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#### Global nuclear expansion now – dozens of countries

**NEI 12** [May 2012, Nuclear Energy Institute, White Paper, “Global Nuclear Power ¶ Development: Major ¶ Expansion Continues”]

Introduction¶ The development of energy policy is a balancing act for ¶ any nation. Resource availability, projections of electricity demand growth, the age of existing infrastructure and ¶ climate change goals are a few of the issues that must ¶ be addressed. A country’s decision to include nuclear ¶ energy in its portfolio can be more complex because ¶ nuclear requires a regulatory and industry infrastructure ¶ to ensure safety, ongoing access to global nuclear trade ¶ through treaties and cooperation agreements, significant ¶ capital for new plant construction and public support for ¶ peaceful use of the technology. In the aftermath of the ¶ Fukushima accident, a few countries—including Germany ¶ and Switzerland—have indicated that that they do not ¶ plan further nuclear expansion. But many more plan to ¶ proceed with nuclear power development.¶ The table on page two shows the 30 countries with existing nuclear programs, and includes their plans for new ¶ nuclear generation. Thirteen of the countries rely on ¶ nuclear power for over one-quarter of their electricity ¶ generation. Another 14 countries are moving ahead with ¶ new plant construction, and others have longer-term ¶ plans for new nuclear development. In rapidly ¶ developing countries like China and India, governments ¶ are planning a major role for new nuclear generation as ¶ they increase basic electrification and keep up with ¶ demand growth from economic expansion. ¶ The case studies in this paper provide examples of how ¶ different countries have balanced their resources and ¶ needs and determined that nuclear generation should be ¶ a part of their energy portfolios. Even in the postFukushima environment, this robust growth is expected ¶ with an additional 329 proposed¶ planned and 68 units proposed in countries without operating nuclear plants. ¶ Nuclear Countries¶ Operating Under Construction Planned Proposed¶ Country¶ As shown in the map, countries with existing nuclear programs are not the only ¶ ones planning to build nuclear plants. Some governments, like those in the ¶ United Arab Emirates and Poland, have made firm commitments to develop the ¶ infrastructure needed for a nuclear program. Other countries like Thailand and ¶ Chile are keeping nuclear energy as an option for the future by announcing ¶ proposals for new reactors. Countries will continue to evaluate policy and energy options as time passes and make appropriate decisions at the national level. ¶ For many nuclear energy will be a part of their clean energy future.¶ As the current status of new nuclear construction demonstrates, the majority of ¶ nuclear energy growth is occurring in non-OECD countries. OECD countries will ¶ build nuclear plants as they seek to replace aging generating fleets and reduce ¶ carbon emissions. But non-OECD countries are building electricity generation ¶ on a large scale to fuel high economic growth and to expand residential electrification. This presents many opportunities for U.S. suppliers to take ¶ advantage of markets aboard. ¶ Brazil¶ From the beginning of its nuclear program in the 1970s, Brazil has remained ¶ supportive of nuclear energy and its role in the country’s generation portfolio. ¶ Brazil has two operating nuclear units, Angra 1 and 2, near Rio de Janeiro, as ¶ well as facilities for uranium enrichment and fuel fabrication in Resende that ¶ serve the two domestic reactors. The planning for the first unit at Angra, a 520 ¶ MW unit designed by Westinghouse, started in the 1970s. Brazil signed a deal ¶ with West Germany for eight 1,300 MW units in the late ¶ 1970s, but economic stagnation and lower demand growth ¶ halted those plans. In 1995, construction on Angra 2 was ¶ restarted with the help of additional German investment.

#### Fast reactors inevitable – US lead key to nuke leadership

**Kirsch 9** [Steve Kirsch, founder and CEO of multiple tech companies collectively worth over %241 billion and MS in Electrical Engineering and Computer Science from MIT, November 2009, "Why We Should Build an Integral Fast Reactor Now,", ]

The genie is out of the bottle: refusing to play will not make fast reactors go away and will ultimately make us less safe. If we don’t re-start our fast reactor technology, then other countries will take the lead. France, Russia, India, Japan, and China all have fast reactor programs and all are either operating fast reactors now, or soon will be. The US shut down our last remaining fast reactor 15 years ago. Leadership is important for two reasons: 1) if we fail to lead, we will have missed taking advantage of our superior technology and missed a major economic opportunity as the premiere supplier of clean power technology and 2) the nuclear industry is in far safer hands if the US leads the way than if we abdicate. For example, if Chernobyl had been a US reactor design, that accident could never have happened.

#### Scenario 1: Prolif – Plan solves it

#### A. Economic incentive to forego ENR and PUREX – means no weapons

**Stanford 10** [IFR FaD context – the need for U.S. implementation of the IFR, 18 February 2010 by Barry Brook, This is a context statement for the IFR FaD series, written by Dr. George S. Stanford. George is a nuclear reactor physicist, part of the team that developed the Integral Fast Reactor. He is now retired from Argonne National Laboratory after a career of experimental work pertaining to power-reactor safety. He is the co-author of Nuclear Shadowboxing: Contemporary Threats from Cold War Weaponry. He is a founding member of the Science Council for Global Initiatives, Brave New Climate]

Background info on proliferation (of nuclear weapons). Please follow the reasoning carefully.¶ – Atomic bombs can be made with highly enriched uranium (90% U-235) or with good-quality plutonium (bomb designers want plutonium that is ~93% Pu-239).¶ – For fuel for an LWR, the uranium only has to be enriched to 3 or 4% U-235.¶ – To make a uranium bomb you don’t need a reactor — but you do need access to an enrichment facility or some other source of highly enriched uranium…¶ – Any kind of nuclear reactor can be used to make weapons-quality plutonium from uranium-238, but the uranium has to have been irradiated for only a very short period. In other words, nobody would try to make a plutonium weapon from ordinary spent fuel, because there are easier ways to get plutonium of much better quality.¶ – Plutonium for a weapon not only has to have good isotopic quality, it also has to be chemically uncontaminated. Thus the lightly irradiated fuel has to be processed to extract the plutonium in a chemically pure form. But mere possession of a reactor is not sufficient for a weapons capability — a facility using a chemical process called PUREX is also needed.¶ – Regardless of how many reactors a country has, it cannot have a weapons capability unless it has either the ability to enrich uranium or to do PUREX-type fuel reprocessing.¶ – Therefore, the spread of weapons capability will be strongly inhibited if the only enrichment and reprocessing facilities are in countries that already have a nuclear arsenal.¶ – But that can only happen if countries with reactors (and soon that will be most of the nations of the world) have absolutely ironclad guarantees that they can get the fuel they need even if they can’t make their own, regardless of how obnoxious their political actions might be.¶ – Such guarantees will have to be backed up by some sort of international arrangement, and that can only come to pass if there is effective leadership for the laborious international negotiations that will have to take place. (For a relevant discussion, see here)¶ – At present, the only nation that has a realistic potential to be such a leader is the United States.¶ – But a country cannot be such a leader in the political arena unless it is also in the technological forefront.¶ – The United States used to be the reactor-technology leader, but it abandoned that role in 1994 when it terminated the development of the IFR.¶ – Since then, other nations — China, India, Japan, South Korea, Russia, France — have proceeded to work on their own fast-reactor versions, which necessarily will involve instituting a fuel-processing capability.¶ – Thus the United States is being left behind, and is rapidly losing its ability to help assure that the global evolution of the technology of nuclear energy proceeds in a safe and orderly manner.¶ – But maybe it’s not too late yet. After all, the IFR is the fast-reactor technology with the post promise (for a variety of reasons), and is ready for a commercial-scale demonstration to settle some uncertainties about how to scale up the pyroprocess as needed, to establish better limits on the expected cost of production units, and to develop an appropriate, expeditious licensing process.

#### B. Commercial leadership and solving uranium – also solves the nuclear arsenal

**Jones 12** [The Hill, “US must remain leader in nuclear enrichment”, Retired General James L. Jones, senior fellow at the Bipartisan Policy Center and co-chairman of its Energy Project. He was national security adviser to President Obama from January 2009 to November 2010, 01/17/12]

Achieving energy security is among our nation’s most pressing requirements in this still-young century. I believe that America must employ a more strategic national energy policy if it is to overcome the many complex energy challenges that will so heavily influence its economic and national security. While our continued dependence on foreign sources of oil might remain the most visible threat to American eneurargy security, consequential energy-related threats such as climate change and the proliferation of nuclear material will continue to bear heavily on our security for many decades to come.¶ Nuclear nonproliferation, long one of America’s chief international security strategies, has been a major priority for this administration, as it has for every administration since World War II. Nuclear power is unique among energy sources because the commercial use of civilian technology is inseparable from nuclear security and proliferation concerns. The commercial trade of nuclear technology can heighten proliferation risks. Such vulnerabilities in a complex and dangerous world must continue to be managed responsibly — a primary objective of the nonproliferation laws and safeguards that accompany the export of U.S. nuclear technology. ¶ ¶ Our commercial leadership in the nuclear industry has been an enduring source of America’s influence in the global marketplace and a potent lever for promoting international cooperation in developing and enforcing nonproliferation regimes. Unfortunately, the U.S. is ceding its leadership in key areas of nuclear technology development. Of greatest concern is potential loss of leadership in the enrichment industry. The U.S. once produced a majority of the world’s supply of enriched uranium necessary to generate nuclear power, but today it produces only 25 percent. The United States Enrichment Corporation (USEC), which operates the United States’s largest commercial uranium enrichment facility, is the only U.S. majority-owned supplier. However, its plant located in Paducah, Ky., uses antiquated and inefficient technology. The enterprise is not well-positioned to compete cost-effectively and its ability to sustain operations remains in serious doubt. ¶ The loss of our only domestically-owned source of enriched uranium will severely undermine America’s influence in the industry and our leadership in vital international nonproliferation efforts. Without the United States as a reliable source of nuclear fuel, particularly in a world with increasing demand for low- and no-carbon electric generation, other nations will have greater incentive to pursue their own enrichment capabilities, increasing the risks of proliferation and the chances that civilian nuclear technology will be diverted for malign purposes. We know well the adverse effects on U.S. national security and international stability of North Korea’s and Iran’s pursuit of nuclear weapons under the guise of commercial enrichment.¶ The disappearance of a domestically owned capability would not only undermine U.S. leadership in a highly consequential arena of global commerce and security, it would render us dependent on foreign-controlled sources of uranium enrichment. This could increase the vulnerability not only of America’s commercial nuclear industry but of our national nuclear arsenal. Tritium, produced using enriched uranium, is necessary to maintain and modernize our nuclear weapons. Relying on foreign suppliers for material essential for maintaining the safety, security and reliability of our nuclear capability is unacceptable.

#### Proliferation likely now – risks Israel strikes

**Chalmers 13** [Royal United Services Institute, independent think-tank founded in 1831 by the Duke of Wellington, “The Nuclear Agenda for 2013: New Solutions to Old Problems”, RUSI Analysis, 10 Jan 2013, Hugh Chalmers, Research Analyst, Nuclear Analysis, formerly had consulting position at the Verification Research, Training and Information Centre, previously held positions at IHS Jane's and the King's College Centre for Science and Security Studies, MA in Science and Security from the King's College Department of War Studies]

After a year characterised by leadership transitions in the US, Russia, China, Japan, and South Korea, political paralysis has pushed many old nuclear problems into 2013. And through the momentum this has afforded them, they will almost certainly colour the coming year.¶ Continuing Crises¶ Chief among these old problems is the Iranian nuclear crisis. Despite increasingly bellicose rhetoric from Israel and the implementation of further sanctions, Iran's stockpile of 20%-enriched uranium almost tripled in 2012 - increasing the threat to what fragile stability exists in the Middle East. The International Atomic Energy Agency (IAEA) can neither confirm nor deny whether Iran's nuclear programme has a military dimension, and the P5+1 group of nations has yet to negotiate a satisfactory conclusion to this crisis.¶ This was in part due to the US Presidential elections in November. The lingering presence of the crisis in US election debates meant that few risks were taken by the US, and consequently the P5+1, to compromise with Iran in the latter half of 2012. And while the IAEA ended the year with a small step towards resolving its dispute with Iran, the US and its partners in the P5+1 start 2013 no closer to their goal than they were a year ago. Unless Iran dramatically reduces its production of 20%-enriched uranium (or significantly increases the conversion of enriched uranium to less-sensitive forms) its stockpile will probably cross Israel's hazy red line of 240kg before mid-2013. If this occurs, the Israeli airstrikes that were narrowly avoided in 2012 may yet haunt 2013.¶ Elections in South Korea and Japan were also coloured by North Korea's successful launch of the Unha-3 rocket in December, which also cast a shadow over the newly-formed Politburo Standing Committee in China. While the timing of the launch ostensibly commemorated the first anniversary of Kim Jong-Il's death, it served equally well as a reminder that North Korea is still prepared to use provocative displays of power to influence regional debates. The launch was rightly met by familiar condemnation from the international community, including an important call from China to abide by UN Security Council Resolutions. However, the Security Council itself has yet to add its voice to this chorus - something it did within four days of North Korea's failed rocket launch in April 2012.¶ While it is too early to judge the impact of the launch, if North Korea feels that provocation has proven productive (and that it may dodge an assertive response from the UN), it may be tempted to consider further provocation. Satellite imagery analysis suggests that North Korea has maintained a readiness to test a nuclear warhead within two week's notice. And if North Korea does indeed hope to eventually mount a nuclear warhead on a modified Unha-3 rocket, it will have to test a reliable, small-scale warhead.¶ Decaying Relations¶ Finally, since Vladimir Putin's controversial return to the Kremlin in March of 2012, a distinct chill has come over US-Russia relations. While the 'reset' in relations between the two powers successfully secured modest reductions in the strategic nuclear arsenals of the two states, it has since stumbled over the deployment of US ballistic missile defence systems in Europe, and fallen over Russia's tit-for-tat response to the blacklisting of select Russian individuals by the US Magnitsky act at the end of 2012.¶ Two important symptoms of this deteriorating relationship will manifest themselves this year. The Nunn-Lugar Cooperative Threat Reduction Program, which safeguarded and dismantled weapons of mass destruction in the former Soviet Union, and the Megatons to Megawatts Program, which converted Russian weapons-origin fissile material into fuel for US reactors, will be dropped by Russia before 2013 is out. Without a thaw in relations between the US and Russia, and the reinvigoration of bilateral nuclear arms control between the two powers, 2013 may leave the global nuclear disarmament movement in a worse state than it found it.

#### Israel strike causes great power war

José Miguel Alonso Trabanco 2009; researcher for Global Research, “The Middle Eastern Powder Keg Can Explode at Anytime,” globalresearch.ca/index.php?context=va&aid=11762

In case of an Israeli and/or American attack against Iran, Ahmadinejad's government will certainly respond. A possible countermeasure would be to fire Persian ballistic missiles against Israel and maybe even against American military bases in the regions. Teheran will unquestionably resort to its proxies like Hamas or Hezbollah (or even some of its Shiite allies it has in Lebanon or Saudi Arabia) to carry out attacks against Israel, America and their allies, effectively setting in flames a large portion of the Middle East. The ultimate weapon at Iranian disposal is to block the Strait of Hormuz. If such chokepoint is indeed asphyxiated, that would dramatically increase the price of oil, this a very threatening retaliation because it will bring intense financial and economic havoc upon the West, which is already facing significant trouble in those respects. In short, the necessary conditions for a major war in the Middle East are given. Such conflict could rapidly spiral out of control and thus a relatively minor clash could quickly and dangerously escalate by engulfing the whole region and perhaps even beyond. There are many key players: the Israelis, the Palestinians, the Arabs, the Persians and their respective allies and some great powers could become involved in one way or another (America, Russia, Europe, China). Therefore, any miscalculation by any of the main protagonists can trigger something no one can stop. Taking into consideration that the stakes are too high, perhaps it is not wise to be playing with fire right in the middle of a powder keg.

#### Prolif causes extinction

Krieger, ‘9

[David, Pres. Nuclear Age Peace Foundation and Councilor – World Future Council, “Still Loving the Bomb After All These Years”, 9-4, https://www.wagingpeace.org/articles/2009/09/04\_krieger\_newsweek\_response.php?krieger]

Jonathan Tepperman’s article in the September 7, 2009 issue of Newsweek, “Why Obama Should Learn to Love the Bomb,” provides a novel but frivolous argument that nuclear weapons “may not, in fact, make the world more dangerous….” Rather, in Tepperman’s world, “The bomb may actually make us safer.” Tepperman shares this world with Kenneth Waltz, a University of California professor emeritus of political science, who Tepperman describes as “the leading ‘nuclear optimist.’” Waltz expresses his optimism in this way: “We’ve now had 64 years of experience since Hiroshima. It’s striking and against all historical precedent that for that substantial period, there has not been any war among nuclear states.” Actually, there were a number of proxy wars between nuclear weapons states, such as those in Korea, Vietnam and Afghanistan, and some near disasters, the most notable being the 1962 Cuban Missile Crisis. Waltz’s logic is akin to observing a man falling from a high rise building, and noting that he had already fallen for 64 floors without anything bad happening to him, and concluding that so far it looked so good that others should try it. Dangerous logic! Tepperman builds upon Waltz’s logic, and concludes “that all states are rational,” even though their leaders may have a lot of bad qualities, including being “stupid, petty, venal, even evil….” He asks us to trust that rationality will always prevail when there is a risk of nuclear retaliation, because these weapons make “the costs of war obvious, inevitable, and unacceptable.” Actually, he is asking us to do more than trust in the rationality of leaders; he is asking us to gamble the future on this proposition. “The iron logic of deterrence and mutually assured destruction is so compelling,” Tepperman argues, “it’s led to what’s known as the nuclear peace….” But if this is a peace worthy of the name, which it isn’t, it certainly is not one on which to risk the future of civilization. One irrational leader with control over a nuclear arsenal could start a nuclear conflagration, resulting in a global Hiroshima. Tepperman celebrates “the iron logic of deterrence,” but deterrence is a theory that is far from rooted in “iron logic.” It is a theory based upon threats that must be effectively communicated and believed. Leaders of Country A with nuclear weapons must communicate to other countries (B, C, etc.) the conditions under which A will retaliate with nuclear weapons. The leaders of the other countries must understand and believe the threat from Country A will, in fact, be carried out. The longer that nuclear weapons are not used, the more other countries may come to believe that they can challenge Country A with impunity from nuclear retaliation. The more that Country A bullies other countries, the greater the incentive for these countries to develop their own nuclear arsenals. Deterrence is unstable and therefore precarious. Most of the countries in the world reject the argument, made most prominently by Kenneth Waltz, that the spread of nuclear weapons makes the world safer. These countries joined together in the Nuclear Non-Proliferation Treaty (NPT) to prevent the spread of nuclear weapons, but they never agreed to maintain indefinitely a system of nuclear apartheid in which some states possess nuclear weapons and others are prohibited from doing so. The principal bargain of the NPT requires the five NPT nuclear weapons states (US, Russia, UK, France and China) to engage in good faith negotiations for nuclear disarmament, and the International Court of Justice interpreted this to mean complete nuclear disarmament in all its aspects. Tepperman seems to be arguing that seeking to prevent the proliferation of nuclear weapons is bad policy, and that nuclear weapons, because of their threat, make efforts at non-proliferation unnecessary and even unwise. If some additional states, including Iran, developed nuclear arsenals, he concludes that wouldn’t be so bad “given the way that bombs tend to mellow behavior.” Those who oppose Tepperman’s favorable disposition toward the bomb, he refers to as “nuclear pessimists.” These would be the people, and I would certainly be one of them, who see nuclear weapons as presenting an urgent danger to our security, our species and our future. Tepperman finds that when viewed from his “nuclear optimist” perspective, “nuclear weapons start to seem a lot less frightening.” “Nuclear peace,” he tells us, “rests on a scary bargain: you accept a small chance that something extremely bad will happen in exchange for a much bigger chance that something very bad – conventional war – won’t happen.” But the “extremely bad” thing he asks us to accept is the end of the human species. Yes, that would be serious. He also doesn’t make the case that in a world without nuclear weapons, the prospects of conventional war would increase dramatically. After all, it is only an unproven supposition that nuclear weapons have prevented wars, or would do so in the future. We have certainly come far too close to the precipice of catastrophic nuclear war. As an ultimate celebration of the faulty logic of deterrence, Tepperman calls for providing any nuclear weapons state with a “survivable second strike option.” Thus, he not only favors nuclear weapons, but finds the security of these weapons to trump human security. Presumably he would have President Obama providing new and secure nuclear weapons to North Korea, Pakistan and any other nuclear weapons states that come along so that they will feel secure enough not to use their weapons in a first-strike attack. Do we really want to bet the human future that Kim Jong-Il and his successors are more rational than Mr. Tepperman?

**Credible nuclear arsenal deters all war and solves Russia and China nuclear war**

**Payne ’12** – professor and head of Defense and Strategic Studies at Missouri State

(Dr. Keith B., Testimony to the Congressional Strategic Posture Commission, United States Senate Appropriations Subcommittee on Energy and Water Development, 7-25-2012)

The GNZC report, however, essentially dismisses this concern by asserting that Russia and China are not now opponents and are unlikely ever to be so again: “The risk of nuclear confrontation between the United States and either Russia or China belongs to the past, not the future.” Such a prediction fits the narrative for further deep reductions, but it does not appear to fit Russian or Chinese actions and statements concerning their ambitions and nuclear developments. Over the past several years, top Russian leaders have made numerous threats of pre-emptive and preventive nuclear attack against US allies and friends. Most recently, the Chief of the Russian General Staff, Gen. Nikolai Makarov threatened a pre-emptive attack against NATO states, and the threat was implicitly nuclear. 11 (Please see the attached compilation of Russian nuclear threats since 2007 by Dr. Mark Schneider). Such threats challenge Western sensibilities and faith in a powerful, global nuclear “taboo,” but they are within the norm of Russian behavior and doctrine regarding nuclear forces. To claim that nuclear weapons will not be salient in contemporary or future US relations with Russia or China is an unwarranted and highly optimistic prediction, not a prudent basis for calculating US deterrence strategies and forces. If wrong, Minimum Deterrence and corresponding low force levels could invite serious risk and provocations. Second, the question of having an adequate deterrence capability cannot be answered simply by determining if we can threaten some given, contemporary set of targets. Deterrence must work in contemporary and future crises, and we will come to those crises with the forces we have in hand. No one knows with confidence “how much of what force” will be necessary for credible deterrence now, and future requirements are particularly arcane because opponents and threats can shift rapidly in this post-Cold War era and the requirements for deterrence correspondingly can change rapidly. This reality complicates the task of calculating “how much is enough” for deterrence. The priority deterrence question now is whether we have sufficient force options and diversity to threaten credibly the wide spectrum of targets that opponents may value over the course of decades. In some plausible scenarios, a small and undiversified US nuclear force may be adequate for deterrence, in other cases, effective deterrence may demand a large and diverse nuclear arsenal with capabilities well beyond those envisaged for Minimum Deterrence. Confident declarations that some fixed Minimum Deterrence force level will prove adequate cannot be based on substance; they reflect only hope and carry considerable risk. Instead, the flexibility and resilience of our forces to adapt to differing deterrence requirements should be considered a fundamental requirement of US force adequacy, and our standing capabilities must be sufficiently large and diverse to adapt to a variety of shifting deterrence demands. It may be convenient to pick some fixed, low number and claim that 300, 400, or 500 weapons will be adequate for deterrence now and in the future, but no one can possibly know if such statements are true. We do know that the more diverse and flexible our forces, the more likely we are to have the types of capabilities needed for deterrence in a time of shifting and uncertain threats, stakes and opponents. But force diversity and flexibility does not come automatically. It is important that our nuclear force posture and infrastructure incorporate these characteristics and that they are manifest to opponents and allies for deterrence and assurance purposes respectively.

#### Scenario 2: Terrorism

#### Terrorism is extremely likely and is comparatively the largest threat to international stability

**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.

#### The only impediment to escalating terror is access to spent fuel

NTI, 12 [Nuclear Threat Initiative, August 1st,“Why Is Highly Enriched Uranium a Threat?”, <http://www.nti.org/analysis/reports/civilian-heu-reduction-and-elimination/>]

Why Is Highly Enriched Uranium a Threat? The most difficult challenge for a terrorist organization seeking to build a nuclear weapon or [improvised nuclear device](http://www.nti.org/glossary/improvised-nuclear-device-ind/) is obtaining [fissile material](http://www.nti.org/glossary/fissile-material/), either [plutonium](http://www.nti.org/glossary/plutonium-pu/) or [highly enriched uranium (HEU)](http://www.nti.org/glossary/highly-enriched-uranium-heu/). HEU, [uranium](http://www.nti.org/glossary/uranium/) that has been processed to increase the proportion of the U-235 [isotope](http://www.nti.org/glossary/isotope/) to over 20%, is required for the construction of a [gun-type nuclear device](http://www.nti.org/glossary/gun-type-nuclear-weapon/), the simplest type of nuclear weapon. The greater the proportion of U-235 (i.e. the higher the [enrichment](http://www.nti.org/glossary/enriched-uranium/) level), the less material is needed for a nuclear explosive device. [Weapons-grade uranium](http://www.nti.org/glossary/weapons-grade-material/) generally refers to uranium enriched to at least 90%, but material of far lower enrichment levels, found in both fresh and [spent nuclear fuel](http://www.nti.org/glossary/spent-nuclear-fuel/), can be used to create a nuclear explosive device. In 2002, the U.S. National Research Council warned that "crude HEU weapons could be fabricated without state assistance," noting that "the primary impediment that prevents countries or technically competent terrorist groups from developing nuclear weapons is the availability of [nuclear material], especially HEU."[1] Creating a nuclear weapon from HEU is technically easier than building a [plutonium](http://www.nti.org/glossary/plutonium-pu/) weapon. Moreover, current technology is unlikely to detect a shielded nuclear device on a truck or boat. Therefore, securing and eliminating stocks of HEU is the surest way to decrease the risk that terrorist groups could use this material to create a nuclear explosion. Where Is Civilian HEU Located? Experts estimate that approximately 70 tons of HEU are used in civilian applications worldwide. [2] As little as 25 kilograms (kg) of U-235 (which amounts to about 28kg of HEU enriched to 90%) is needed to produce a nuclear weapon; about 40-60kg is needed for a cruder nuclear device. [3] Bomb-grade material can be obtained from HEU that is fresh (unirradiated), and [irradiated](http://www.nti.org/glossary/irradiate/) (also referred to as spent). Fresh and lightly irradiated fuel (such as fuel used in critical assemblies and pulse reactors) is not significantly [radioactive](http://www.nti.org/glossary/radioactivity/), and is therefore relatively safe to handle. Although using nuclear fuel in high-powered reactors initially makes it highly radioactive and thus very difficult to handle safely (often this fuel is referred to as "self-protecting"), [spent fuel](http://www.nti.org/glossary/spent-nuclear-fuel/) loses its radioactivity over time, making it easier to handle and potentially more attractive to terrorists. HEU is currently used in the civilian sphere to fuel [research reactors](http://www.nti.org/glossary/research-reactor/), critical assemblies, pulsed reactors, and a few fast reactors. According to the [International Atomic Energy Agency (IAEA)](http://www.nti.org/glossary/international-atomic-energy-agency/), 244 research reactors are in operation or temporarily shut down across 56 countries. A further 441 reactors have been shut down or decommissioned, while eight are planned or under construction. [4] Many of the research reactors that have been shut down, but not decommissioned, have spent HEU fuel on-site. The IAEA database notes that over 20,000 spent fuel assemblies from research reactors are enriched to levels above 20 percent. Nearly half of these stored fuel assemblies are enriched to levels at or above 90 percent.[5] That said, there is no current comprehensive, authoritative inventory of civil HEU globally, which is a major obstacle to progress in this area. According to the Government Accountability Office, even the [United States](http://www.nti.org/country-profiles/united-states/) has failed to maintain an accurate inventory of the HEU that it has exported over the years as attempts to balance the books could only account for 10 percent of the material. [6] The United States and the [Soviet Union](http://www.nti.org/country-profiles/russia/) supplied much of the HEU fuel used in research reactors world-wide. Other producers include [China](http://www.nti.org/country-profiles/china/) (which sent HEU fuel for research reactors to Nigeria, Ghana, [Iran](http://www.nti.org/country-profiles/iran/), [Pakistan](http://www.nti.org/country-profiles/pakistan/), and [Syria](http://www.nti.org/country-profiles/syria/), as well as enriched uranium to [South Africa](http://www.nti.org/country-profiles/south-africa/), and [Argentina](http://www.nti.org/country-profiles/argentina/)); [France](http://www.nti.org/country-profiles/france/) (to Chile and [India](http://www.nti.org/country-profiles/india/)); the [United Kingdom](http://www.nti.org/country-profiles/united-kingdom/) (to [Australia](http://www.nti.org/country-profiles/australia/), India, and [Japan](http://www.nti.org/country-profiles/japan/)); and South Africa (which did not export this fuel).[7] Before 1978, when Washington and Moscow became concerned about the implications of their exports of highly enriched fuels, most of the fuel supplied by the United States (the bulk of which went to North American and the Asia-Pacific), was of very high enrichment levels (90% and above). The Soviet-supplied fuel, chiefly sent to Eastern Europe, was typically 80% enriched. Under several U.S.-led initiatives, many countries have returned HEU fuel, both fresh and spent, to its country of origin in order to reduce the risk of theft. HEU is also used in targets in reactors that produce [medical isotopes](http://www.nti.org/glossary/medical-isotopes/). HEU is used for this purpose annually in reactors in Belgium, Canada, France, the Netherlands, and Russia.[8] Other countries, including Australia and [Indonesia](http://www.nti.org/country-profiles/indonesia/), have begun producing these isotopes with [LEU](http://www.nti.org/glossary/low-enriched-uranium-leu/) targets, and still other countries, such as [Egypt](http://www.nti.org/country-profiles/egypt/), are currently developing and implementing their LEU target-based production process. [9] In particular, South Africa—a major exporter—converted its Safari-1 reactor to rely on both LEU targets and fuel for the production of [medical isotopes](http://www.nti.org/glossary/radioisotope/). Most of the other major producers of medical isotopes, including Canada, the Netherlands, and France, utilize LEU fuels in their reactors, but continue to rely on HEU targets. However, a number of these countries, particularly in Western Europe, have pledged to convert to LEU targets. Progress towards fuller use of LEU is not universal, however. A Russian project, for example, aims to produce enough molybdenum-99 using HEU fuel and targets to satisfy 20 percent of global demand by 2015. [10] In addition to use in research and test reactors and for medical isotope production, HEU is used in naval propulsion and space propulsion research. The material is also used for testing fast reactor core designs using [mixed oxide (MOX) fuel](http://www.nti.org/glossary/mixed-oxide-mox-fuel/). For further information on HEU in civilian applications, see [Civilian Uses of HEU](http://www.nti.org/analysis/articles/civilian-uses-heu/). Security of Civilian HEU Many civilian facilities with HEU on-site do not have adequate security. The IAEA reported that during one of its missions, it discovered a research reactor with HEU that "was observed to have essentially no physical protection." [11] The IAEA assisted the facility with enhancing its security, but reported that overall, "deficiencies remain in the legal, administrative, and technical arrangements for controlling and protecting nuclear materials ... in many countries." [12] The U.S. Department of Energy has been assisting with physical protection upgrades for 22 foreign research reactors through the Global Research Reactor Program. A September 2009 GAO report found that while most sites that have received upgrades generally met IAEA security guidelines, in some cases, critical security weaknesses remained. [23] It is not a simple matter to upgrade security measures; the majority of the world's research reactors are located in universities or other publicly accessible research centers. While security concerns have dramatically increased since 9/11, it is difficult to reconfigure a site that was not built with physical protection in mind. Storage of spent fuel stocks is generally even less secure than fresh fuel stocks, as until a few years ago spent nuclear fuel was considered "self-protecting" and few facilities wanted to spend money securing a material that was no longer of economic value. It is far more effective to remove this material from vulnerable locations than to attempt to increase security on-site. Programs to Reduce and Eliminate HEU There have been efforts to reduce the amount of HEU at civilian facilities since 1978, when Washington initiated the [Reduced Enrichment for Research and Test Reactors (RERTR) Program](http://www.nti.org/glossary/rertr-program/). Moscow also began its own program to reduce enrichment at Soviet-built research reactors outside of the Soviet Union, and changed its HEU export policies, supplying these reactors with 36% HEU in lieu of 80% HEU. In the past 25 years, many countries have cooperated with the RERTR program or initiated their own, similar programs. In May 2004, the U.S. Department of Energy launched the [Global Threat Reduction Initiative (GTRI](http://www.nti.org/glossary/global-threat-reduction-initiative/)), which the IAEA, Russia, and others have since joined. Among its goals, the GTRI seeks to "minimize and eventually eliminate any reliance on HEU in the civilian fuel cycle, including conversion of research and test reactors worldwide from the use of HEU to the use of LEU fuel and targets." As of early 2012, U.S.-led efforts have converted to LEU or verified the shut down of 88 HEU-fueled facilities.[14] The RERTR program is also working on the conversion of a handful of medical isotope producers that use HEU targets in their reactors. The program includes some of the largest producers of medical isotopes, located in Europe. To date, the RERTR program has helped to successfully convert isotope-producing reactors in Argentina and South Africa. At present, there are no longer any technical barriers to conversion to LEU and only political and financial issues remain. [15] Besides converting facilities to use LEU fuel and targets, there have also been efforts to consolidate fresh and spent HEU fuel at a smaller number of relatively secure locations. This has involved removing the fuel, mostly to the United States and Russia, from other countries, as well as consolidating the fuel within countries. U.S. programs in this area (the Russian Research Reactor Fuel Return program to repatriate fuel to Russia, and the Foreign Research Reactor Spent Nuclear Fuel Acceptance Program to repatriate U.S.-origin fuel), have all been subsumed under the 2004 GTRI initiative. Together, the two programs have returned over 2,735kg of spent and fresh HEU fuel to the United States and Russia as of 2012. [16] According to the IAEA's definition of the quantity of HEU necessary to construct a nuclear explosive device, the amount of repatriated HEU is equivalent to up to 80 weapons. [17] Despite the progress of these efforts, many HEU sites remain worldwide, with a significant portion of them located in Russia. [26] A related program, the Material Consolidation and Conversion (MCC) project, established in 1999, reduces this excess Russian civilian HEU by blending it down into LEU. As of the end of 2011, approximately 13.5 of an estimated 17 tons of U-235 in excess Russian civilian HEU had been blended down. [18] Both the United States and Russia also have large quantities of excess HEU from their defense programs. In Russia, excess HEU from weapons is blended down to LEU within the framework of the Megatons to Megawatts program (also known as the [HEU-LEU program](http://www.nti.org/glossary/heu-deal/)). The resulting LEU is then released for civilian use. The program will end in 2013, at which point 500 tons of HEU will have been downblended. [19] The United States initially declared some 174 metric tons of HEU as excess to military needs, designating this material as civilian. [20] An additional 200 metric tons were officially removed from the U.S. weapons stockpile in November 2005. [21]

#### That’s key to the nuclear taboo – solves 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.**

#### Causes retaliatory nuclear war

**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.

### 2

#### Warming is real and anthropogenic – CO2 is key

Rahmstorf, November 12 [Stefan Rahmstorf is a German oceanographer and climatologist. Since 2000, he has been a Professor of Physics of the Oceans at Potsdam University. He received his Ph.D. in oceanography from Victoria University of Wellington.Comparing climate projections to observations up to 2011, Stefan Rahmstorf et al 2012 Environ Res. Lett. 7 044035 [doi:10.1088/1748-9326/7/4/044035](http://dx.doi.org/10.1088/1748-9326/7/4/044035) © 2012 IOP Publishing Ltd Received 19 July 2012, accepted for publication 9 November 2012 Published 27 November 2012. <http://iopscience.iop.org/1748-9326/7/4/044035/article>]

Climate projections like those of the Intergovernmental Panel on Climate Change (IPCC [2001](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib10), [2007](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib11)) are increasingly used in decision-making. It is important to keep track of how well past projections match the accumulating observational data. Five years ago, it was found that CO2 concentration and global temperature closely followed the central prediction of the third IPCC assessment report during 1990–2006, whilst sea level was tracking along the upper limit of the uncertainty range (Rahmstorf et al [2007](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib24)). Here we present an update with five additional years of data and using advances in removing short-term noise from global temperature data. Atmospheric carbon dioxide concentration continues to match the prediction: the mean value reached in 2011 was 390.5 ppm (NOAA [2012](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib21)), only about 1.5 ppm higher than the central IPCC projections published in 2001. For historical perspective, in his article 'Are we on the brink of a pronounced global warming?', Broecker ([1975](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib1)) predicted an increase from 322 ppm observed in 1970 to 403 ppm in 2010. A more detailed analysis of anthropogenic climate forcing, which also includes other greenhouse gases, aerosols and surface albedo changes, is beyond the scope of this letter. Here we focus on two prime indicators of climate change: the evolution of global-mean temperature and sea level. 2. Global temperature evolution To compare global temperature data to projections, we need to consider that IPCC projections do not attempt to predict the effect of solar variability, or specific sequences of either volcanic eruptions or El Niño events. Solar and volcanic forcing are routinely included only in 'historic' simulations for the past climate evolution but not for the future, while El Niño–Southern Oscillation (ENSO) is included as a stochastic process where the timing of specific warm or cool phases is random and averages out over the ensemble of projection models. Therefore, model-data comparisons either need to account for the short-term variability due to these natural factors as an added quasi-random uncertainty, or the specific short-term variability needs to be removed from the observational data before comparison. Since the latter approach allows a more stringent comparison it is adopted here. Global temperature data can be adjusted for solar variations, volcanic aerosols and ENSO using multivariate correlation analysis (Foster and Rahmstorf [2011](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib6), Lean and Rind [2008](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib14), [2009](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib15), Schönwiese et al [2010](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib28)), since independent data series for these factors exist. We here use the data adjusted with the method exactly as described in Foster and Rahmstorf, but using data until the end of 2011. The contributions of all three factors to global temperature were estimated by linear correlation with the multivariate El Niño index for ENSO, aerosol optical thickness data for volcanic activity and total solar irradiance data for solar variability (optical thickness data for the year 2011 were not yet available, but since no major volcanic eruption occurred in 2011 we assumed zero volcanic forcing). These contributions were computed separately for each of the five available global (land and ocean) temperature data series (including both satellite and surface measurements) and subtracted. The five thus adjusted data sets were averaged in order to avoid any discussion of what is 'the best' data set; in any case the differences between the individual series are small (Foster and Rahmstorf [2011](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib6)). We show this average as a 12-months running mean in figure [1](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749fig1), together with the unadjusted data (likewise as average over the five available data series). Comparing adjusted with unadjusted data shows how the adjustment largely removes e.g. the cold phase in 1992/1993 following the Pinatubo eruption, the exceptionally high 1998 temperature maximum related to the preceding extreme El Niño event, and La Niña-related cold in 2008 and 2011. Figure 1. Observed annual global temperature, unadjusted (pink) and adjusted for short-term variations due to solar variability, volcanoes and ENSO (red) as in Foster and Rahmstorf ([2011](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib6)). 12-months running averages are shown as well as linear trend lines, and compared to the scenarios of the IPCC (blue range and lines from the third assessment, green from the fourth assessment report). Projections are aligned in the graph so that they start (in 1990 and 2000, respectively) on the linear trend line of the (adjusted) observational data. [Export PowerPoint slide](http://iopscience.iop.org/1748-9326/7/4/044035/powerpoint/figure/erl439749fig1) [Download figure (96 KB)](http://iopscience.iop.org/1748-9326/7/4/044035/downloadFigure/figure/erl439749fig1) Note that recently a new version of one of those time series has become available: version of 4 the HadCRUT data (Morice et al [2012](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib20)). Since the differences are small and affect only one of five series, the effect of this update on the average shown in figure [1](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749fig1) is negligible. We chose to include version 3 of the data in this graph since these data are available up to the end of 2011, while version 4 so far is available only up to the end of 2010. The removal of the known short-term variability components reduces the variance of the data without noticeably altering the overall warming trend: it is 0.15 °C/decade in the unadjusted and 0.16 °C/decade in the adjusted data. From 1990–2011 the trends are 0.16 and 0.18 °C/decade and for 1990–2006 they are 0.22 and 0.20 °C/decade respectively. The relatively high trends for the latter period are thus simply due to short-term variability, as discussed in our previous publication (Rahmstorf et al [2007](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib24)). During the last ten years, warming in the unadjusted data is less, due to recent La Niña conditions (ENSO causes a linear cooling trend of −0.09 °C over the past ten years in the surface data) and the transition from solar maximum to the recent prolonged solar minimum (responsible for a −0.05 °C cooling trend) (Foster and Rahmstorf [2011](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib6)). Nevertheless, unadjusted observations lie within the spread of individual model projections, which is a different way of showing the consistency of data and projections (Schmidt [2012](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib27)). Figure [1](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749fig1) shows that the adjusted observed global temperature evolution closely follows the central IPCC projections, while this is harder to judge for the unadjusted data due to their greater short-term variability. The IPCC temperature projections shown as solid lines here are produced using the six standard, illustrative SRES emissions scenarios discussed in the third and fourth IPCC reports, and do not use any observed forcing. The temperature evolution for each, including the uncertainty range, is computed with a simple emulation model, hence the temperature curves are smooth. The temperature ranges for these scenarios are provided in the summary for policy makers of each report, in figure 5 in case of the third assessment and in table SPM.3 in case of the fourth assessment (where the full time evolution is shown in figure 10.26 of the report; Meehl et al [2007](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib18)). For historic perspective, Broecker in 1975 predicted a global warming from 1980–2010 by 0.68 °C, as compared to 0.48 °C according to the linear trend shown in figure [1](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749fig1), an overestimate mostly due to his neglect of ocean thermal inertia (Rahmstorf [2010](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib23)). A few years later, Hansen et al ([1981](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib8)) analysed and included the effect of ocean thermal inertia, resulting in lower projections ranging between 0.28 and 0.45 °C warming from 1980–2010. Their upper limit thus corresponds to the observed warming trend. They further correctly predicted that the global warming signal would emerge from the noise of natural variability before the end of the 20th century. 3. Global sea-level rise Turning to sea level, the quasi linear trend measured by satellite altimeters since 1993 has continued essentially unchanged when extending the time series by five additional years. It continues to run near the upper limit of the projected uncertainty range given in the third and fourth IPCC assessment reports (figure [2](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749fig2)). Here, the sea-level projections provided in figure 5 of the summary for policy makers of the third assessment and in table SPM.3 of the fourth assessment are shown. The satellite-based linear trend 1993–2011 is 3.2 ± 0.5 mm yr−1, which is 60% faster than the best IPCC estimate of 2.0 mm yr−1 for the same interval (blue lines). The two temporary sea-level minima in 2007/2008 and 2010/2011 may be linked to strong La Niña events (Llovel et al [2011](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib17)). The tide gauges show much greater variability, most likely since their number is too limited to properly sample the global average (Rahmstorf et al [2012](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib25)). For sea level the fourth IPCC report did not publish the model-based time series (green lines), but these were made available online in 2012 (CSIRO [2012](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib5)). They do not differ significantly from the projections of the third IPCC report and thus continue to underestimate the observed upward trend. Figure 2. Sea level measured by satellite altimeter (red with linear trend line; AVISO data from (Centre National d'Etudes Spatiales) and reconstructed from tide gauges (orange, monthly data from Church and White ([2011](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib4))). Tide gauge data were aligned to give the same mean during 1993–2010 as the altimeter data. The scenarios of the IPCC are again shown in blue (third assessment) and green (fourth assessment); the former have been published starting in the year 1990 and the latter from 2000. [Export PowerPoint slide](http://iopscience.iop.org/1748-9326/7/4/044035/powerpoint/figure/erl439749fig2) [Download figure (91 KB)](http://iopscience.iop.org/1748-9326/7/4/044035/downloadFigure/figure/erl439749fig2) Could this underestimation appear because the high observed rates since 1993 are due to internal multi-decadal variability, perhaps a temporary episode of ice discharge from one of the ice sheets, rather than a systematic effect of global warming? Two pieces of evidence make this very unlikely**.** First, the IPCC fourth assessment report (IPCC [2007](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib11)) found a similar underestimation also for the time period 1961–2003: the models on average give a rise of 1.2 mm yr−1, while the best data-based estimate is 50% larger at 1.8 mm yr−1 (table 9.2 of the report; Hegerl et al [2007](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib9)). This is despite using an observed value for ice sheet mass loss (0.19 mm yr−1) in the 'modelled' number in this comparison. Second, the observed rate of sea-level rise on multi-decadal timescales over the past 130 years shows a highly significant correlation with global temperature (Vermeer and Rahmstorf [2009](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib30)) by which the increase in rate over the past three decades is linked to the warming since 1980, which is very unlikely to be a chance coincidence. Another issue is whether non-climatic components of sea-level rise, not considered in the IPCC model projections, should be accounted for before making a comparison to data, namely water storage in artificial reservoirs on land (Chao et al [2008](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib3)) and the extraction of fossil groundwater for irrigation purposes (Konikow [2011](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib13)). During the last two decades, both contributions approximately cancel (at −0.3 and +0.3 mm yr−1) so would not change our comparison in figure [2](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749fig2), see figure 11 of Rahmstorf et al ([2012](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib25)) based on the data of Chao et al ([2008](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib3)) and Konikow ([2011](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib13)). This is consistent with the lack of recent trend in net land-water storage according to the GRACE satellite data (Lettenmaier and Milly [2009](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib16)). For the period 1961–2003, however, the effect of dam building (which peaked in the 1970s at around −0.9 mm yr−1) very likely outstripped groundwater extraction, thus widening the gap between modelled and observed climatically-forced sea-level rise. It is instructive to analyse how the rate of sea-level rise changes over longer time periods (figure [3](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749fig3)). The tide gauge data (though noisy, see above) show that the rate of sea-level rise was around 1 mm yr−1 in the early 20th century, around 1.5–2 mm yr−1 in mid-20th-century and increased to around 3 mm yr−1 since 1980 (orange curve). The satellite series is too short to meaningfully compute higher order terms beyond the linear trend, which is shown in red (including uncertainty range). Finally, the AR4 projections are shown in three bundles of six emissions scenarios: the 'mid' estimates in green, the 'low' estimates (5-percentile) in cyan and the 'high' estimates (95-percentile) in blue. These are the scenarios that comprise the often-cited AR4-range from 18 to 59 cm sea-level rise for the period 2090–99 relative to 1980–99 (IPCC [2007](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib11)). For the period 2000–2100, this corresponds to a range of 17–60 cm sea-level rise. Figure 3. Rate of sea-level rise in past and future. Orange line, based on monthly tide gauge data from Church and White ([2011](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib4)). The red symbol with error bars shows the satellite altimeter trend of 3.2 ± 0.5 mm yr−1 during 1993–2011; this period is too short to determine meaningful changes in the rate of rise. Blue/green line groups show the low, mid and high projections of the IPCC fourth assessment report, each for six emissions scenarios. Curves are smoothed with a singular spectrum filter (ssatrend; Moore et al [2005](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib19)) of 10 years half-width. [Export PowerPoint slide](http://iopscience.iop.org/1748-9326/7/4/044035/powerpoint/figure/erl439749fig3) [Download figure (94 KB)](http://iopscience.iop.org/1748-9326/7/4/044035/downloadFigure/figure/erl439749fig3) Figure [3](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749fig3) shows that in all 'low' estimates, the rate of rise stays well below 3 mm yr−1 until the second half of the 21st century, in four of the six even throughout the 21st century. The six 'mid' estimates on average give a rise of 34 cm, very close to what would occur if the satellite-observed trend of the last two decades continued unchanged for the whole century. However, figure [3](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749fig3) shows that the reason for this relatively small projected rise is not an absence of acceleration. Rather, all these scenarios show an acceleration of sea-level rise in the 21st century, but from an initial value that is much lower than the observed recent rise. Figure [3](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749fig3) further shows that only the 'high' models represented in the range of AR4 models validate when compared to the observational data and can in this regard be considered valid projection models for the future. These 'high' model scenarios represent a range of 21st century rise of 37–60 cm. Nevertheless, this range cannot be assumed to represent the full range of uncertainty of future sea-level rise, since the 95-percentile can only represent a very small number of models, given that 23 climate models were used in the AR4. The model(s) defining the upper 95-percentile might not get the right answer for the right reasons, but possibly by overestimating past temperature rise. Note that the IPCC pointed out that its projections exclude 'future rapid dynamical changes in ice flow'. The projections now published online (CSIRO [2012](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib5)) include an alternative version that includes 'scaled-up ice sheet discharge'. These projections validate equally well (or poorly) with the observed data, since they only differ substantially in the future, not in the past, from the standard projections. The sea-level rise over 2000–2100 of the 'high' bundle of these scenarios is 46–78 cm. Alternative scalings of sea-level rise have been developed, which in essence postulate that the rate of sea-level rise increases in proportion to global warming (e.g. Grinsted et al [2009](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib7), Rahmstorf [2007](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib22)). This approach can be calibrated with past sea-level data (Kemp et al [2011](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib12), Vermeer and Rahmstorf [2009](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib30)) and leads to higher projections of future sea-level rise as compared to those of the IPCC. The latter is immediately plausible: if we consider the recently observed 3 mm yr−1 rise to be a result of 0.8 °C global warming since preindustrial times (Rahmstorf et al [2012](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib25)), then a linear continuation of the observed warming of the past three decades (leading to a 21st century warming by 1.6 °C, or 2.4 °C relative to preindustrial times) would linearly raise the rate of sea-level rise to 9 mm yr−1, as in the highest scenario in figure [3](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749fig3)—but already for a rather moderate warming scenario, not the 'worst case' emissions scenario. 4. Conclusions In conclusion, the rise in CO2 concentration and global temperature has continued to closely match the projections over the past five years, while sea level continues to rise faster than anticipated**.** The latter suggests that the 21st Century sea-level projections of the last two IPCC reports may be systematically biased low. Further support for this concern is provided by the fact that the ice sheets in Greenland and Antarctica are increasingly losing mass (Rignot et al [2011](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib26), Van den Broeke et al [2011](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib29)), while those IPCC projections assumed that Antarctica will gain enough mass in future to largely compensate mass losses from Greenland (see figure 10.33 in Meehl et al ([2007](http://iopscience.iop.org/1748-9326/7/4/044035/article#erl439749bib18))). For this reason, an additional contribution ('scaled-up ice sheet discharge') was suggested in the IPCC fourth assessment. Our results highlight the need to thoroughly validate models with data of past climate changes before applying them to projections.

#### And, it causes extinction – but US leadership can reverse it

Ferris, 1/17/13 [The Big Thaw, [Elizabeth Ferris](http://www.brookings.edu/experts/ferrise) Co-Director, [Brookings-LSE Project on Internal Displacement](http://www.brookings.edu/about/projects/idp), <http://www.brookings.edu/research/papers/2013/01/the-big-thaw>

Global warming is occurring at a faster pace than predicted by scientists. Temperatures are rising, icecaps and glaciers are melting, and extreme weather events are becoming both more frequent and more intense. Last fall, the National Snow and Ice Data Center documented a record low of the level of Arctic sea ice – a figure 49 percent lower than the 1979-2000 average. If these trends continue, the results will be far-reaching for life on this planet. But if the warming accelerates dramatically and if polar ice melts even faster, the results could be catastrophic. This could occur if the Greenland ice sheet or the West Antarctica Ice Sheet (WAIS) collapses, triggering a significant rise in sea levels throughout the world with particularly devastating impacts on populations living in low-lying coastal areas. Although the effects of climate change are likely to be long-term and the worst effects will probably neither be experienced in your presidency nor even in your lifetime, the future is inherently unpredictable. Climate change is already affecting communities around the world. It is likely to produce devastating consequences whether in the near or distant future. Taking bold steps now to address climate change offers an opportunity for you not only to leave a legacy that will impact future generations but also an opportunity to address current problems resulting from the effects of climate change. Recommendations: • Raise the priority of climate change on your foreign policy agenda, in particular by re-vitalizing negotiations over a post-Kyoto treaty. The Doha round of negotiations, which ended last month, was disappointing. Countries are further away today than they were a year ago on reducing emissions. U.S. leadership can reverse current trends of inadequate globalcommitment to reduce greenhouse gases. • Support measures that will enable communities and countries to adapt to the most egregious effects of climate change. On the international level this means supporting and leading the difficult discussions around climate finance and using U.S. aid to support government planning to respond to the effects of climate change, including financial assistance to encourage communities to stay where they are as well as to plan for the relocation of communities whose homes will no longer be habitable. • Support effective multilateral action to increase both mitigation and adaptation measures. Use your influence with the multilateral development banks to encourage more attention to disaster riskreduction measures in development planning. Work with international agencies and legal experts to devise an international legal regime for dealing with the expected increase in trans-border migration. It is easier to put a system in place before a crisis is at hand. • Strengthen domestic efforts to mitigate the effects of climate change by reducing carbon emissions and enhancing domestic capacity to prepare for, respond, and recover from sudden-onset natural disasters. Background: Since the first report of the Intergovernmental Panel on Climate Change (IPCC) in 1990, the projections about the impact of global warming have become direr. From projecting the widespread consequences of a global rise in temperature of 2 degrees Celsius by the end of the century, current projections are that the rise in temperature will double to 4 degrees Celsius. The seas are rising 60 percent faster than predicted by the IPCC. The Greenland ice sheet is shrinking twice as fast as estimated by the IPCC and is losing mass at about five times the rate it was in the early 1990s. If the Greenland ice sheet were to melt completely, global sea rise could reach seven meters. And the consequences of global warming go far beyond sea-level rise. For example, the National Oceanic and Atmospheric Administration warns that the conditions that led to the 2011 Texas drought are 20 times more likely to occur now than in the 1960s as a result of increases in greenhouse gas concentrations. Although climate change will have many negative effects in different parts of the world, including prolonged droughts, reduction in arable land, declining agricultural productivity, and increased flooding due to more extreme weather events, the impact of sea level rise perhaps best illustrates the potential dangers. Throughout the world, more people are living in coastal areas as the result of population growth, urbanization and government policies. Presently 10 percent of the world’s population — 600 million people — live in low-elevation coastal zones and the percentage is growing. Sixty-five percent of the world’s megacities (those over 5 million) are located in these coastal areas. A rise in sea level of even a meter would have major implications for coastal populations; if sea levels were to rise by several meters, the consequences would be catastrophic. Most obviously, sea level rise will submerge land, causing countries to lose physical territory. The areas expected to experience the largest land loss by 2030 are the Arctic Ocean coasts of Canada, Alaska, Siberia and Greenland as well as coastal areas of Pakistan, Sri Lanka, southeast Indonesia, and eastern Africa. In the United States, particularly vulnerable areas include the coastal areas of the east and west coasts and the Gulf of Mexico. Rising sea levels will affect economics, politics, community life and security. For example, the mega-deltas of Asia are the food baskets of the region, and the impact of a sea level rise on food security will be considerable. But perhaps the most significant impact of climate change in general and rising sea levels in particular will be the displacement of people. Migration is a complex process driven by a range of economic, social and political factors but it is becoming clear that environmental factors will increasingly influence migration. In Bangladesh, for example, moving to cities has become a common coping strategy in the face of flooding. One of the IPCC background studies posits that a 40-centimeter rise in sea levels will affect 100 million people. As hundreds of millions of people in Africa and Asia are at risk of flooding by 2060, it is likely that many will move to cities such as Dhaka and Lagos that are located in coastal flood plain areas. In other words, the trend is for people to migrate to areas of greater — not lesser — environmental vulnerability. At the same time, as the UK’s authoritative Foresight study concludes, those who are able to migrate may well be the lucky ones; those who are unable to move may be the most vulnerable. Large-scale migration has many consequences. If sea level rise renders small island states uninhabitable (which is likely to occur long before the islands are actually submerged by the seas), issues of sovereignty, legal status, and responsibility will present the world with huge challenges. Most climate change-induced or displacement will be internal, placing strain on infrastructure and pressure on governments to deliver services. Political instability, conflict poor governance exacerbate these problems. Climate change is a threat multiplier, often affecting those countries least able to respond appropriately. How will governments cope with the movement of large numbers of people from coasts toward inland areas? There is also a possibility that some, perhaps many, will seek to move to other countries because of the effects of climate change. The international legal system is unprepared to deal with trans-border movements triggered by environmental factors or disasters, since the displaced do not fall under the 1951 Refugee Convention (unless they leave because of political turmoil exacerbated by climate change.) Projecting possible massive displacement from climate change is complicated by the difficulty of comprehending the interrelationships between the different effects of climate change, for example, changes in fish stocks and coral reefs brought about by the acidification of the world’s oceans; changing patterns of disease; changing habitats for animals and plants; the intersection of deforestation and increasingly arid climates in some parts of the world. Delicate ecological balances are changing in ways that are as yet poorly understood. Similarly, there is much we do not know about the dynamic nature of the effects of climate change. For example, some scientists are reporting that the melting of Arctic ice itself is releasing more carbon into the atmosphere, increasing global warming which will in turn increase the rate of Arctic ice melt. Most scientists have observed that the climate is becoming warmer and that extreme weather events are becoming more frequent. While it is impossible to attribute any single weather event, such as Hurricane Sandy, to climate change, the global trends clearly demonstrate an increase in the frequency of extreme weather events. These trends are likely to intensify. The interaction between increasing extreme weather events and other effects of climate change – such as increased erosion, acidification of the seas, desertification, sea-level rise – is also likely to lead to large-scale movement of people. Conclusion: There are certainly obstacles and pitfalls to making climate change a centerpiece of your foreign policy. Perhaps the projections of scientists are too pessimistic and the effects of global warming will not be as serious as now thought. Perhaps you will be unable to marshal the necessary political support to enact necessary legislation. Perhaps other governments will fail to rally to your leadership and perhaps the negotiations over climate change mitigation and adaptation will widen, not narrow the North- South divide. It is certainly understandable that you would want to put aside these longer-term challenges and focus on more immediate economic issues. But a climate catastrophe could be lurking around the corner. Unless urgent action is taken now, the effects of climate change on life on this planet and on life in the United States will increase. Climate change is a domestic, foreign policy, security, development, human rights, and intergenerational justice issue. Preparing better for climate change disasters at home and abroad is a good short-term prophylactic. But making serious and sustained efforts to reduce global warming can solidify America’s present leadership in the world. It can lay the foundation for the country’s sustainable future development. It can address the causes of future humanitarian crises and alleviate future human suffering. It can be a legacy issue for the Obama administration that will impact the world for generations.

#### Causes extinction – oceans

**Sify 2010 –** Sydney newspaper citing Ove Hoegh-Guldberg, professor at University of Queensland and Director of the Global Change Institute, and John Bruno, associate professor of Marine Science at UNC (Sify News, “Could unbridled climate changes lead to human extinction?”, <http://www.sify.com/news/could-unbridled-climate-changes-lead-to-human-extinction-news-international-kgtrOhdaahc.html>, WEA)

The findings of the comprehensive report: 'The impact of climate change on the world's marine ecosystems' emerged from a synthesis of recent research on the world's oceans, carried out by two of the world's leading marine scientists. One of the authors of the report is Ove Hoegh-Guldberg, professor at The University of Queensland and the director of its Global Change Institute (GCI). 'We may see sudden, unexpected changes that have serious ramifications for the overall well-being of humans, including the capacity of the planet to support people. This is further evidence that we are well on the way to the next great extinction event,' says Hoegh-Guldberg. 'The findings have enormous implications for mankind, particularly if the trend continues. The earth's ocean, which produces half of the oxygen we breathe and absorbs 30 per cent of human-generated carbon dioxide, is equivalent to its heart and lungs. This study shows worrying signs of ill-health. It's as if the earth has been smoking two packs of cigarettes a day!,' he added. 'We are entering a period in which the ocean services upon which humanity depends are undergoing massive change and in some cases beginning to fail', he added. The 'fundamental and comprehensive' changes to marine life identified in the report include rapidly warming and acidifying oceans, changes in water circulation and expansion of dead zones within the ocean depths. These are driving major changes in marine ecosystems: less abundant coral reefs, sea grasses and mangroves (important fish nurseries); fewer, smaller fish; a breakdown in food chains; changes in the distribution of marine life; and more frequent diseases and pests among marine organisms. Study co-author John F Bruno, associate professor in marine science at The University of North Carolina, says greenhouse gas emissions are modifying many physical and geochemical aspects of the planet's oceans, in ways 'unprecedented in nearly a million years'. 'This is causing fundamental and comprehensive changes to the way marine ecosystems function,' Bruno warned, according to a GCI release. These findings were published in Science

#### The IFR is the only way to reduce coal emissions sufficiently to avert the worst climate disasters

**Kirsch 9** (Steve Kirsch, Bachelor of Science and a Master of Science in electrical engineering and computer science from the Massachusetts Institute of Technology, American serial entrepreneur who has started six companies: Mouse Systems, Frame Technology, Infoseek, Propel, Abaca, and OneID, "Why We Should Build an Integral Fast Reactor Now," 11/25/9) http://skirsch.wordpress.com/2009/11/25/ifr/

To prevent a climate disaster, we must eliminate virtually all coal plant emissions worldwide in 25 years. The best way and, for all practical purposes, the only way to get al. countries off of coal is not with coercion; it is to make them want to replace their coal burners by giving them a plug-compatible technology that is less expensive. The IFR can do this. It is plug-compatible with the burners in a coal plant (see Nuclear Power: Going Fast). No other technology can upgrade a coal plant so it is greenhouse gas free while reducing operating costs at the same time. In fact, no other technology can achieve either of these goals. The IFR can achieve both.¶ The bottom line is that without the IFR (or a yet-to-be-invented technology with similar ability to replace the coal burner with a cheaper alternative), it is unlikely that we’ll be able to keep CO2 under 450 ppm.¶ Today, the IFR is the only technology with the potential to displace the coal burner. That is why restarting the IFR is so critical and why Jim Hansen has listed it as one of the top five things we must do to avert a climate disaster.[4]¶ Without eliminating virtually all coal emissions by 2030, the sum total of all of our other climate mitigation efforts will be inconsequential. Hansen often refers to the near complete phase-out of carbon emissions from coal plants worldwide by 2030 as the sine qua non for climate stabilization (see for example, the top of page 6 in his August 4, 2008 trip report).¶ To stay under 450ppm, we would have to install about 13,000 GWe of new carbon-free power over the next 25 years. That number was calculated by Nathan Lewis of Caltech for the Atlantic, but others such as Saul Griffith have independently derived a very similar number and White House Science Advisor John Holdren used 5,600 GWe to 7,200 GWe in his presentation to the Energy Bar Association Annual Meeting on April 23, 2009. That means that if we want to save the planet, we must install more than 1 GWe per day of clean power every single day for the next 25 years. That is a very, very tough goal. It is equivalent to building one large nuclear reactor per day, or 1,500 huge wind turbines per day, or 80,000 37 foot diameter solar dishes covering 100 square miles every day, or some linear combination of these or other carbon free power generation technologies. Note that the required rate is actually higher than this because Hansen and Rajendra Pachauri, the chair of the IPCC, now both agree that 350ppm is a more realistic “not to exceed” number (and we’ve already exceeded it).¶ Today, we are nowhere close to that installation rate with renewables alone. For example, in 2008, the average power delivered by solar worldwide was only 2 GWe (which is to be distinguished from the peak solar capacity of 13.4GWe). That is why every renewable expert at the 2009 Aspen Institute Environment Forum agreed that nuclear must be part of the solution. Al Gore also acknowledges that nuclear must play an important role.¶ Nuclear has always been the world’s largest source of carbon free power. In the US, for example, even though we haven’t built a new nuclear plant in the US for 30 years, nuclear still supplies 70% of our clean power!¶ Nuclear can be installed very rapidly; much more rapidly than renewables. For example, about two thirds of the currently operating 440 reactors around the world came online during a 10 year period between 1980 and 1990. So our best chance of meeting the required installation of new power goal and saving the planet is with an aggressive nuclear program.¶ Unlike renewables, nuclear generates base load power, reliably, regardless of weather. Nuclear also uses very little land area. It does not require the installation of new power lines since it can be installed where the power is needed. However, even with a very aggressive plan involving nuclear, it will still be extremely difficult to install clean power fast enough.¶ Unfortunately, even in the US, we have no plan to install the clean power we need fast enough to save the planet. Even if every country were to agree tomorrow to completely eliminate their coal plant emissions by 2030, how do we think they are actually going to achieve that? There is no White House plan that explains this. There is no DOE plan. There is no plan or strategy. The deadlines will come and go and most countries will profusely apologize for not meeting their goals, just like we have with most of the signers of the Kyoto Protocol today. Apologies are nice, but they will not restore the environment.¶ We need a strategy that is believable, practical, and affordable for countries to adopt. The IFR offers our best hope of being a centerpiece in such a strategy because it the only technology we know of that can provide an economically compelling reason to change.¶ At a speech at MIT on October 23, 2009, President Obama said “And that’s why the world is now engaged in a peaceful competition to determine the technologies that will power the 21st century. … The nation that wins this competition will be the nation that leads the global economy. I am convinced of that. And I want America to be that nation, it’s that simple.”¶ Nuclear is our best clean power technology and the IFR is our best nuclear technology. The Gen IV International Forum (GIF) did a study in 2001-2002 of 19 different reactor designs on 15 different criteria and 24 metrics. The IFR ranked #1 overall. Over 242 experts from around the world participated in the study. It was the most comprehensive evaluation of competitive nuclear designs ever done. Top DOE nuclear management ignored the study because it didn’t endorse the design the Bush administration wanted.¶ The IFR has been sitting on the shelf for 15 years and the DOE currently has no plans to change that.¶ How does the US expect to be a leader in clean energy by ignoring our best nuclear technology? Nobody I’ve talked to has been able to answer that question.¶ We have the technology (it was running for 30 years before we were ordered to tear it down). And we have the money: The Recovery Act has $80 billion dollars. Why aren’t we building a demo plant?¶ IFRs are better than conventional nuclear in every dimension. Here are a few:¶ Efficiency: IFRs are over 100 times more efficient than conventional nuclear. It extracts nearly 100% of the energy from nuclear material. Today’s nuclear reactors extract less than 1%. So you need only 1 ton of actinides each year to feed an IFR (we can use existing nuclear waste for this), whereas you need 100 tons of freshly mined uranium each year to extract enough material to feed a conventional nuclear plant.¶ Unlimited power forever: IFRs can use virtually any actinide for fuel. Fast reactors with reprocessing are so efficient that even if we restrict ourselves to just our existing uranium resources, we can power the entire planet forever (the Sun will consume the Earth before we run out of material to fuel fast reactors). If we limited ourselves to using just our DU “waste” currently in storage, then using the IFR we can power the US for over 1,500 years without doing any new mining of uranium.[5]¶ Exploits our largest energy resource: In the US, there is 10 times as much energy in the depleted uranium (DU) that is just sitting there as there is coal in the ground. This DU waste is our largest natural energy resource…but only if we have fast reactors. Otherwise, it is just waste. With fast reactors, virtually all our nuclear waste (from nuclear power plants, leftover from enrichment, and from decommissioned nuclear weapons)[6] becomes an energy asset worth about $30 trillion dollars…that’s not a typo…$30 trillion, not billion.[7] An 11 year old child was able to determine this from publicly available information in 2004.

#### Inventing something cheaper is key – alternative methods can’t solve warming

**Kirsch 9** (Steve Kirsch, Bachelor of Science and a Master of Science in electrical engineering and computer science from the Massachusetts Institute of Technology, American serial entrepreneur who has started six companies: Mouse Systems, Frame Technology, Infoseek, Propel, Abaca, and OneID, "How Does Obama Expect to Solve the Climate Crisis Without a Plan?" 7/16/9) [http://www.huffingtonpost.com/steve-kirsch/how-does-obama-expect-to\_b\_236588.html-http://www.huffingtonpost.com/steve-kirsch/how-does-obama-expect-to\_b\_236588.html](http://www.huffingtonpost.com/steve-kirsch/how-does-obama-expect-to_b_236588.html-http%3A//www.huffingtonpost.com/steve-kirsch/how-does-obama-expect-to_b_236588.html)

The ship is sinking slowly and we are quickly running out of time to develop and implement any such plan if we are to have any hope of saving the planet. What we need is a plan we can all believe in. A plan where our country's smartest people all nod their heads in agreement and say, "Yes, this is a solid, viable plan for keeping CO2 levels from touching 425ppm and averting a global climate catastrophe."¶ ¶ At his Senate testimony a few days ago, noted climate scientist James Hansen made it crystal clear once again that the only way to avert an irreversible climate meltdown and save the planet is to phase out virtually all coal plants worldwide over a 20 year period from 2010 to 2030. Indeed, if we don't virtually eliminate the use of coal worldwide, everything else we do will be as effective as re-arranging deck chairs on the Titanic.¶ ¶ Plans that won't work¶ ¶ Unfortunately, nobody has proposed a realistic and practical plan to eliminate coal use worldwide or anywhere close to that. There is no White House URL with such a plan. No environmental group has a workable plan either.¶ ¶ Hoping that everyone will abandon their coal plants and replace them with a renewable power mix isn't a viable strategy -- we've proven that in the U.S. Heck, even if the Waxman-Markey bill passes Congress (a big "if"), it is so weak that it won't do much at all to eliminate coal plants. So even though we have Democrats controlling all three branches of government, it is almost impossible to get even a weak climate bill passed.¶ ¶ If we can't pass strong climate legislation in the U.S. with all the stars aligned, how can we expect anyone else to do it? So expecting all countries to pass a 100% renewable portfolio standard (which is far far beyond that contemplated in the current energy bill) just isn't possible. Secondly, even if you could mandate it politically in every country, from a practical standpoint, you'd never be able to implement it in time. And there are lots of experts in this country, including Secretary Chu, who say it's impossible without nuclear (a point which I am strongly in agreement with).¶ ¶ Hoping that everyone will spontaneously adopt carbon capture and sequestration (CCS) is also a non-starter solution. First of all, CCS doesn't exist at commercial scale. Secondly, even if we could make it work at scale, and even it could be magically retrofitted on every coal plant (which we don't know how to do), it would require all countries to agree to add about 30% in extra cost for no perceivable benefit. At the recent G8 conference, India and China have made it clear yet again that they aren't going to agree to emission goals.¶ ¶ Saying that we'll invent some magical new technology that will rescue us at the last minute is a bad solution. That's at best a poor contingency plan.¶ ¶ The point is this: It should be apparent to us that we aren't going to be able to solve the climate crisis by either "force" (economic coercion or legislation) or by international agreement. And relying on technologies like CCS that may never work is a really bad idea.¶ ¶ The only remaining way to solve the crisis is to make it economically irresistible for countries to "do the right thing." The best way to do that is to give the world a way to generate electric power that is economically more attractive than coal with the same benefits as coal (compact power plants, 24x7 generation, can be sited almost anywhere, etc). Even better is if the new technology can simply replace the existing burner in a coal plant. That way, they'll want to switch. No coercion is required.

### 3

#### Euro-American nuclear collaboration now – but US funding shortfalls block its effectiveness

**Lovering, Luke, and Brook 12** [Jessica Lovering is a policy analyst, and Max Luke is a policy associate, in the Breakthrough Institute’s Energy & Climate program. Barry Brook is a Breakthrough Senior Fellow, November 16, 2012, “How U.S.-European Cooperation Can Deliver Cheaper, Safer Nuclear Energy”, Breakthrough Institute]

As the debate over climate policy picks up again in the wake of Hurricane Sandy and President Obama’s reelection, policymakers should prioritize efforts that will accelerate the adoption of zero-carbon technologies, especially the only proven baseload source available: next generation nuclear.¶ Whereas traditional nuclear reactors from the 1950s were designed in secret, advanced models are being researched, designed, and financed by innovative international collaborations. Take GE-Hitachi's PRISM, a joint American-Japanese venture to construct a power plant in the United Kingdom capable of processing plutonium. Or the recent announcement that South Korea's national electric utility, KEPCO, had been awarded a contract to build the first nuclear plant in the United Arab Emirates, using Australian-mined uranium for fuel.¶ An expanding international community recognizes the importance of developing advanced nuclear reactor designs to meet energy needs and address global warming. Thirteen countries have joined the Generation IV International Forum (GIF), for instance, a cooperative endeavor to encourage governments and industry to support advanced nuclear energy concepts. Member countries, which include the United States, Japan, Russia, and China, have agreed to expand R&D funding for advanced nuclear projects that meet stringent sustainability, economic, safety and nonproliferation goals.¶ Yet despite international agreement on the necessity of next generation nuclear systems, there is a dearth of support at the national level. In the US, annual federal RD&D spending for advanced fission reactors has not exceeded $200 million in the last 10 years, following much larger budgets through the 1970s to mid-1990s. The majority of research and investment in advanced nuclear systems today comes from Asia, and most new nuclear is constructed in developing nations. Yet many of the countries most interested in building more nuclear are largely stuck with old Generation II designs.¶ Private industry appears ready to take a leadership role in the development and deployment of advanced nuclear builds, but the right government incentives, international agreements and support structures must be in place for this to occur. GE-Hitachi, for example, submitted a proposal last year to build a pair of next generation modular fast reactors in the UK, the first commercial advanced nuclear plant. These “PRISM” reactors are based on an Integral Fast Reactor (IFR) design that is widely considered one of the most promising next generation models (see this white paper by Breakthrough Senior Fellow Barry Brook and Tom Blees of the Science Council for Global Initiatives). In addition to providing clean electricity, PRISM reactors would burn weapons material, offering a cost-effective solution to the UK’s plutonium disposal problem. If built, the reactors would be able to process all of the UK’s stockpiled plutonium within five years and then generate decades of clean energy, in addition to providing a full commercial demonstration of the technology. Other European countries and the United States should seek out and support these win-win scenarios, where an advanced clean technology can be demonstrated while also solving a separate policy problem.

#### Effective collaboration ends European coal dependence

**Lynas 11** [European Dialogue, “WHY NUCLEAR POWER IS STILL A GOOD CHOICE”, April 18, 2011, Mark Lynas, a British author, journalist and environmental activist who focuses on climate change, contributor to New Statesman, Ecologist, Granta and Geographical magazines, and The Guardian and The Observer, degree in history and politics from the University of Edinburgh]

They can. The irony of Fukushima is that in forcing us all to confront our deepest fears about the dangers of nuclear power, we find many of them to be wildly irrational — based on scare stories propagated through years of unchallenged mythology and the repeated exaggerations of self-proclaimed "experts" in the anti-nuclear movement. As the British environmental writer George Monbiot has pointed out, if we took the scientific consensus on nuclear energy as seriously as we take the scientific consensus on climate change, we environmentalists would be telling a very different story.¶ The science on radiation tells us that the effects of Fukushima are serious but so far much less so than some of the more hyperbolic media coverage might suggest. The power plant operator, Tokyo Electric Power Co., has been releasing enormous quantities of radioactive water into the sea, for example. It sounds scary, but a member of the public would have to eat seaweed and seafood harvested just one mile from the discharge pipe for a year to receive an effective dose of 0.6 millisieverts. To put this in context, every American receives on average 3 millisieverts each year from natural background radiation, and a hundred times more than this in some naturally radioactive areas. As for the Tokyo tap water that was declared unsafe for babies, the highest measured levels of radioactivity were 210 becquerels per liter, less than a quarter of the European legal limit of 1,000 becquerels per liter. Those leaving Tokyo because of this threat will have received more radiation on the airplane flight out than if they had been more rational and stayed put.¶ For the green movement, which is often justifiably accused of making the perfect the enemy of the good, having to confront real-world choices about energy technologies is painful. Most environmentalists assert that a combination of renewables and efficiency can decarbonize our energy supply and save us both from global warming and the presumed dangers of nuclear power. This is technically possible but extremely unlikely in practice. In the messy real world, countries that decide to rely less on nuclear will almost certainly dig themselves even deeper into a dependence on dirty fossil fuels, especially coal.¶ In the short term, this is already happening. In Germany — whose government tried to curry favor with a strongly anti-nuclear population by rashly closing seven perfectly safe nuclear plants after the Fukushima crisis began — coal has already become the dominant factor in electricity prices once again. Regarding carbon dioxide emissions, you can do the math: Just add about 11 million tons per year for each nuclear plant replaced by a coal plant newly built or brought back onto the grid.¶ In China the numbers become even starker. Coal is cheap there (as are the thousands of human lives lost in extracting it each year), and if the hundred or so new nuclear plants previously proposed in China up to 2030 are not built, it is a fair bet that more than a billion tons can be added to annual global carbon dioxide emissions as a result.¶ Japan is also heavily dependent on coal, so it is a fair bet that less nuclear power there will add substantially to the country's emissions. No wonder the Japanese are insisting on backing off from the Kyoto climate treaty. Looking at the entire global picture, I estimate that turning away from nuclear power could make the difference between whether the world warms by 2 degrees Celsius (bad but manageable) and 3 degrees Celsius (disastrous) in the next century.¶ We have already made this mistake once. In the 1970s it looked as if nuclear power was going to play a much bigger role than eventually turned out to be the case. What happened was Three Mile Island, and the birth of an anti-nuclear movement that stopped dozens of half-built or proposed reactors; coal plants were substituted instead. It is therefore fair to say that the environmental movement played a substantial role in causing global warming, surely an ecological error it should learn from in years ahead.¶ Don't get me wrong: I am an enthusiastic proponent of replacing fossil fuels with renewable energy sources. I strongly support wind, solar and other clean-tech options. But all energy technologies come with an ecological price tag. Wind turbines kill and injure birds and bats. Solar thermal plants proposed in the Mojave Desert have conservationists up in arms. If we are serious about taking biodiversity into consideration as well as climate change, these concerns cannot be idly dismissed. In terms of land use, nuclear scores very well, because the comparatively small quantities of fuel required means less land disturbed or ruined by mines, processing and related uses.¶ Take Japan again. According to some recent number crunching by the Breakthrough Institute, a centrist environmental think tank, phasing out Japan's current nuclear generation capacity and replacing it with wind would require a 1.3-billion-acre wind farm, covering more than half the country's total land mass. Going for solar instead would require a similar land area, and would in economic terms cost the country more than a trillion dollars.¶ Those debating the future of nuclear power also tend to focus on out-of-date technology. No one proposes to build boiling-water reactors of 1960s-era Fukushima vintage in the 21st century. Newer designs have a much greater reliance on passive safety, as well as a host of other improvements. Fourth-generation options, such as the "integral fast reactor" reportedly being considered by Russia, could be even better. Fast-breeders like the IFR will allow us to power whole countries cleanly by burning existing stockpiles of nuclear waste, depleted uranium and military-issue plutonium. And the waste left over at the end would become safe after a mere 300 years, so no Yucca Mountains needed there. IFRs exist only on paper, however; we need to urgently research prototypes before moving on to large-scale deployment.¶ What is needed is perspective. Nuclear energy is not entirely safe, as Fukushima clearly shows, even if the current radiation-related death toll is zero and will likely remain so. But coal and other fossil fuels are far, far worse. And insisting only on renewables risks worsening global warming as an unintended consequence. We need a portfolio of clean energy technologies, deployed in the most environmentally responsible way. Above all, let us base our energy policy on a scientifically valid appreciation of real-world risk, and not on scare stories from the past.

#### S-PRISM key to end coal – modularity and plug-compatibility

**Salmon 9** [Reuters, “Nuclear power: Going fast”, Felix Salmon, finance editor for Reuters, graduate of University of Glasgow, winner of 2010 Excellence in Statistical Reporting Award presented by the American Statistical Association, over a decade of financial reporting experience, JUNE 23, 2009]

I was offline most of yesterday attending a high-intensity series of presentations hosted by Esquire magazine in the magnificent suite of rooms at the top of the new Hearst tower. GE’s Eric Loewen was there, talking about nuclear power, and specifically what he calls a PRISM reactor — a fourth-generation nuclear power station which runs on the nuclear waste generated by all the previous generations of nuclear power stations.¶ PRISM is GE’s name for an integral fast reactor, or IFR, and it’s a pretty great technology. The amount of fuel which already exists for such reactors would be enough to power the world for millennia — no new mining needed. Fast reactors also solve at a stroke the problem of what to do with the vast amounts of nuclear waste which are being stockpiled unhappily around the world. They’re super-safe: if they fail they just stop working, they don’t melt down. And they can even literally replace coal power stations:¶ One nice thing about the S-PRISM is that they’re modular units and of relatively low output (one power block of two will provide 760 MW). They could be emplaced in excavations at existing coal plants and utilize the same turbines, condensers (towers or others), and grid infrastructure as the coal plants currently use, and the proper number of reactor vessels could be used to match the capabilities of those facilities. Essentially all you’d be replacing is the burner (and you’d have to build a new control room, of course, or drastically modify the current one). Thus you avoid most of the stranded costs. If stranded costs can thus be kept to a minimum, both here and, more importantly, in China, we’ll be able to talk realistically not just about stopping to build new coal plants but replacing the existing ones, even the newest ones.¶ And best of all they’re eminently affordable: Loewen showed that they could be profitable selling energy at just 5 cents per KwH — which means that you don’t need to price carbon emissions at all to make these power stations economically attractive.

#### Otherwise, coal exports to Europe are inevitable

**Stafford 12** [“Obama's Nuclear Power Plans”, James Stafford, editor, oilprice.org, 23 November 2012]

While nuclear is experiencing a bit of a revival in the US and coal languishes in its death throes, globally, coal is enjoying gains. Some 1,200 new coal plants are in the works worldwide—the bulk of them in China and India—as countries take advantage of cheap coal prices in the US. But even Europe is importing increasing amounts of coal from the US. US coal exports have reached a decade high.¶ For Europe, this is troubling. As the European public puts increasing pressure on governments to abandon any dreams of fracking shale gas reserves over environmental concerns, the energy gap is being filled in by more polluting coal. This is the subject of our special investor piece today. There is good news—and bad. While the European Parliament has rejected a fracking ban proposal, this doesn’t mean we’re about to see a shale gas free-for-all. Hurdles and pitfalls abound.

#### German coal reliance kills Eurozone – European nuclear revival key to solve

**Mauldin 11** [Paul, B.S. and an M.S. in electrical engineering from the University of California-Berkeley and is a registered professional engineer, worked in the energy industry for more than 25 years, developing and implementing advanced energy technologies, research director for Pacific Gas and Electric Co, national and international energy consultant, Smart Energy Portal, “Germany’s Nuclear Decisions – Maybe Not the Optimal Timing??”, Sept 27, 2011]

Germany wants to be 'green' and non-nuclear and there's no question that Germany has been setting the bar for renewable energy. At present, over 20 percent of national production is from renewables, particularly wind. The goals are lofty - by 2020 Germany plans to produce 35% of electricity from local renewables and 50% by 2030. Significant goals indeed - considering that Germany is Europe’s largest electricity market.¶ At present Germany produces more electricity than it consumes, and has considerable excess generation capacity. Although, because of some internal transmission constraints, Germany imports small amounts of power.¶ This rosy picture could change dramatically in a few years due to both nuclear power policy decisions and Eurozone economics.¶ Germany is the fourth largest producer of nuclear power in the world. In 2000 following the country’s pace-setting start-up of wind and solar technology, and pressure by various green organizations, the government agreed to phase out all nuclear power plants by 2021. In September 2010, however, the German government reached a hard-fought deal to allow the nation’s 17 nuclear plants to run, on average, 12 years longer than planned, with some remaining in production until the 2030s.¶ Then came the Japanese Fukushima Daiichi nuclear disaster that turned the world perception of nuclear power safety on its ear. As a result, Germany changed its mind again and now plans to close all nuclear plants in the country by 2022. A tall order considering that nuclear power now provides almost one-third of the country's electricity generation.¶ Germany plans to replace the nukes with a combination of gas-fired and coal-fired electricity and increased imports.¶ Talk about not-in-my-backyard on a national scale! Germany will end up buying a lot of imported power, particularly from the French nuclear plants, while satisfying domestic anti-nuke, anti-coal sentiments.¶ Then there’s the never-ending Eurozone economic crisis. Germany is looked to as the shining knight to rescue Greece and several other nations from defaulting on international loans. But regardless of Germany’s intervention, things could go south in a hurry and the value of the euro could collapse. If it does, economists estimate a drop of up to 25% of German GDP in the first year after a major disruption of the European Monetary Union.¶ Germany’s European neighbors aren’t optimistic. “Germany will be even more dependent on fossil fuels and imports and its electricity will be more expensive and polluting,” French Industry Minister Eric Besson said. “German households pay twice as much for power than homes in France, where 80 percent of electricity comes from atomic plants.”¶ No matter how you look at it, this is not a good time to increase dependence on energy imports or to increase electric rates. We’ll see how much the German ratepayers are willing to shell out.¶ We may see Germany changing its nuclear power policies– again!

#### Eurozone collapse leads to global trade wars – specifically involves China

Reuters 11 (5-20, “Euro Woes Increase Risk of Trade Wars”, http://blogs.reuters.com/great-debate/2010/05/20/euro-woes-increase-risk-of-trade-wars/)

Europe won’t just be exporting deflation to the rest of the world, it will export serious trade tensions as well: first between the United States and China, and, possibly, eventually between Europe and the United States. The austerity required to get Greece and other weak euro zone nations’ budgets in shape will exert a powerful deflationary force, as many countries which formerly imported more than they exported will be forced to cut back. As well, the euro has dropped very sharply. Germany’s quixotic campaign against speculators — banning naked short selling against government debt and government credit default swaps — gave the euro its latest shove downward, but the trend has been strong for months. The euro is now about 15 percent below where it started the year against the dollar, making U.S. exports less competitive and adding to pressure on the United States to be the world’s foie gras goose: being force-fed everyone else’s exports while its own unemployment rate remains high. That Britain is now embarking on its own round of budget cuts will only make matters worse, adding up to one more important actor trying to consume less and export more courtesy of a devaluing currency. Perhaps the best outcome is rising trade and currency tensions between the United States and China, while at worst this could set the stage for broader conflicts and a round of tit-for-tat tariffs to match similar currency devaluations. Michael Pettis, a professor at Peking University, explains the issue succinctly on his blog, in which he says: “Make no mistake, if southern European trade deficits decline, someone somewhere must bear the brunt of the corresponding adjustment. The only question is who?” The scale of the adjustment is large; taken together Spain, Italy, Portugal and Greece account for about 16 percent of global trade deficits. Add in France, which will surely share some of the pain, and we get up to about 20 percent. You simply cannot have savage recessions and budget cutbacks in these countries without it exerting a powerful force on their trade partners. Clearly the first fault lines will not be across the Atlantic. Talk of the potential for coordinated intervention to support the euro, or at least to make its fall against the dollar a two-way market, attest to the strength of U.S.-European relationships. This is a group that managed the 2007 and 2008 conflagration without ending up at each others’ throats. CHINA MAY BALK AT REVALUATION Pettis points out that within China there is an attitude that the fall in the euro against the dollar, which has made the yuan correspondingly stronger against the euro, is an argument for caution by China in revaluing its currency. Remember too that the European Union comprises China’s largest export market, so it will suffer a double blow, once now by a rising currency and again going forward as Europe adjusts. U.S. Treasury Secretary Timothy Geithner is traveling to Beijing next week to press trade and currency issues. Expectations had been that this would lay the groundwork for some measure of a revaluation of the yuan, which is kept artificially low by the Chinese. The euro zone mess seems to have put paid to that immediate hope. Washington and Geithner are unlikely to want to make already fragile international markets even more so by talking tough next week, but, as the U.S. elections in November near, and, if U.S. unemployment fails to fall, the pressure to take action against China in the form of not just verbal battering but actual tariffs may become too much. I’d note that the U.S. primary elections on Tuesday showed voter anger is focused on incumbents in general and Washington in specific. It would not be a surprise for the administration to try to focus that anger outside the country. So, rising trade tensions with China, but there is also a meaningful chance that tensions will rise eventually between the United States and Europe. Thus far European efforts to address euro zone issues have been disorganized and riven by internal dissension. Germany did not, it appears, consult its partners about its short selling plan. While the European Central Bank’s excellent relationship with the Federal Reserve will help, there is a real chance that the euro suffers a disorganized meltdown and that Europe cannot agree among itself about how, or whether, to stop it. That, especially if combined with Chinese intransigence, could prove to be intolerable for the United States. Trade wars added greatly to the depth and length of the Great Depression. The world’s ability to avoid a similar fight has been one of the blessings of the last two years. Not everyone can export their way back into the black, at least not everyone at the same time. How that is resolved as Europe melts into another recession will be one of the key issues of 2010 and 2011.

#### That spills over into Chinese military conflict

Landy 7 (Ben, Director of Research and Strategy at the Atlantic Media Company, publisher of the Atlantic Monthly, National Journal, and Government Executive magazines April 3, http://chinaredux.com/2007/04/03/protectionism-and-war/#comments)

**The greatest threat for the 21st century** is that these economic flare-ups between the US and China will not be contained, but might spill over into the realm of military aggression between these two world powers**.** Economic conflict breeds military conflict. The **stakes of trade override the ideological power of the Taiwan issue**. China’s ability to continue growing at a rapid rate takes precedence, since there can be no sovereignty for China without economic growth. The United States’ role as the world’s superpower is dependent on its ability to lead economically. As many of you will know from reading this blog, I do not believe that war between the US and China is imminent, or a foregone conclusion in the future. I certainly do not hope for war. But I have little doubt that **protectionist policies** on both sides **greatly increase the likelihood of conflict–far more than increases in military budgets and anti-satellite tests.**

#### The impact is extinction

**Straits Times 2000** (6/25, “No One Gains In War Over Taiwan”, Lexis)

THE DOOMSDAY SCENARIO THE high-intensity scenario postulates a cross-strait war escalating into a full-scale war between the US and China. If Washington were to conclude that splitting China would better serve its national interests, then a full-scale war becomes unavoidable. Conflict on such a scale would embroil other countries far and near and -- horror of horrors -- raise the possibility of a nuclear war. Beijing has already told the US and Japan privately that it considers any country providing bases and logistics support to any US forces attacking China as belligerent parties open to its retaliation. In the region, this means South Korea, Japan, the Philippines and, to a lesser extent, Singapore. If China were to retaliate, east Asia will be **set on fire**. And the conflagration may not end there as opportunistic powers elsewhere may try to overturn the existing world order. With the US distracted, Russia may seek to redefine Europe's political landscape. The balance of power in the Middle East may be similarly upset by the likes of Iraq. In south Asia, hostilities between India and Pakistan, each armed with its own nuclear arsenal, could enter a new and dangerous phase. Will a full-scale Sino-US war lead to a nuclear war? According to General Matthew Ridgeway, commander of the US Eighth Army which fought against the Chinese in the Korean War, the US had at the time thought of using nuclear weapons against China to save the US from military defeat. In his book The Korean War, a personal account of the military and political aspects of the conflict and its implications on future US foreign policy, Gen Ridgeway said that US was confronted with two choices in Korea -- truce or a broadened war, which could have led to the use of nuclear weapons. If the US had to resort to nuclear weaponry to defeat China long before the latter acquired a similar capability, there is little hope of winning a war against China 50 years later, short of using nuclear weapons. The US estimates that China possesses about 20 nuclear warheads that can destroy major American cities. Beijing also seems prepared to go for the nuclear option. A Chinese military officer disclosed recently that Beijing was considering a review of its "non first use" principle regarding nuclear weapons. Major-General Pan Zhangqiang, president of the military-funded Institute for Strategic Studies, told a gathering at the Woodrow Wilson International Centre for Scholars in Washington that although the government still abided by that principle, there were strong pressures from the military to drop it. He said military leaders considered the use of nuclear weapons mandatory if the country risked dismemberment as a result of foreign intervention. Gen Ridgeway said that should that come to pass, we would see the **destruction of civilisation**. There would be no victors in such a war. While the prospect of a **nuclear** **Armaggedon** over Taiwan might seem inconceivable, it cannot be ruled out entirely, for China puts sovereignty above everything else.

#### Trade conflicts escalate to global war

**Patrick 09** – Director of the Program on International Institutions & Global Governance CFR

(Stewart-, March 13, National Interest, “Protecting Free Trade”, [http://www.nationalinterest.org/Article.aspx?id= 21084](http://www.nationalinterest.org/Article.aspx?id=21084); Jacob)

President Obama has committed to working with U.S. trade partners to avoid “escalating protectionism.” He is wise to do so. As never before, U.S. national security requires a commitment to open trade.

President Obama and his foreign counterparts should reflect on the lessons of the 1930s—and the insights of Cordell Hull. The longest-serving secretary of state in American history (1933–1944), Hull helped guide the United States through the Depression and World War II. He also understood a fundamental truth: “When goods move, soldiers don’t.”

In the 1930s, global recession had catastrophic political consequences—in part because policymakers took exactly the wrong approach. Starting with America’s own Smoot Hawley Tariff of 1930, the world’s major trading nations tried to insulate themselves by adopting inward looking protectionist and discriminatory policies. The result was a vicious, self-defeating cycle of tit-for-tat retaliation. As states took refuge in prohibitive tariffs, import quotas, export subsidies and competitive devaluations, international commerce devolved into a desperate competition for dwindling markets. Between 1929 and 1933, the value of world trade plummeted from $50 billion to $15 billion. Global economic activity went into a death spiral, exacerbating the depth and length of the Great Depression.

The economic consequences of protectionism were bad enough. The political consequences were worse. As Hull recognized, global economic fragmentation lowered standards of living, drove unemployment higher and increased poverty—accentuating social upheaval and leaving destitute populations “easy prey to dictators and desperadoes.” The rise of Nazism in Germany, fascism in Italy and militarism in Japan is impossible to divorce from the economic turmoil, which allowed demagogic leaders to mobilize support among alienated masses nursing nationalist grievances.

Open economic warfare poisoned the diplomatic climate and exacerbated great power rivalries, raising, in Hull’s view, “constant temptation to use force, or threat of force, to obtain what could have been got through normal processes of trade.” Assistant Secretary William Clayton agreed: “Nations which act as enemies in the marketplace cannot long be friends at the council table.”

This is what makes growing protectionism and discrimination among the world’s major trading powers today so alarming. In 2008 world trade declined for the first time since 1982. And despite their pledges, seventeen G-20 members have adopted significant trade restrictions. “Buy American” provisions in the U.S. stimulus package have been matched by similar measures elsewhere, with the EU ambassador to Washington declaring that “Nobody will take this lying down.” Brussels has resumed export subsidies to EU dairy farmers and restricted imports from the United States and China. Meanwhile, India is threatening new tariffs on steel imports and cars; Russia has enacted some thirty new tariffs and export subsidies. In a sign of the global mood, WTO antidumping cases are up 40 percent since last year. Even less blatant forms of economic nationalism, such as banks restricting lending to “safer” domestic companies, risk shutting down global capital flows and exacerbating the current crisis.

If unchecked, such economic nationalism could raise diplomatic tensions among the world’s major powers. At particular risk are U.S. relations with China, Washington’s most important bilateral interlocutor in the twenty-first century. China has called the “Buy American” provisions “poison”—not exactly how the Obama administration wants to start off the relationship. U.S. Treasury Secretary Timothy Geithner’s ill-timed comments about China’s currency “manipulation” and his promise of an “aggressive” U.S. response were not especially helpful either, nor is Congress’ preoccupation with “unfair” Chinese trade and currency practices. For its part, Beijing has responded to the global slump by rolling back some of the liberalizing reforms introduced over the past thirty years. Such practices, including state subsidies, collide with the spirit and sometimes the law of open trade.

The Obama administration must find common ground with Beijing on a coordinated response, or risk retaliatory protectionism that could severely damage both economies and escalate into political confrontation. A trade war is the last thing the United States needs, given that China holds $1 trillion of our debt and will be critical to solving flashpoints ranging from Iran to North Korea.

In the 1930s, authoritarian great-power governments responded to the global downturn by adopting more nationalistic and aggressive policies. Today, the economic crisis may well fuel rising nationalism and regional assertiveness in emerging countries. Russia is a case in point. Although some predict that the economic crisis will temper Moscow’s international ambitions, evidence for such geopolitical modesty is slim to date. Neither the collapse of its stock market nor the decline in oil prices has kept Russia from flexing its muscles from Ukraine to Kyrgyzstan. While some expect the economic crisis to challenge Putin’s grip on power, there is no guarantee that Washington will find any successor regime less nationalistic and aggressive.

Beyond generating great power antagonism, misguided protectionism could also exacerbate political upheaval in the developing world. As Director of National Intelligence Dennis Blair recently testified, the downturn has already aggravated political instability in a quarter of the world’s nations. In many emerging countries, including important players like South Africa, Ukraine and Mexico, political stability rests on a precarious balance. Protectionist policies could well push developing economies and emerging market exporters over the edge. In Pakistan, a protracted economic crisis could precipitate the collapse of the regime and fragmentation of the state. No surprise, then, that President Obama is the first U.S. president to receive a daily economic intelligence briefing, distilling the security implications of the global crisis.

What guidance might Cordell Hull give to today’s policymakers? To avoid a protectionist spiral and its political spillovers, the United States must spearhead multilateral trade liberalization involving all major developed and developing countries.

#### Coal locks in European energy dependence

**Wynn 12** [“Coal poses EU power price risk: Wynn”, Gerard Wynn, Reuters market analyst Senior Environmental Markets Correspondent, Nov 20, 2012]

A return to rising world coal prices next year would underscore the European Union's energy dependence, given global gas prices also appear on a long-term upward trend.¶ European coal import prices have this year fallen following a shale gas boom which suppressed U.S. power prices and coal demand.¶ But the forward curve projects steadily rising benchmark prices, presumably based on expectations of returning demand from Asian emerging economies including China where government stimulus efforts are expected to kick in (see Chart 1).¶ The forward curve suggests a return to levels seen either side of peak European coal import prices in 2011.¶ That is bad news for European wholesale power prices recently suppressed in countries able to substitute gas for cheaper coal.¶ Higher coal prices would remove a buffer against higher gas prices and expose the EU vulnerability to globally traded energy.¶ Global traded LNG prices have risen on the back of demand from Japan (following the Fukushima nuclear crisis) which has replaced a U.S. collapse (following a domestic shale gas boom).¶ That rising trajectory in LNG prices may now be a long-term trend, reversing a previous dip.¶ "There is no guarantee that with recovering demand for natural gas in the EU, relatively cheap LNG ... will continue to be as easily or cheaply available as in recent years," said the EU quarterly market report.¶ "The significant falls in imports of LNG currently being observed in the EU (in excess of falling consumption) could be a first warning sign," it said.

#### That causes Russian aggression

Zenyo Baran, Autumn 2007. Senior fellow and director of the Center for Eurasian Policy at the Hudson Institute in Washington, D.C. “EU Energy Security: Time to End Russian Leverage,” Washington Quarterly 30.4, http://mes.reviewhudson.org/files/publications/07autumn\_baran.pdf.

Much has been made of President Vladimir Putin’s recent aggressive posturing against Europe and the United States. In the past few months, the Russian leader imposed a “moratorium” on the Conventional Armed Forces in Europe (CFE) Treaty, compared U.S. government policies to those of the Third Reich, and threatened to aim nuclear-tipped missiles at European targets again. These developments are certainly troubling, but the days when NATO troops looked warily across the Folda Gap in Germany for signs of invading Soviet tanks are long gone. Russian power and influence is no longer measured in ballistic missile accuracy or bomber production but in miles of pipeline constructed and barrels of oil per day exported, and for Europe, this energy invasion has already begun. Questions regarding the security and sustainability of energy supply have mostly been left to individual EU member states and to the invisible hand of the market. Many European leaders preferred not to discuss the geopolitics of energy, instead delegating this portfolio to their economic ministries. Moreover, there is little unity among member states’ energy policies. Russia, the European Union’s primary oil and gas provider, has deliberately taken advantage of this lack of cohesion to gain favorable energy deals and heighten European dependence on Russian supplies. Moscow is pursuing a divide and conquer strategy of amassing bilateral deals with member states. This disunity has also allowed Moscow to preemptively block European attempts to construct transport routes for Caspian and Central Asian oil and gas that do not involve Russia. Given Russia’s high-level political involvement in energy issues, the EU needs a corresponding degree of intensity. Specifically, Europe must realize the very real foreign and security policy ramifications that the supply of energy has. Enhancing cooperation on energy security within the EU is essential to withstand Russian pressure. Europe’s Troubling Dependence The lack of reliable and sustainable European access to energy represents a clear threat to the continent’s security. Under the leadership of Putin, the Kremlin has pursued a strategy whereby Europe’s substantial dependence on Russian energy is leveraged to obtain economic and political gains. If this situation continues, the EU will find itself in further danger, as its dependence leaves it beholden to Russian interests. There simply is no readily available alternative to the supplies the EU receives from Russia, particularly natural gas. Unlike oil, gas is extremely difficult and costly to ship via tankers; pipelines are the preferred method of transportation. Thus, if a supplier refuses to provide gas or charges an unreasonable price, the consumer cannot quickly or easily turn to another source. The consumer state would have no choice but to accept the supplier’s conditions or go without natural gas, an option that is all but unacceptable for most. The unjust manipulation or interruption of energy supplies is as much a security threat as military action is, especially since the EU relies on Russia for more than 30 percent of its oil imports and 50 percent of its natural gas imports. 1 This dependence is not distributed evenly. As one heads eastward, Russia’s share of the energy supply grows ever larger. No fewer than seven eastern European countries receive at least 90 percent of their crude oil imports from Russia, and six EU nations are entirely dependent on Russia for their natural gas imports. The Ukrainian gas crisis in January 2006 catapulted energy security to the forefront of the EU agenda. On the very day it took over the presidency of the Group of Eight (G-8)—a presidency that had announced energy security as its key theme—Russia halted natural gas deliveries to Ukraine. Because the gas pipelines crossing Ukraine carry supplies destined for EU markets, this shutdown resulted in significant supply disruptions for several member states, raising awareness that dependence on Russia has increased Europe’s geopolitical vulnerability. Several EU states have experienced the misfortune of Russian supply cuts directly. Disputes between Russia and the Baltic states have led to the halt of pipeline deliveries of oil multiple times. In January 2003, Russia ceased supplying oil via pipeline to Latvia’s Ventspils Nafta export facility. This embargo, which followed Riga’s unwillingness to sell the facility to a Russian energy company, continues to this day. In July 2006, Moscow shut down a pipeline supplying Lithuania’s Mazeikiu Nafta refinery, which is the largest company in Lithuania and one of the biggest oil refineries in central and eastern Europe. As with Ventspils Nafta, this shutdown came after a Russian company failed to obtain the energy infrastructure it coveted. Moscow has further sought to increase Europe’s dependence on Russian energy supplies by acquiring significant stakes in the energy distribution companies and infrastructure of EU member states, typically through its proxy, Gazprom. This massive energy company—the world’s largest—has control over the Russian gas pipeline network and consequently handles all Russian and Central Asian exports, either directly or through wholly owned subsidiaries. Such a preponderance of power would be troubling enough if the company were transparent, privately owned, and played by the rules of the free market, but Gazprom is none of those things. It is majority state owned and has deep ties to the Russian government. Many of the company’s executive management and board members also occupy or previously occupied key positions within the Kremlin. For many years, Gazprom has owned significant portions of energy companies throughout the former Soviet Union. It is the largest or second-largest shareholder in the gas utilities of Estonia, Latvia, and Lithuania. Recently, Gazprom has been expanding its influence even further into the domestic gas distribution networks of western Europe. In the past two years, Gazprom has signed deals with Eni (Italy), Gasunie (the Netherlands), BASF (Germany), E.ON Ruhrgas (Germany), and Gaz de France. Desperate for access to energy and the profits it brings, European companies are played against each other by the Kremlin in order to secure more advantageous conditions for Russia. If one company does not want to agree to Moscow’s terms, a competitor will gladly accept them, leaving the first company with nothing. In addition to the economic disadvantages of such dependence, the broader foreign policy goals of EU states also suffer. Specifically, EU members limit their criticisms of Moscow, lest they be given a raw deal at the negotiating table. Russia’s increasingly tainted record on transparency, responsible governance, and human rights is thus allowed to stand unchallenged and unquestioned. Dependency also erodes EU support for key allies in Europe and Asia. Azerbaijan, Georgia, Kazakhstan, Turkmenistan, and Ukraine—all crucial energy producers or transit countries—have each been subject to intimidation by Moscow. Instead of standing up to this harassment, Europe’s dependence compels its leaders to look the other way. Most disturbing of all is that this dependence even leads the EU to turn a blind eye when Moscow utilizes these tactics against fellow EU members. The July 2006 shutdown of the Lithuanian pipeline, for example, drew little protest outside of Poland and the Baltic states. Russia claimed that this cutoff was the result of technical difficulties yet refused all offers from third parties to examine the damaged pipe or assist repairs in any way. Although this incident is suspicious enough on its own, it becomes a clear case of political manipulation given Russia’s status as a repeat offender. Many times over the past decade, Moscow has utilized near-identical tactics in countries it considers to be its near abroad. It has repeatedly cut off energy supplies during a political dispute, smugly blamed technical difficulties for the problem, and eventually shifted supplies to another destination unless the victim acceded to the Kremlin’s demands. Despite this history and repeated pleas from President Valdas Adamkus, the response from most western European countries was rather muted during the Lithuanian shutdown. The countries of the West have never experienced these strong-arm tactics firsthand and fail to view it as anything more than an economic dispute. Moreover, they were too concerned that standing up for Lithuania would ruin their chances to get preferential access to Russian oil and gas resources. By design, the Russian strategy is driving a wedge between eastern and western Europe, exacerbating the challenges the EU faces in devising a common energy policy, as was seen during the dispute between Poland and Germany ahead of the June EU summit. This diplomatic row was ostensibly over Russia’s failure to remove its embargo on Polish meat products but more broadly involved the perceived reluctance of Berlin to stand up to Moscow on a whole host of issues, not the least of which was energy. The EU’s inability to take Russia to task for its illiberal market actions threatens European energy security in another way. It decreases efficiency in an already inefficient Russian energy industry, raising costs for consumers. Russia’s increasingly state-owned energy industry is largely unregulated. Without competitive market forces, companies such as Gazprom have no reason to behave like commercially minded entities. The absence of market stimuli is having detrimental effects on Russian productivity. Between 1998 and 2005, output in Russia’s then-mostly privately owned oil sector rose by 50 percent. 2 During that same period, production in the gas sector (Gazprom) barely grew at all. Since 2004, when the Kremlin began its consolidation over the oil sector in earnest, Russian oil production has leveled off as well. 3 Due to the extremely close relationship between the energy industry and the Kremlin, Russia’s oil and gas companies can pursue strategies that make little economic sense but that serve the long-term interests of the Russian state, namely, ensuring European dependence on Russian energy supplies. For example, Russia’s undersea Nord Stream pipeline will cost at least three times more than a proposed overland route through Lithuania and Poland would have. Given the environmental sensitivity of the Baltic Sea, some industry insiders are predicting costs as high as $10 billion or even $15 billion. 4 By divorcing western Europe’s gas supply from eastern Europe’s, however, the undersea route grants Moscow the ability to manipulate the European energy market more effectively. Needless to say, the unnecessarily high cost of the pipeline’s construction will be passed on to European consumers. Many industry experts have expressed concern that corruption and inefficiency, coupled with Moscow’s refusal to allow significant foreign investment in the energy sector, will soon lead the Russian oil and gas industry to burn out. 5 Instead of developing new oil and gas fields or investing in its energy infrastructure, Russia has utilized windfall profits to pursue the aggressive policy of expansion and acquisition described above. Unless Moscow is able to secure additional gas supplies from fields in Central Asia, it may struggle to meet its commitments to Europe, which is why maintaining full control over Central Asia’s export routes is so critical for the Kremlin. Engaging the Caspian Enshrined as the second of the three pillars of the EU, the Common Foreign and Security Policy (CFSP) states that the EU should seek to promote democracy, rule of law, and respect for human rights within its borders and abroad. Yet, dependence on Russian energy supplies undermines Europe’s efforts to foster the ideals of good governance, market transparency, and democracy both in Russia and in Russia’s neighbors. Although the establishment of these principles in energy suppliers is a worthy goal in its own right, doing so will also create a more stable environment for energy sector development, thereby improving European security. Diversifying oil and gas supplies by constructing pipelines directly from the Caucasus and Central Asia to Europe would not only decrease Russia’s influence on EU countries but would also loosen Moscow’s grip on Europe’s neighbors. If the EU wishes to foster true reform within former Soviet states, it must offer them a non-Russian perspective, which can best be done through cooperation on joint energy projects. In the Caspian region, this strategy has been pursued with success by the United States. In the late 1990s, the United States pushed hard for the construction of several oil and gas pipelines that would carry Caspian energy westward without transiting Russia. It did so to break Russia’s monopoly on the region’s energy transportation system, thereby giving the Caspian countries greater economic and political independence from Moscow. Naturally, this proposal prompted strong objections and highpressure tactics by the Russian government.

#### That’s key to EU-Russian stability.

Ronald Asmus, Jan/Feb 2008. Executive Director of the Transatlantic Center at the German Marshall Fund of the United States, in Brussels. From 1997 to 2000, he served as U.S. Deputy Assistant Secretary of State for European Affairs. “Europe's Eastern Promise; Rethinking NATO and EU Enlargement,” Foreign Affairs 87.1, http://digilib.lib.unipi.gr/ket/bitstream/ket/739/1/Europe's\_Eastern\_Promise\_Asmus.pdf.

In light of these new circumstances in Russia, enlargement needs to be rethought from the ground up, starting with its strategic rationale. After the accession of a band of countries from the Baltic states in the north to Bulgaria and Romania in the south, many in the West assumed that the enlargement project was almost complete, with the western Balkans constituting the last piece of unfinished business. They were surprised to suddenly find new countries from Eurasia, and specifically the wider Black Sea region, starting to knock on the doors of NATO and the EU -- and unsure how to respond. In dealing with these new candidate countries, the West must stick to the values and diplomatic principles it laid down in the 1990s, including the notion that countries are free to choose their alliances. But that alone is unlikely to be enough, because although these countries clearly consider themselves European, many Europeans do not feel the same historical or moral commitment to them or see a compelling strategic need to integrate them. Thus, in addition to moral and political arguments, the United States and Europe need to articulate a strong strategic rationale for anchoring them to the West. That argument is straightforward. The challenge of securing Europe's eastern border from the Baltics to the Black Sea has been replaced by the need to extend peace and stability along the southern rim of the Euro-Atlantic community -- from the Balkans across the Black Sea and further into Eurasia, a region that connects Europe, Russia, and the Middle East and involves core security interests, including a critical energy corridor. Working to consolidate democratic change and build stability in this area is as important for Western security today as consolidating democracy in central and eastern Europe was in the 1990s. It is not only critical to expanding the democratic peace in Europe but also vital to repositioning the West vis-à-vis both Central Asia and the Middle East. This strategy presents an opportunity to redraw the strategic map of Europe and Eurasia in a way that enhances the security of countries on Europe's periphery as well as that of the United States and Europe. The United States and Europe also need to rethink what anchoring means in practice. In the 1990s, it meant pursuing membership in NATO and the EU roughly in parallel. Now the West needs to be more flexible and take a long-term view. The goal is to tie these countries as closely to the West as politics and interests on both sides allow. For some countries, this may mean eventual membership in both NATO and the EU; for others, it may mean membership only in NATO; and for the rest, it may mean membership in neither but simply much closer relations. Policy will have to be much more à la carte than prix fixe. The link between NATO membership and EU membership should be relaxed, if not dropped. The EU has enough on its plate sustaining its commitments to the western Balkans and Turkey; anything beyond that is probably a nonstarter for the time being. NATO will once again have to take the lead in anchoring countries such as Georgia and others in the wider Black Sea region. The West must also rethink how it should engage and reach out to these countries. If membership is less plausible as a short-term option, then the quality of ties short of membership must be improved to compensate. Outreach must grow in importance and may increasingly become the centerpiece of U.S. and European strategy. At the moment, the fear of future enlargement is one factor actually holding allies back, with institutions afraid of taking even small steps down what some fear could be a slippery slope. Yet precisely because the countries in question are weaker and more endangered, NATO and the EU should actually be reaching out and engaging them earlier. They need the security umbrella and engagement of the West as much, if not more, than the countries of central and eastern Europe did. The way out of this dilemma is to consider membership a long-term goal and focus in the mean time on strengthening Western outreach and engagement. This means recasting policy tools to address the different needs of the countries that are less developed politically and economically. Tools such as NATO's "membership action plan" should be extended earlier and tied less closely to actual membership commitments, thus allowing these countries to benefit from guidance and engagement while downplaying the question of the end goal. At the same time, the EU needs to enhance its own tools, such as the Common Foreign and Security Policy and the European Neighborhood Policy, as well as reach out to these countries more directly by offering them political and economic support. When communism collapsed, NATO and the EU had little idea how to reach out to postcommunist countries and anchor them to the West. Bureaucrats in both institutions said it could not be done. But political will and strategic imagination prevailed, and fresh approaches were developed. Political will can do the same today. As for Russia, neither Washington nor Brussels wants a confrontation with Moscow at a time when they face daunting challenges beyond Europe. But this does not mean the West should abandon its belief that the spread of democracy along Russia's borders contributes to peace and stability just because the current authoritarian rulers in Moscow disagree. Nor should the West abandon its principles and succumb to the sphere-of-influence thinking currently emanating from Moscow. If the United States and Europe still hope that democracy will eventually take root in Russia, they must recognize that consolidating a proWestern, democratic Ukraine would indirectly encourage democratization in Russia. Of course, antidemocratic forces in Russia will oppose such a move. After all, Moscow only acquiesced in previous rounds of NATO and EU enlargement because it concluded that the United States and Europe were determined to carry them out and that its efforts to oppose the West would be futile. Western unity on issues such as the future of Ukraine is therefore of the utmost importance. Still, holding true to NATO's and the EU's core principles and expanding these organizations' reach does not mean starting a new Cold War. The West and Moscow should look for other areas in which their interests are more aligned, such as expanding trade and investment or controlling nuclear proliferation and building a new arms control regime. The key question is whether Russia -- when faced with a unified West -- will start to look for common ground. As strong as Russia may appear at the moment, it remains a country with real long-term structural weaknesses and problems. It, too, needs friends and allies, and the United States and Europe should be among them. UNCERTAIN FUTURES Three very different scenarios for the future of Western policy toward Europe's periphery reveal just how high the stakes are in this region. In the bestcase scenario, the United States and Europe would regroup under the next U.S. president and launch a new era of transatlantic cooperation by overcoming differences on Iraq, avoiding disagreements over Iran, and stabilizing Afghanistan. This renaissance would include a new and ambitious democratic-enlargement strategy, and the results would be significant. Securing independence for Kosovo without turning Serbia against the West would facilitate the successful integration of the western Balkans into NATO and the EU. In Turkey, the AKP-led government would continue democratic reforms, bringing the country closer to EU accession. Georgia and Ukraine would continue to move closer to the West as well. That prospect would help create positive pressure for democratic change in Azerbaijan and encourage Armenia's reorientation toward the West. By 2012, a reunified West would have begun to build an arc of democratic stability eastward into Eurasia and especially the wider Black Sea region. Realizing that its real adversaries lie elsewhere, Russia would eventually have no choice but to reassess its policy and seek a new rapprochement with the West. A less optimistic scenario is stagnation. In this case, the United States and Europe would regain some political momentum after 2008 but fail to achieve any significant democratic breakthroughs. A new U.S. administration would manage to stabilize and then extricate itself from Iraq, but transatlantic tensions over Iran and other Middle Eastern issues would persist. Kosovo would achieve independence, but in a manner that leaves Serbia alienated and unable to find its way back onto the path toward EU accession. In the western Balkans, only Croatia would remain on track for both EU and NATO membership. Turkey's prospects for joining the EU would fade, and reforms in Georgia and Ukraine would stall. Azerbaijan would remain an autocratic pro-Western ally increasingly vulnerable to growing radicalization from within. By 2012, the West would have patched up relations across the Atlantic but without breakthroughs in the Balkans or Turkey -- let alone in Ukraine or the wider Black Sea region. All of this would lead to a more competitive relationship with Russia, resulting in stalemate and a new chill in relations with Moscow. In the worst-case scenario, rather than the West consolidating new democratic breakthroughs, Russia would succeed in a strategy of rollback. The United States and Europe would not achieve a meaningful rapprochement, and they would fail to consolidate democracy in the western Balkans. Kosovo would become independent, but without agreement from all sides. This would launch Serbia on a new nationalist trajectory, bringing further instability to the region. U.S. failure in Iraq would lead to partition, estranging Turkey and prompting Ankara to invade northern Iraq and further loosen its ties to the West. This, in turn, would badly damage Turkey's already strained relations with both Washington and Brussels. Ukraine would drift back to autocracy, and Georgia, the one liberal democratic experiment in the Black Sea region, would lose reform momentum and teeter toward failure. Last November's declaration of a state of emergency in Tbilisi was a reminder of how fragile and vulnerable this experiment is. Using its energy supplies and influence, Russia would emerge as an authoritarian capitalist alternative to the West, attracting autocratic leaders throughout Europe and Eurasia. Rather than a renaissance of the transatlantic alliance, the result would be a retreat of democracy and a further splintering of the democratic West. As these scenarios make clear, the western Balkans, Georgia, Ukraine, and the wider Black Sea region are less stable and more at risk today than central and eastern Europe were a decade ago. And the stakes are high. A world in which Ukraine has successfully anchored itself to the West would be very different from one in which it has failed to do so. A world in which Georgia's success has sparked democratic progress in the region and helped stabilize the southern flank of the Euro-Atlantic community would be a much safer one than a world in which Georgia has become an authoritarian state in Russia's sphere of influence. And a world in which the democratic West is ascendant would be very different from one in which an autocratic, nationalist Russia is on the rise.

#### Nuclear war

Roger **McDermott,** 12/6/**2011.** Honorary senior fellow, department of politics and international relations, university of Kent at Canterbury and senior fellow in Eurasian military studies, Jamestown Foundation. “General Makarov Highlights the “Risk” of Nuclear Conflict,” Eurasia Daily Monitor, <http://www.jamestown.org/programs/edm/single/?tx_ttnews%5Btt_news%5D=38748&tx_ttnews%5BbackPid%5D=27&cHash=dfb6e8da90b34a10f50382157e9bc117>.

In the current election season the Russian media has speculated that the Defense Minister Anatoliy Serdyukov may be replaced, possibly by Dmitry Rogozin, Russia’s Ambassador to NATO, which masks deeper anxiety about the future direction of the Armed Forces. The latest rumors also partly reflect uncertainty surrounding how the switch in the ruling tandem may reshuffle the pack in the various ministries, as well as concern about managing complex processes in Russian defense planning. On November 17, Russia’s Chief of the General Staff, Army-General Nikolai Makarov, offered widely reported comments on the potential for nuclear conflict erupting close to the country’s borders. His key observation was controversial, based on estimating that thepotential for armed conflict along the entire Russian periphery had grown dramatically over the past twenty years (Profil, December 1; Moskovskiy Komsomolets, November 28; Interfax, November 17). During his speech to the Defense Ministry’s Public Council on the progress and challenges facing the effort to reform and modernize Russia’s conventional Armed Forces, Makarov linked the potential for local or regional conflict to escalate into large-scale warfare “possibly even with nuclear weapons.” Many Russian commentators were bewildered by this seemingly “alarmist” perspective. However, they appear to have misconstrued the general’s intention, since he was actually discussing conflict escalation (Interfax, ITAR-TASS, November 17; Moskovskiy Komsomolets, Krasnaya Zvezda, November 18). Makarov’s remarks, particularly in relation to the possible use of nuclear weapons in war, were quickly misinterpreted. Three specific aspects of the context in which Russia’s most senior military officer addressed the issue of a potential risk of nuclear conflict may serve to necessitate wider dialogue about the dangers of escalation. There is little in his actual assertion about the role of nuclear weapons in Russian security policy that would suggest Moscow has revised this; in fact, Makarov stated that this policy is outlined in the 2010 Military Doctrine, though he understandably made no mention of its classified addendum on nuclear issues (Kommersant, November 18). Russian media coverage was largely dismissive of Makarov’s observations, focusing on the idea that he may have represented the country as being surrounded by enemies. According to Kommersant, claiming to have seen the materials used during his presentation, armed confrontation with the West could occur partly based on the “anti-Russian policy” pursued by the Baltic States and Georgia, which may equally undermine Moscow’s future relations with NATO. Military conflict may erupt in Central Asia, caused by instability in Afghanistan or Pakistan; or western intervention against a nuclear Iran or North Korea; energy competition in the Arctic or foreign inspired “color revolutions” similar to the Arab Spring and the creation of a European Ballistic Missile Defense (BMD) system that could undermine Russia’s strategic nuclear deterrence also featured in this assessment of the strategic environment (Kommersant, November 18). Since the reform of Russia’s conventional Armed Forces began in late 2008, Makarov has consistently promoted adopting network-centric capabilities to facilitate the transformation of the military and develop modern approaches to warfare. Keen to displace traditional Russian approaches to warfare, and harness military assets in a fully integrated network, Makarov possibly more than any senior Russian officer appreciates that the means and methods of modern warfare have changed and are continuing to change (Zavtra, November 23; Interfax, November 17). The contours of this evolving and unpredictable strategic environment, with the distinctions between war and peace often blurred, interface precisely in the general’s expression of concern about nuclear conflict: highlighting the risk of escalation. However, such potential escalation is linked to the reduced time involved in other actors deciding to intervene in a local crisis as well as the presence of network-centric approaches among western militaries and being developed by China and Russia. From Moscow’s perspective, NATO “out of area operations” from Kosovo to Libya blur the traditional red lines in escalation; further complicated if any power wishes to pursue intervention in complex cases such as Syria. Potential escalation resulting from local conflict, following a series of unpredictable second and third order consequences, makes Makarov’s comments seem more understandable; it is not so much a portrayal of Russia surrounded by “enemies,” as a recognition that, with weak conventional Armed Forces, in certain crises Moscow may have few options at its disposal (Interfax, November 17). There is also the added complication of a possibly messy aftermath of the US and NATO drawdown from Afghanistan and signs that the Russian General Staff takes Central Asian security much more seriously in this regard. The General Staff cannot know whether the threat environment in the region may suddenly change. Makarov knows the rather limited conventional military power Russia currently possesses, which may compel early nuclear first use likely involving sub-strategic weapons, in an effort to “de-escalate” an escalating conflict close to Russia’s borders. Moscow no longer primarily fears a theoretical threat of facing large armies on its western or eastern strategic axes; instead the information-era reality is that smaller-scale intervention in areas vital to its strategic interests may bring the country face-to-face with a network-centric adversary capable of rapidly exploiting its conventional weaknesses. As Russia plays catch-up in this technological and revolutionary shift in modern warfare capabilities, the age-old problem confronts the General Staff: the fastest to act is the victor (See EDM, December 1). Consequently, Makarov once again criticized the domestic defense industry for offering the military inferior quality weapons systems. Yet, as speed and harnessing C4ISR (Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance) become increasingly decisive factors in modern warfare, the risks for conflict escalation demand careful attention – especially when the disparate actors possess varied capabilities. Unlike other nuclear powers, Russia has to consider the proximity of several nuclear actors close to its borders. In the coming decade and beyond, Moscow may pursue dialogue with other nuclear actors on the nature of conflict escalation and de-escalation. However, with a multitude of variables at play ranging from BMD, US Global Strike capabilities, uncertainty surrounding the “reset” and the emergence of an expanded nuclear club, and several potential sources of instability and conflict, any dialogue must consider escalation in its widest possible context. Makarov’s message during his presentation, as far as the nuclear issue is concerned, was therefore a much tougher bone than the old dogs of the Cold War would wish to chew on.

### Plan

#### The United States federal government should provide initial funding for integral fast reactors using the S-PRISM design in the United States.

### Solvency

#### Initial funding solves investor confidence and creates rapid deployment

**Lovering 12** [Jessica Lovering is a policy analyst, and Max Luke is a policy associate, in the Breakthrough Institute’s Energy & Climate program. Barry Brook is a Breakthrough Senior Fellow, November 16, 2012, “How U.S.-European Cooperation Can Deliver Cheaper, Safer Nuclear Energy”, Breakthrough Institute]

Advanced nuclear technologies and small modular reactors (SMRs) are being actively researched and designed, particularly in nations where governments recognize the strategic necessity of nuclear energy in the future energy mix – China, South Korea, United Arab Emirates, and others. Further research is required to understand how governments can best advance next generation nuclear designs, but many of the policies that have helped renewable technologies succeed – federally backed loan guarantees, feed-in tariffs, access to public lands for demonstration projects, and others – show signs of promise.¶ Yet the initial development and deployment of advanced nuclear, which is required to give confidence to commercial utilities to build these at a large scale, is not occurring fast enough. It is time that the United States and European countries recognize advanced nuclear as a potentially crucial component of a clean-energy transition. Without the rapid deployment of nuclear power, our energy needs will probably continue to be met predominately by fossil fuels, and the oft-cited 2°C global warming target will almost certainly not be met.

#### Plan’s mechanism results in successful commercial demonstration

**Kirsch et al. 9** [Steve Kirsch, Bachelor of Science and a Master of Science in electrical engineering and computer science from the Massachusetts Institute of Technology, “The Integral Fast Reactor (IFR) project: Q&A”, collaborative attempt to answer questions regarding the integral fast reactor, contribution material, peer editing and review by George Stanford, PhD, a physicist, retired from Argonne National Laboratory, B.Sc. with Honours, Acadia University, M.A.,Wesleyan University, Ph.D. in experimental nuclear physics, Yale University, Tom Blees, Science Council for Global Initiatives, Carl Page, computer science professor at MSU, page last modified 2013]

Q. What's the next step?¶ The commercial demonstration should be a top national priority. A private consortium involving GE might be able to do it as well.¶ Ideally, Congress should fund DOE to have GE build a demonstration plant built. In order to expedite certification and licensing by the NRC, the most expeditious way would be to build a reactor vessel for $50 million, stick it at a university or national lab, and instead of filling it with sodium fill it with water. Build a mockup of the fuel assemblies, also out of non-radioactive material, and use that setup-which would require no licensing-as a prototype to demonstrate to the NRC the efficacy of the systems. For example, the NRC would say, what happens if you drop a fuel assembly when refueling. So you'd go over and run through it with the prototype. Once the thing is certified, you could drain it and use it in an actual power plant, where a single module would produce 380 MWe. They're designed to be built in power blocks of 2 reactor vessels each, feeding one large turbine that would put out 760 MW. You could fire up the first power block as soon as it's ready, even as you build further ones at the same facility. All would share a central control room and recycling facility.

#### That facilitates global expansion of the IFR

**Kirsch et al. 9** [Steve Kirsch, Bachelor of Science and a Master of Science in electrical engineering and computer science from the Massachusetts Institute of Technology, “The Integral Fast Reactor (IFR) project: Q&A”, collaborative attempt to answer questions regarding the integral fast reactor, contribution material, peer editing and review by George Stanford, PhD, a physicist, retired from Argonne National Laboratory, B.Sc. with Honours, Acadia University, M.A.,Wesleyan University, Ph.D. in experimental nuclear physics, Yale University, Tom Blees, Science Council for Global Initiatives, Carl Page, computer science professor at MSU, page last modified 2013]

Q. If this is really so good, how come GE isn't building S-PRISM on their own nickel?¶ Nobody wants to risk it since it isn't a slam dunk. You don't get a reward if you solve global warming. And government funding doesn't seem to be so easy. DOE tried to get funding for GNEP (which included IFR technology) and got shot down (so far).¶ GE is a large conservative corporation. They already service a fleet of lightwater reactors, are building more of them around the world, and have the promise of yet more. It's hard enough in this country to move into new levels of reactor technology without trying to leapfrog straight into the 4th generation. Their 3rd generation ESBWR is in the 5th round of NRC certification, whereas the S-PRISM (a souped up and more developed version of the PRISM) isn't at the starting gate. These things take years at the glacial pace of the NRC, though of course if President Obama decided to go all Manhattan project on it we could most definitely get there quickly enough. If GE started pushing 4th generation breeder reactors, can you imagine the hue and cry from the antie groups? What's their incentive to do that? If they're convinced that ultimately we'll end up at 4th generation reactors anyway and they can make plenty of dough and keep a low profile just taking the go slow approach, don't you imagine that's exactly what they'll do? Besides, conceivably another country with whom we have nuclear technology sharing agreements might very well certify and build it before the NRC ever gets out of the starting gate, which would make it much easier for the eventual NRC certification.¶ Q. If this is really so good, how come someone in government isn't trying to get it restarted?¶ The DOE is attempting to resuscitate fast-reactor technology, as part of the GNEP (Global Nuclear Energy Partnership) initiative. See¶ http://www.gnep.energy.gov/gnepPRs/gnepPR011007.html, and http://www.gnep.energy.gov/.¶ The IFR is one form of fast-reactor technology (metallic fuel with pyroprocessing), but there are others -- inferior, according to the IFR scientists. The important thing these days is to get the U.S. back into a leadership role in the development and management of nuclear power, recognizing that recycling in fast reactors is necessary if the long-lived waste is to be consumed, and if the full energy potential of the uranium is to be exploited. The GNEP would resuscitate fast-reactor technology in this country.¶ Q. Critics claim fast reactors are “expensive to build, complex to operate, susceptible to prolonged shutdown as a result of even minor malfunctions, and difficult and time-consuming to repair.”¶ I'm not aware of anyone who is an expert on Integral Fast Reactor technology (who actually really understands the science) who has this view. One Nobel prize winning physicist who was recently briefed on the IFR (Burton Richter, former Director of SLAC) told me that, at best, there is insufficient scientific evidence to make such a statement. Is there someone who knows the fast reactor science as well as Dr. Chang or Dr. Till who holds that view? Certainly not the MIT study (as they admitted up front). So whose expert opinion are you relying on here?¶ Secondly, if your statement was true, then aren't these statements directly in direct conflict with the facts? If the critics are to be relied upon, then none of the following would have been possible at all:¶ – The Monju reactor was undamaged by the fire (rated 1 on a scale of 0 to 7, with 7 being the most serious accident), and has been kept shut down for political reasons. I think it has been given the go-ahead to start up.¶ – The EBR-II fast reactor worked flawlessly for many years (http://www.world-nuclear.org/info/inf98.html 31 years from 1963-1994)¶ – The Phenix fast reactor in France has been on-line for decades.¶ – The Superphenix reactor was shut down for political reasons, after it finally had its problems behind it and was working well.¶ – The Russian BN-600 has been working well for decades.¶ Ray Hunter was for the past 29 years as the former Deputy Director of the Office of Nuclear Energy, Science and Technology in the U.S. Department of Energy (DOE). Should his view count? Here's what he wrote to me:¶ My name is Ray Hunter. I am the former Deputy Director of the Office of Nuclear Energy, Science and Technology in the U.S. Department of Energy (DOE). I spent more than 29 years in DOE and the predecessor agencies working on developing advanced nuclear reactors for civilian nuclear power applications. After evaluating several alternatives, I came to the conclusion that a sodium cooled fast reactor using metal fuel and non aqueous reprocessing offered the best option to compliment and eventually replace Light Water Reactors (LWR’s). The basis for my conclusion was the successful proof of principle demonstration work completed by Argonne National Laboratory. It is important to understand that there were had two versions of the IFR concept; the second version involved a sodium cooled reactor using mixed uranium oxide and plutonium oxide fuel and aqueous reprocessing. The second version required separating Plutonium-239 for fabrication into new fuel which was considered to be a major proliferation issue. Unfortunately, the Clinton administration considered all fast reactors concepts as too much of a proliferation risk and cancelled all work on fast reactors. Actually, the decision to forgo processing of LWR fuel as enacted into law by 1982 Radioactive Waste Management Policy Act was the precursor for ending fast reactor technology development. The Department did continue to support in corporation with industry advanced LWR designs for future use. These advanced designs have been approved by the Nuclear Regulatory Commissions but none have been ordered in the U.S. because of the unresolved waste issue and the economic risk of trying to build and license a nuclear power plant in the U.S. Versions of these advanced LWR designs have already been built and are operating in Japan and South Korea.¶ The ill conceived U.S. policy of a once through LWR fuel cycle has never been adopted by any other nuclear power nation. According to Senator Reid, Yucca Mountain will not proceed as long as his any say in the matter. Until there is a path forward on LWR spent fuel, it is unlikely any new nuclear plant will be built in the U.S. The technical facts clearly show that the most cost effective and environmentally sound way to deal with LWR spent fuel is use the IFR concept with metal fuel and non aqueous reprocessing. While the proposed GNEP concept does not require plutonium separation, it is still based on oxide fuel and aqueous reprocessing which does allay proliferation concerns. Also, the GNEP concept is being offered as global solution for minimizing nuclear proliferation based on certain countries doing reprocessing including the U.S. but our current law precludes it. ¶ I am attaching a recent letter I sent to Senator Reid. In my judgment, we need to focus on the waste issue to break the logjam on nuclear power in the U.S. We don’t need to deploy the IFR in the private sector for the foreseeable future to get the benefits of expanded nuclear power use. If inviting the IAEA to oversee IFR facilities at government sites would promote acceptance of reprocessing, then we should proceed accordingly. Any thoughts you have on this matter would be appreciated.¶ Q. A lot of critics claim the plants will be too expensive to build.¶ The cost of a power plant is often expressed in terms of dollars per kilowatt of capacity. Every $1,000/kWe in initial cost adds, very roughly, one cent per kilowatt-hour to the cost of the electricity (assuming a 40-year write-off period and an interest rate of 8.5% per year).¶ The cost of a nuclear plant is very hard to predict these days, because it depends heavily on the regulatory climate. In more detail, here's something Eric Loewen (GE) has written on the subject of cost:¶ . . . This is not to say that PRISM or any other nuclear reactor will be inexpensive when built in the United States. The same GE Hitachi reactors that were built in Japan in the late 90s for about $1,400/kW are estimated to cost several times that much in the USA. Considering that the actual cost of raw materials is an insignificant portion of that price (about $35/kW), and that interest rates are at record low levels, the significantly higher price tags being bandied about by private utility companies reflects a regulatory/corporate/governmental environment that needs fixing. Part of the problem could be solved by a commitment to nuclear power from the federal government, streamlined licensing procedures for standardized designs, and shielding from interminable lawsuits like those that crippled the nuclear power industry in the 70s and 80s. ¶ There is nothing inherently uneconomical about nuclear power. Japan imports virtually all their building materials and has high labor costs. If they can build GE ABWR plants for a very reasonable price, there is no reason why the USA shouldn't be able to do the same.¶ Q. How many IFR plants do we need to replace all the coal plants in the US?¶ There are 200 nuclear plants now supplying 20% of our power. Coal provides about half our power. So you'd need about 400 new nuclear plants to displace all the coal plants.

#### The plan solves cost-competitiveness and international adaptation –

#### a. Gradual upsizing

**Till 11** [“PLENTIFUL ENERGY ¶ The Story of the Integral Fast Reactor¶ The complex history of a ¶ simple reactor technology, ¶ with emphasis on its ¶ scientific basis for non-specialists¶ CHARLES E. TILL, Nuclear physicist and associate lab director at Argonne National Laboratory West, and YOON IL CHANG”]

Some notion of likely cost competitiveness can be gained from past fast reactor ¶ construction experience, but the information available is limited. It can be said that ¶ the capital costs per MWe of the early fast reactors built around the world were ¶ much higher than those of LWRs. But the comparisons are not by any means direct ¶ and unambiguous. In comparison to the LWR, every difference between the two ¶ adds a cost increment to the fast reactor. With one significant exception, they were ¶ much smaller in size and electrical capacity than the LWRs built for commercial ¶ electricity generation. There were only a few of them. They were built as ¶ demonstration plants, by governments underwriting fast reactor development. There ¶ was basically one demonstration per country, with no follow-on to take advantage ¶ of the experience and lessons learned. Nor were they scaled up and replicated. The ¶ LWR had long since passed the stage where first-of-a-kind costs were involved, and ¶ had the advantage of economies of scale as well. Further, their purpose was ¶ commercial, with the attendant incentive to keep costs down. None of this has ¶ applied to fast reactors built to the present time.¶ Experience with thermal reactor types, as well as other large-scale construction, ¶ has shown that capital cost reduction follows naturally through a series of demonstration plants of increasing size once feasibility is proven. This has been ¶ true in every country, with exceptions only in the periods when construction ¶ undergoes lengthy delays due to organized anti-nuclear legal challenges. But this ¶ phased approach of multiple demonstration plants is no longer likely to be ¶ affordable, and in any case, with the experience worldwide now, it is probably ¶ unnecessary for a fast reactor plant today. Estimating the ―settled down‖ capital ¶ cost potential is not an easy task without such experience. Nevertheless, as the ¶ economic competitiveness of the fast reactor is taken to be a prerequisite to ¶ commercial deployment, we do need to understand the capital cost potential of the ¶ fast reactor and what factors influence it. 275

#### b. International cooperation and modeling

**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/](http://bravenewclimate.com/2011/02/24/advanced-nuclear-power-systems-to-mitigate-climate-change/-http%3A//bravenewclimate.com/2011/02/24/advanced-nuclear-power-systems-to-mitigate-climate-change/)

There are many compelling reasons to pursue the rapid demonstration of a full-scale IFR, as a lead-in to a subsequent global deployment of this technology within a relatively short time frame. Certainly the urgency of climate change can be a potent tool in winning over environmentalists to this idea. Yet political expediency—due to widespread skepticism of anthropogenic causes for climate change—suggests that the arguments for rolling out IFRs can be effectively tailored to their audience. Energy security—especially with favorable economics—is a primary interest of every nation.¶ The impressive safety features of new nuclear power plant designs should encourage a rapid uptick in construction without concern for the spent fuel they will produce, for all of it will quickly be used up once IFRs begin to be deployed. It is certainly manageable until that time. Burying spent fuel in non-retrievable geologic depositories should be avoided, since it represents a valuable clean energy resource that can last for centuries even if used on a grand scale.¶ Many countries are now beginning to pursue fast reactor technology without the cooperation of the United States, laboriously (and expensively) re-learning the lessons of what does and doesn’t work. If this continues, we will see a variety of different fast reactor designs, some of which will be less safe than others. Why are we forcing other nations to reinvent the wheel? Since the USA invested years of effort and billions of dollars to develop what is arguably the world’s safest and most efficient fast reactor system in the IFR, and since several nations have asked us to share this technology with them (Russia, China, South Korea, Japan, India), there is a golden opportunity here to develop a common goal—a standardized design, and a framework for international control of fast reactor technology and the fissile material that fuels them. This opportunity should be a top priority in the coming decade, if we are serious about replacing fossil fuels worldwide with sufficient pace to effectively mitigate climate change and other environmental and geopolitical crises of the 21st century.

#### c. Modularity

**Blees 9** [“Integral Fast Reactors for the masses”, Brave New Climate, Posted on 12 February 2009 on post by Barry Brook, Professor of Climate Change @ University of Adelaide, Tom Blees, National Center for Atmospheric Research]

IFRs would be wholly modular, both the reactors and recycling facilities, built in factories and assembled on site. Thus the fabrication of the modules could be distributed among companies around the world (Siemens, GE, Westinghouse, AREVA, Toshiba, etc) and would certainly benefit from economies of scale, as well as improved quality control.¶ In my book I assumed a cost of $2,000/kilowatt for the capital cost of the plant. As a comparison, private utility companies in the USA, where we suffer from a system that is broken on a host of levels, claim it will cost from $6-9,000/kilowatt. Yet GE was able to build their ABWR nuclear plants in Japan for about $1,400/kW. Clearly the USA (and GE is a U.S. company, and remember Japan imports virtually all the materials and has high labor costs) could do better if they got sane about their regulatory, political, and corporate mess.¶ It’s been alleged that the cost of nuclear power plants are rising stratospherically because of the increasing cost of commodities, but that’s simply not true. Per Peterson, professor of nuclear engineering at the University of California in Berkeley, recently went back and calculated the materials costs for 70s-era nuclear power plants, which used far more materials/kW than the new IFRs would, but he plugged in commodities costs from 2008. The result: The cost per kilowatt comes to about $34! Virtually all of the cost of a nuclear plant comes from fabrication, labor, and profits, not from materials costs. And having a cushion from $34 to $2,000 should be seen as entirely realistic in a situation where something is built in factory-fabricated modules. In fact, should we begin deploying IFRs worldwide, the cost should be able to be considerably less than $2,000/kW.

#### IFR’s are really safe

**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/

Metal Fuel: The Ultimate Safety Valve¶ One of the most important of the many superlatives of the IFR is its use of a metal fuel comprised of uranium, plutonium and zirconium, and the ingenious manner in which the Argonne team solved the problems of fuel expansion and fuel fabrication, as well as the potentially dangerous overheating scenario. Unlike the fuel fabrication of oxide-fueled reactors that requires the dimensions of the fuel pellets to be uniform to very exacting tolerances, the metal fuel for the IFR can be simply injected into molds and then cooled and inserted into metal tubes (cladding) with a great deal of dimensional tolerance, with a sodium bond filling any voids. If an accident situation occurs that would cause the core to overheat, such as a loss of coolant flow accident, the metal fuel itself will expand, causing neutron leakage to terminate the chain reaction, relying on nothing but the laws of physics.¶ The passive safety characteristics of the IFR were tested in EBR-II on April 3, 1986, against two of the most severe accident events postulated for nuclear power plants. The first test (the Loss of Flow Test) simulated a complete station blackout, so that power was lost to all cooling systems. The second test (the Loss of Heat Sink Test) simulated the loss of ability to remove heat from the plant by shutting off power to the secondary cooling system. In both of these tests, the normal safety systems were not allowed to function and the operators did not interfere. The tests were run with the reactor initially at full power.¶ In both tests, the passive safety features simply shut down the reactor with no damage. The fuel and coolant remained within safe temperature limits as the reactor quickly shut itself down in both cases. Relying only on passive characteristics, EBR-II smoothly returned to a safe condition without activation of any control rods and without action by the reactor operators. The same features responsible for this remarkable performance in EBR-II will be incorporated into the design of future IFR plants, regardless of how large they may be [xi].¶ While the IFR was under development, a consortium of prominent American companies led by General Electric collaborated with the IFR team to design a commercial-scale reactor based upon the EBR-II research. This design, currently in the hands of GE, is called the PRISM (Power Reactor Innovative Small Module). A somewhat larger version (with a power rating of 380 MWe) is called the S-PRISM. As with all new nuclear reactor designs (and many other potentially hazardous industrial projects), probabilistic risk assessment studies were conducted for the S-PRISM. Among other parameters, the PRA study estimated the frequency with which one could expect a core meltdown. This occurrence was so statistically improbable as to defy imagination. Of course such a number must be divided by the number of reactors in service in order to convey the actual frequency of a hypothetical meltdown. Even so, if one posits that all the energy humanity requires were to be supplies solely by IFRs (an unlikely scenario but one that is entirely possible), the world could expect a core meltdown about once every 435,000 years [xii]. Even if the risk assessment understated the odds by a factor of a thousand, this would still be a reactor design that even the most paranoid could feel good about.