asp

We rate Global Climate Change as a greater threat for human extinction in this century. Most scientists forecast disruptions and dislocations, if current trends persist. The extinction danger is more likely if we alter an environmental process that causes harmful effects and leads to conditions that make the planet uninhabitable to humans. Considering that there is so much that is unknown about global systems, we consider climate change to be the greatest danger to human extinction. However, there is no evidence of imminent danger. Nuclear war at some point in this century might happen. It is unlikely to cause human extinction though. While several countries have nuclear weapons, there are few with the firepower to annihilate the world. For those nations it would be suicidal to exercise that option. The pattern is that the more destructive technology a nation has, the more it tends towards rational behavior. Sophisticated precision weapons then become better tactical options. The bigger danger comes from nuclear weapons in the hands of terrorists with the help of a rogue state, such as North Korea. The size of such an explosion would not be sufficient to threaten humanity as a whole. Instead it could trigger a major war or even world war. Under this scenario human extinction would only be possible if other threats were present, such as disease and climate change. We monitor war separately. However we also need to incorporate the dangers here .

#### Nuke war doesn’t result in extinction.

Seitz 11, Harvard University Center for International Affairs visiting scholar, (Russell, “Nuclear winter was and is debatable,” Nature, 7-7-11, Vol 475, pg37)

Alan Robock'scontention that there has been no real scientific debate about the 'nuclear winter' concept is itself **debatable** (Nature 473, 275–276; 2011). **This potential climate disaster**, popularized in Science in 1983, **rested on** the output of **a one-dimensional model that was later shown to** overestimatethe smoke **a nuclear holocaust** might engender. More refined estimates, combined with advanced three-dimensional models (see http://go.nature.com.libproxy.utdallas.edu/kss8te), have dramatically reduced the extent and severity of the projected cooling. Despite this, Carl Sagan, who co-authored the 1983 Science paper, went so far as to posit “the extinction of Homo sapiens” (C. Sagan Foreign Affairs 63, 75–77; 1984). **Some regarded this apocalyptic prediction as** an exercise inmythology. George **Rathjens of** the **M**assachusetts **I**nstitute of **T**echnology **protested: “Nuclear winter is** the worstexample of themisrepresentation of science **to the public** in my memory,” (see http://go.nature.com.libproxy.utdallas.edu/yujz84) **and climatologist** Kerry **Emanuel** observed that **the subject had “become** notorious for its lack of scientific integrity**”** (Nature 319, 259; 1986). Robock's single-digit fall in temperature is at odds with the subzero (about −25 °C) continental cooling originally projected for a wide spectrum of nuclear wars. Whereas Sagan predicted darkness at noon from a US–Soviet nuclear conflict, Robock projects global sunlight that is several orders of magnitude brighter for a Pakistan–India conflict — literally the difference between night and day. Since 1983**, the projected worst-case cooling has fallen** from a Siberian deep freeze spanning 11,000 degree-days Celsius (a measure of the severity of winters) **to numbers so** unseasonably **small as to call** the very term **'nuclear winter' into question.**