**1AC – Nuke Leadership**

**Contention 1 is Nuclear Leadership –**

**US nuclear leadership is in terminal decline – countries are looking to expand nuclear use now. Federal action to revitalize our domestic industry is the only way to manage new reactor security and proliferation risks internationally by setting global norms**

**Wallace and Williams 12** [MICHAEL WALLACE is a senior adviser leading the U.S. Nuclear Energy Project at CSIS. He is a member of the National Infrastructure Advisory Council (NIAC), which advises the president on matters related to homeland security, and a member of the Board of Directors for Baltimore Gas and Electric, SARAH WILLIAMS is program coordinator and research associate in the U.S. Nuclear Energy Project at CSIS, she was a Herbert Scoville Jr. peace fellow and program coordinator at the Center for Science, Technology and Security Policy at the American Association for the Advancement of Science, “Nuclear Energy in America: Preventing its Early Demise”, 2012, <http://csis.org/files/publication/120405_GF_Final_web-sm.pdf>, Chetan]

America’s nuclear energy industry is in decline. Low natural gas prices, financing hurdles, new safety and security requirements, failure to resolve the waste issue and other factors are hastening the day when existing reactors become uneconomic, making it virtually impossible to build new ones. Two generations after the United States took this wholly new and highly sophisticated technology from laboratory experiment to successful commercialization, our nation is in danger of losing an industry of unique strategic importance, unique potential for misuse, and unique promise for addressing the environmental and energy security demands of the future. The pace of this decline, moreover, could be more rapid than most policymakers and stakeholders anticipate. With 104 operating reactors and the world’s largest base of installed nuclear capacity, it has been widely assumed that the United States—even without building many new plants— would continue to have a large presence in this industry for some decades to come, especially if existing units receive further license extensions. Instead, current market conditions are such that growing numbers of these units are operating on small or even negative profit margins and could be retired early. Meanwhile, China, India, Russia, and other countries are looking to significantly expand their nuclear energy commitments. By 2016, China could have 50 nuclear power plants in operation, compared with only 14 in 2011. India could add 8 new plants and Russia 10 in the same time frame. These trends are expected to accelerate out to 2030, by which time China, India, and Russia could account for nearly 40 percent of global nuclear generating capacity. Meanwhile, several smaller nations, mostly in Asia and the Middle East, are planning to get into the nuclear energy business for the first time. In all, as many as 15 new nations could have this technology within the next two decades. Meanwhile, America’s share of global nuclear generation is expected to shrink, from about 25 percent today to about 14 percent in 2030, and—if current trends continue—to less than 10 percent by mid-century. With the center of gravity for global nuclear investment shifting to a new set of players, the United States and the international community face a difficult set of challenges: stemming the spread of nuclear weapons-usable materials and know-how; preventing further catastrophic nuclear accidents; providing for safe, long-term nuclear waste management; and protecting U.S. energy security and economic competitiveness. In this context, **federal action to reverse the American nuclear industry’s impending decline is a national security imperative**. The United States cannot afford to become irrelevant in a new nuclear age. Our nation’s commercial nuclear industry, its military nuclear capabilities, and its strong regulatory institutions can be seen as three legs of a stool. All three legs are needed to support America’s future prosperity and security and to shape an international environment that is conducive to our long-term interests. Three specific aspects of U.S. leadership are particularly important. First, managing the national and global security risks associated with the spread of nuclear technology to countries that don’t necessarily share the same perspective on issues of nonproliferation and nuclear security or may lack the resources to implement safeguards in this area. An approach that relies on influence and involvement through a viable domestic industry is likely to be more effective and less expensive than trying to contain these risks militarily. Second, setting global norms and standards for safety, security, operations, and emergency response. As the world learned with past nuclear accidents and more recently with Fukushima, a major accident anywhere can have lasting repercussions everywhere. As with nonproliferation and security, America’s ability to exert leadership and influence in this area is **directly linked** to the strength of our domestic industry and our active involvement in the global nuclear enterprise. A strong domestic civilian industry and regulatory structure have **immediate** national security significance in that they help support the nuclear capabilities of the U.S. Navy, national laboratories, weapons complex, and research institutions. Third, in the past, the U.S. government could exert influence by striking export agreements with countries whose regulatory and legal frameworks reflected and were consistent with our own nonproliferation standards and commitments. At the same time, our nation set the global standard for effective, independent safety regulation (in the form of the Nuclear Regulatory Commission), led international efforts to reduce proliferation risks (through the 1970 NPT Treaty and other initiatives), and provided a model for industry self-regulation. The results were not perfect, but America’s institutional support for global nonproliferation goals and the regulatory behaviors it modeled clearly helped shape the way nuclear technology was adopted and used elsewhere around the world. This influence seems **certain to wane** if the United States is no longer a major supplier or user of nuclear technology. With existing nonproliferation and safety and security regimes looking increasingly inadequate in this rapidly changing global nuclear landscape, American leadership and leverage is more important and more central to our national security interests than ever. To maintain its leadership role in the development, design, and operation of a growing global nuclear energy infrastructure, the next administration, whether Democrat or Republican, must recognize the invaluable role played by the commercial U.S. nuclear industry and take action to prevent its early demise.

**Small modular reactors establish the US as a leader in nuclear tech**

**Rosner and Goldberg 11** – William E. Wrather Distinguished Service Professor in the Departments of Astronomy and Astrophysics and Physics at the University of Chicago, and Special Assistant to the Director at the Argonne National Laboratory (Robert and Stephen, November. “Small Modular Reactors – Key to Future Nuclear Power Generation in the U.S.” <https://epic.sites.uchicago.edu/sites/epic.uchicago.edu/files/uploads/EPICSMRWhitePaperFinalcopy.pdf>)

As stated earlier, SMRs have the potential to achieve significant greenhouse gas emission reductions. They could provide alternative baseload power generation to facilitate the retirement of older, smaller, and less efficient coal generation plants that would, otherwise, not be good candidates for retrofitting carbon capture and storage technology. They could be deployed in regions of the U.S. and the world that have less potential for other forms of carbon-free electricity, such as solar or wind energy. There may be technical or market constraints, such as projected electricity demand growth and transmission capacity, which would support SMR deployment but not GW-scale LWRs. From the on-shore manufacturing perspective, a key point is that the manufacturing base needed for SMRs can be developed domestically. Thus, while the large commercial LWR industry is seeking to transplant portions of its supply chain from current foreign sources to the U.S., the SMR industry offers the potential to establish **a large domestic manufacturing base** building upon already existing U.S. manufacturing infrastructure and capability, including the Naval shipbuilding and underutilized domestic nuclear component and equipment plants. The study team learned that a number of sustainable domestic jobs could be created – that is, the full panoply of design, manufacturing, supplier, and construction activities – if the U.S. can establish itself as a credible and substantial designer and manufacturer of SMRs. While many SMR technologies are being studied around the world, a strong U.S. commercialization program can enable U.S. industry to be first to market SMRs, thereby serving as a **fulcrum** for export growth as well as a lever in influencing international decisions on deploying both nuclear reactor and nuclear fuel cycle technology. A viable U.S.-centric SMR industry would enable the U.S. to **recapture** technological leadership in commercial nuclear technology, which has been lost to suppliers in France, Japan, Korea, Russia, and, now rapidly emerging, China.

**This is especially true for small reactors – countries are looking to follow the NRC’s lead in new technical standards and operations for SMRs**

**Lovering et al 12** [Jessica Lovering, Ted Nordhaus, and Michael Shellenberger are policy analyst, chairman, and president of the Breakthrough Institute, a public policy think tank and research organization. “Out of the Nuclear Closet”, September 7th, 2012, <http://www.foreignpolicy.com/articles/2012/09/07/out_of_the_nuclear_closet>, Chetan]

To move the needle on nuclear energy to the point that it might actually be capable of displacing fossil fuels, we'll need new nuclear technologies that are cheaper and smaller. Today, there are a range of nascent, smaller nuclear power plant designs, some of them modifications of the current light-water reactor technologies used on submarines, and others, like thorium fuel and fast breeder reactors, which are based on entirely different nuclear fission technologies. Smaller, modular reactors can be built much faster and cheaper than traditional large-scale nuclear power plants. Next-generation nuclear reactors are designed to be incapable of melting down, produce drastically less radioactive waste, make it very difficult or impossible to produce weapons grade material, use less water, and require less maintenance. Most of these designs still face substantial technical hurdles before they will be ready for commercial demonstration. That means a great deal of research and innovation will be necessary to make these next generation plants viable and capable of displacing coal and gas. The United States could be a leader on developing these technologies, but unfortunately U.S. nuclear policy remains mostly stuck in the past. Rather than creating new solutions, efforts to restart the U.S. nuclear industry have mostly focused on encouraging utilities to build the next generation of large, light-water reactors with loan guarantees and various other subsidies and regulatory fixes. With a few exceptions, this is largely true elsewhere around the world as well. Nuclear has enjoyed bipartisan support in Congress for more than 60 years, but the enthusiasm is running out. The Obama administration deserves credit for authorizing funding for two small modular reactors, which will be built at the Savannah River site in South Carolina. But a much more sweeping reform of U.S. nuclear energy policy is required. At present, the Nuclear Regulatory Commission has little institutional knowledge of anything other than light-water reactors andvirtually no capability to review or regulate alternative designs. This affects nuclear innovation in other countries as well, since the NRC remains, despite its many critics, the **global gold standard** for thorough regulation of nuclear energy. Most other countries **follow the NRC's lead** when it comes to establishing new technical and operational standards for the design, construction, and operation of nuclear plants. What's needed now is a new national commitment to the development, testing, demonstration, and early stage commercialization of a broad range of new nuclear technologies -- from much smaller light-water reactors to next generation ones -- in search of a few designs that can be mass produced and deployed at a significantly lower cost than current designs. This will require both greater public support for nuclear innovation and an entirely different regulatory framework to review and approve new commercial designs. In the meantime, developing countries will continue to build traditional, large nuclear powerplants. But time is of the essence. With the lion's share of future carbon emissions coming from those emerging economic powerhouses, the need to develop smaller and cheaper designs that can scale faster is all the more important. A true nuclear renaissance can't happen overnight. And it won't happen so long as large and expensive light-water reactors remain our only option. But in the end, there is no credible path to mitigating climate change without a massive global expansion of nuclear energy. If you care about climate change, nothing is more important than developing the nuclear technologies we will need to get that job done.

**And without effective management, global prolif is inevitable**

**Macalister 9** [Jerry Macalister – journalist for the Guardian, “New Generation Of Nuclear Power Stations ’Risk Terrorist Anarchy’”, March 16th, 2009, <http://www.guardian.co.uk/environment/2009/mar/16/nuclearpower-nuclear-waste>, Chetan]

The new generation of atomic power stations planned for Britain, China and many other parts of the world risks proliferation that could lead to "nuclear anarchy", a security expert warned in a report published today. Governments and multilateral organisations must come up with a strategy to deal the impact of the new nuclear age, which will produce enough plutonium to make 1m nuclear weapons by 2075, argues Frank Barnaby from the Oxford Research Group thinktank in a paper for the Institute for Public Policy Research (IPPR). "We are at a crossroads. Unless governments work together to safeguard nuclear energy supplies, the rise in unsecured nuclear technology will put us all in danger. Without this, we are hurtling towards a state of nuclear anarchy where terrorists or rogue states have the ways and means of making nuclear weapons or 'dirty bombs', the consequences of which are unimaginable," says Barnaby. Any country choosing to operate new-generation nuclear reactors in future would have relatively easy access to plutonium, which is used to make the most efficient atomic weapons, along with the nuclear physicists and engineers to design them. These countries would be latent nuclear-weapon powers "and it is to be expected that some will take the political decision to become actual nuclear weapons powers," argues Barnaby in his paper submitted to the IPPR's independent Commission on National Security chaired by former Nato boss, Lord George Robertson. The issue of nuclear proliferation security has been largely ignored until today as the nuclear power debate has concentrated on the economics, social issues and how to deal with radioactive waste. Ministers in the UK have made clear their desire to see a new generation of facilities to replace existing ones at a time when North Sea gas is running out and the country needs to reduce its reliance on fossil fuels to meet its Kyoto protocol carbon emission targets. Nuclear power plants across the life cycle produce one third of the CO2 of gas-fired ones. Barnaby says that a shortage of uranium for the kind of reactors that EDF and others are considering building in Britain could encourage them to reprocess fuel and produce more plutonium. But he is equally convinced that a nuclear renaissance will lead to fast breeder reactors which produce more nuclear fuel than they use and which could be useful to terrorists. The Atomic Energy Agency and the Organisation for Economic Co-operation and Development have already suggested that uranium resources would last less than 70 years if processed using the current generation of light water nuclear reactors. Barnaby wants the non-proliferation treaty strengthened at a "make or break" review conference next year and would also like to see countries as yet without nuclear capabilities discouraged from obtaining enriched uranium, a problem highlighted in the case of Iran. Ian Kearns, deputy commissioner of the IPPR's security commission, said it was crucial that the rush to address climate change did not worsen the international security environment. "A global nuclear renaissance, if badly managed, could bring enormous complications in terms of nuclear non-proliferation and terrorism. Policymakers need to be alert to the dangers and to construct policies that bring secure low-carbon energy and a stable nuclear weapons environment," he said. Companies such as E.ON of Germany who want to build new nuclear plants in Britain declined to comment on the issue.

**SMR’s are prolif resistant – multiple features**

**Kuznetsov 8** – former Lead Researcher at the Kurchatov Institute (Russia) (Vladimir, March-August. “Options for small and medium sized reactors (SMRs) to overcome loss of economies of scale and incorporate increased proliferation resistance and energy security” Progress in Nuclear Energ Vol 50 issues 2-6, p 248. ScienceDirect)

For many less developed countries, these are the features of enhanced proliferation resistance and increased robustness of barriers for sabotage protection that may ensure the progress of nuclear power. All NPPs with innovative SMRs will provide for the implementation of the established safeguards veriﬁcation procedures under the agreements of member states with the IAEA. In addition to this, many innovative SMRs offer certain intrinsic **proliferation resistance** features to prevent the misuse, diversion or undeclared production of ﬁssile materials and/or to facilitate the implementation of safeguards (IAEA, 2006b). For example, many of water-cooled SMRs employ low enrichment uranium and once-through fuel cycle as basic options. Therefore, the features contributing to proliferation resistance of such SMRs are essentially similar to that of presently operated PWRs and BWRs. They also include an unattractive isotopic composition of the plutonium in the discharged fuel, and radiation barriers provided by the spent fuel. The intrinsic proliferation resistance features common to all HTGRs include high fuel burn-up (low residual inventory of plutonium, high content of 240 Pu); a difﬁcult to process fuel matrix; radiation barriers; and a low ratio of ﬁssile to fuelblock/fuel-pebble mass. Although several HTGRs make a provision for reprocessing of the TRISO fuel, the corresponding technology has not been established yet and, until such time as when the technology becomes readily available, the lack of the technology is assumed to provide an enhanced proliferation resistance. All liquid metal cooled SMRs are fast reactors that can ensure a self-sustainable operation on ﬁssile materials or realize fuel breeding to feed other reactors present in nuclear energy systems. In both cases, and if the fuel cycle is closed, the need of fuel enrichment and relevant uranium enrichment facilities would be eliminated, which is a factor contributing to enhanced proliferation resistance. Other features to enhance proliferation resistance of fast reactors are the following: No separation of plutonium and uranium at any fuel cycle stage and leaving a small (1e2% by weight) fraction of ﬁssion products permanently in the fuel; Denaturing of the ﬁssile materials, e.g., through the optimization of the core design to achieve a higher content of 238 Pu in the plutonium, to preclude the possibility of weapon production via securing an inadmissibly high level of residual heat of the plutonium fuel e the 238 Pu/Pu ratio needed to achieve this still needs to be deﬁned adequately.

**New and rapid proliferators are uniquely destabilizing – offensive posturing, launch on warning, poor control**

**Horowitz 9** – professor of Political Science at the University of Pennsylvania (Michael, The Spread of Nuclear Weapons and International Conflict: Does Experience Matter?,” Journal of Conflict Resolution, 53.2, Apr 09 pg. 234-257)

Learning as states gain experience with nuclear weapons is complicated. While to some extent, nuclear acquisition might provide information about resolve or capabilities, it also generates uncertainty about the way an actual conflict would go—given the new risk of nuclear escalation—and uncertainty about relative capabilities. **Rapid proliferation** may especially heighten uncertainty given the potential for reasonable states to disagree at times about the quality of the capabilities each possesses.2 What follows is an attempt to describe the implications of inexperience and incomplete information on the behavior of nuclear states and their potential opponents over time. Since it is impossible to detail all possible lines of argumentation and possible responses, the following discussion is necessarily incomplete. This is a first step. The acquisition of nuclear weapons increases the confidence of adopters in their ability to impose costs in the case of a conflict and the expectations of likely costs if war occurs by potential opponents. The key questions are whether nuclear states learn over time about how to leverage nuclear weapons and the implications of that learning, along with whether actions by nuclear states, over time, convey information that leads to changes in the expectations of their behavior—shifts in uncertainty— on the part of potential adversaries. Learning to Leverage? When a new state acquires nuclear weapons, how does it influence the way the state behaves and how might that change over time? Although nuclear acquisition might be orthogonal to a particular dispute, it might be related to a particular security challenge, might signal revisionist aims with regard to an enduring dispute, or might signal the desire to reinforce the status quo. This section focuses on how acquiring nuclear weapons influences both the new nuclear state and potential adversaries. In theory, systemwide perceptions of nuclear danger could allow new nuclear states to partially skip the early Cold War learning process concerning the risks of nuclear war and enter a proliferated world more cognizant of nuclear brinksmanship and bargaining than their predecessors. However, each new nuclear state has to resolve its own particular civil–military issues surrounding operational control and plan its national strategy in light of its new capabilities. **Empirical research** by Sagan (1993), Feaver (1992), and Blair (1993) suggests that viewing the behavior of other states does not create the necessary tacit knowledge; there is **no substitute for experience** when it comes to handling a nuclear arsenal, even if experience itself cannot totally prevent accidents. Sagan contends that civil–military instability in many likely new proliferators and pressures generated by the requirements to handle the responsibility of dealing with nuclear weapons will skew decision-making toward **more offensive strategies** (Sagan 1995). The questions surrounding Pakistan’s nuclear command and control suggest there is no magic bullet when it comes to new nuclear powers’ making control and delegation decisions (Bowen and Wolvén 1999). Sagan and others focus on inexperience on the part of new nuclear states as a key behavioral driver. **Inexperienced operators** and the bureaucratic desire to “justify” the costs spent developing nuclear weapons, combined with organizational biases that may favor escalation to avoid decapitation—the “**use it or lose it” mind-set**— may cause new nuclear states to adopt riskier launch postures, such as **launch on warning,** or at least be perceived that way by other states (Blair 1993; Feaver 1992; Sagan 1995).3 Acquiring nuclear weapons could alter state preferences and make states **more likely to escalate disputes** once they start, given their new capabilities.4 But their general lack of experience at leveraging their nuclear arsenal and effectively communicating nuclear threats could mean new nuclear states will be more likely to **select adversaries poorly and to find themselves in disputes with resolved adversaries that will reciprocate militarized challenges**. The “nuclear experience” logic also suggests that more experienced nuclear states sahould gain knowledge over time from nuclearized interactions that helps leaders effectively identify the situations in which their nuclear arsenals are likely to make a difference. Experienced nuclear states learn to select into cases in which their comparative advantage, nuclear weapons, is more likely to be effective, increasing the probability that an adversary will not reciprocate. Coming from a slightly different perspective, uncertainty about the consequences of proliferation on the balance of power and the behavior of new nuclear states on the part of their potential adversaries could also shape behavior in similar ways (Schelling 1966; Blainey 1988). While a stable and credible nuclear arsenal communicates clear information about the likely costs of conflict, in the short term, nuclear proliferation is likely to increase uncertainty about the trajectory of a war, the balance of power, and the preferences of the adopter.

#### Prolif is fast – breakdown of norms

**Blechman, 8** – Stimson Center Co-Founder, Stimson Center Nuclear Disarm Distinguished Fellow, Ph.D. (Barry, 9/29. “Nuclear Proliferation: Avoiding a Pandemic.” http://www.stimson.org/books-reports/nuclear-proliferation-avoiding-a-pandemic/)

There is serious risk that the international agreements and processes that have kept the number of nations armed with nuclear weapons fairly low are breaking down. Over the past ten years, three nations joined the six previously declared nuclear powers and a tenth is in the offing. Unless strong actions are taken during the first 18 months of the administration, we could see a world of twenty or even thirty nuclear-armed states by the 2020s. Meeting this challenge requires specific, near-term steps to shore up the current regime plus bold actions to move eventually to a world completely free of nuclear weapons.

**New prolif destroys nuclear hesitancy which guarantees escalation**

**Cimbala, 8** (Stephen, Distinguished Prof. Pol. Sci. – Penn. State Brandywine, Comparative Strategy, “Anticipatory Attacks: Nuclear Crisis Stability in Future Asia”, 27, InformaWorld)

If the possibility existed of a mistaken preemption during and immediately after the Cold War, between the experienced nuclear forces and command systems of America and Russia, then it may be a matter of even more concern with regard to states with newer and more opaque forces and command systems. In addition, the Americans and Soviets (and then Russians) had a great deal of experience getting to know one another’s military operational proclivities and doctrinal idiosyncrasies, including those that might influence the decision for or against war. Another consideration, relative to nuclear stability in the present century, is that the Americans and their NATO allies shared with the Soviets and Russians a commonality of culture and historical experience. Future threats to American or Russian security from weapons of mass destruction may be presented by states or nonstate actors motivated by cultural and social predispositions not easily understood by those in the West nor subject to favorable manipulation during a crisis. The spread of nuclear weapons in Asia presents a complicated mosaic of possibilities in this regard. States with nuclear forces of variable force structure, operational experience, and command-control systems will be thrown into a matrix of complex political, social, and cultural crosscurrents contributory to the possibility of war. In addition to the existing nuclear powers in Asia, others may seek nuclear weapons if they feel threatened by regional rivals or hostile alliances. Containment of nuclear proliferation in Asia is a desirable political objective for all of the obvious reasons. Nevertheless, the present century is unlikely to see the nuclear hesitancy or risk aversion that marked the Cold War, in part, because the military and political discipline imposed by the Cold War superpowers no longer exists, but also because states in Asia have new aspirations for regional or global respect.12 The spread of ballistic missiles and other nuclear-capable delivery systems in Asia, or in the Middle East with reach into Asia, is especially dangerous because plausible adversaries live close together and are already engaged in ongoing disputes about territory or other issues.13 The Cold War Americans and Soviets required missiles and airborne delivery systems of intercontinental range to strike at one another’s vitals. But short-range ballistic missiles or fighter-bombers suffice for India and Pakistan to launch attacks at one another with potentially “strategic” effects. China shares borders with Russia, North Korea, India, and Pakistan; Russia, with China and NorthKorea; India, with Pakistan and China; Pakistan, with India and China; and so on. The short flight times of ballistic missiles between the cities or military forces of contiguous states means that very little time will be available for warning and attack assessment by the defender. Conventionally armed missiles could easily be mistaken for a tactical nuclear first use. Fighter-bombers appearing over the horizon could just as easily be carrying nuclear weapons as conventional ordnance. In addition to the challenges posed by shorter flight times and uncertain weapons loads, potential victims of nuclear attack in Asia may also have first strike–vulnerable forces and command-control systems that increase decision pressures for rapid, and possibly mistaken, retaliation. This potpourri of possibilities challenges conventional wisdom about nuclear deterrence and proliferation on the part of policymakers and academic theorists. For policymakers in the United States and NATO, spreading nuclear and other weapons of mass destruction in Asia could profoundly shift the geopolitics of mass destruction from a European center of gravity (in the twentieth century) to an Asian and/or Middle Eastern center of gravity (in the present century).14 This would profoundly shake up prognostications to the effect that wars of mass destruction are now passe, on account of the emergence of the “Revolution in Military Affairs” and its encouragement of information-based warfare.15 Together with this, there has emerged the argument that large-scale war between states or coalitions of states, as opposed to varieties of unconventional warfare and failed states, are exceptional and potentially obsolete.16 The spread of WMD and ballistic missiles in Asia could overturn these expectations for the obsolescence or marginalization of major interstate warfare.

**1AC – Warming**

#### Contention 2 is warming

#### Newest and BEST studies show that warming is real and anthropogenic

Muller 12 (Richard A., professor of physics at the University of California, Berkeley, and a former MacArthur Foundation fellow, “The Conversion of a Climate-Change Skeptic,” 7-28-12, <http://www.nytimes.com/2012/07/30/opinion/the-conversion-of-a-climate-change-skeptic.html?_r=2&pagewanted=all>)

CALL me a converted skeptic. Three years ago I identified problems in previous climate studies that, in my mind, threw doubt on the very existence of global warming. Last year, following an intensive research effort involving a dozen scientists, I concluded that global warming was real and that the prior estimates of the rate of warming were correct. I’m now going a step further: Humans are almost entirely the cause. My total turnaround, in such a short time, is the result of careful and objective analysis by the Berkeley Earth Surface Temperature project, which I founded with my daughter Elizabeth. Our results show that the average temperature of the earth’s land has risen by two and a half degrees Fahrenheit over the past 250 years, including an increase of one and a half degrees over the most recent 50 years. Moreover, it appears likely that essentially all of this increase results from the human emission of greenhouse gases. These findings are stronger than those of the Intergovernmental Panel on Climate Change, the United Nations group that defines the scientific and diplomatic consensus on global warming. In its 2007 report, the I.P.C.C. concluded only that most of the warming of the prior 50 years could be attributed to humans. It was possible, according to the I.P.C.C. consensus statement, that the warming before 1956 could be because of changes in solar activity, and that even a substantial part of the more recent warming could be natural. Our Berkeley Earth approach used sophisticated statistical methods developed largely by our lead scientist, Robert Rohde, which allowed us to determine earth land temperature much further back in time. We carefully studied issues raised by skeptics: biases from urban heating (we duplicated our results using rural data alone), from data selection (prior groups selected fewer than 20 percent of the available temperature stations; we used virtually 100 percent), from poor station quality (we separately analyzed good stations and poor ones) and from human intervention and data adjustment (our work is completely automated and hands-off). In our papers we demonstrate that none of these potentially troublesome effects unduly biased our conclusions. The historic temperature pattern we observed has abrupt dips that match the emissions of known explosive volcanic eruptions; the particulates from such events reflect sunlight, make for beautiful sunsets and cool the earth’s surface for a few years. There are small, rapid variations attributable to El Niño and other ocean currents such as the Gulf Stream; because of such oscillations, the “flattening” of the recent temperature rise that some people claim is not, in our view, statistically significant. What has caused the gradual but systematic rise of two and a half degrees? We tried fitting the shape to simple math functions (exponentials, polynomials), to solar activity and even to rising functions like world population. By far the best match was to the record of atmospheric carbon dioxide, measured from atmospheric samples and air trapped in polar ice. Just as important, our record is long enough that we could search for the fingerprint of solar variability, based on the historical record of sunspots. That fingerprint is absent. Although the I.P.C.C. allowed for the possibility that variations in sunlight could have ended the “Little Ice Age,” a period of cooling from the 14th century to about 1850, our data argues strongly that the temperature rise of the past 250 years cannot be attributed to solar changes. This conclusion is, in retrospect, not too surprising; we’ve learned from satellite measurements that solar activity changes the brightness of the sun very little.

**It’s the most likely scenario for extinction**

**Deibel 7** [Terry L. Professor of IR at National War College, 2007 “Foreign Affairs Strategy: Logic for American Statecraft”, Conclusion: American Foreign Affairs Strategy Today]

Finally, **there is one major existential threat** to American security (as well as prosperity) of a nonviolent nature, **which**, though far in the future, **demands urgent action. It is the threat of global warming to the stability of the climate upon which all earthly life depends. Scientists** worldwide have **been observing** the gathering of this threat **for three decades now, and what was once a** mere **possibility has passed through probability to near certainty**. Indeed **not one of more than 900 articles on climate change published in refereed scientific journals from 1993 to 2003 doubted that anthropogenic warming is occurring. “In legitimate scientific circles**,” writes Elizabeth Kolbert, “**it is virtually impossible to find evidence of disagreement over the fun damentals of global warming**.” Evidence from a vast international scientific monitoring effort accumulates almost weekly, as this sample of newspaper reports shows: an international panel predicts “brutal droughts, floods and violent storms across the planet over the next century”; climate change could “literally alter ocean currents, wipe away huge portions of Alpine Snowcaps and aid the spread of cholera and malaria”; “glaciers in the Antarctic and in Greenland are melting much faster than expected, and…worldwide, plants are blooming several days earlier than a decade ago”; “rising sea temperatures have been accompanied by a significant global increase in the most destructive hurricanes”; “NASA scientists have concluded from direct temperature measurements that 2005 was the hottest year on record, with 1998 a close second”;“**Earth’s warming climate is estimated to contribute to more than 150,000 deaths and 5 million illnesses each year” as disease spreads**; “widespread bleaching from Texas to Trinidad…killed broad swaths of corals” due to a 2-degree rise in sea temperatures. “**The world is slowly disintegrating**,” concluded Inuit hunter Noah Metuq, who lives 30 miles from the Arctic Circle. “They call it climate change…but we just call it breaking up.” From the founding of the first cities some 6,000 years ago until the beginning of the industrial revolution, carbon dioxide levels in the atmosphere remained relatively constant at about 280 parts per million (ppm). At present they are accelerating toward 400 ppm, and by 2050 they will reach 500 ppm, about double pre-industrial levels. **Unfortunately, atmospheric CO2 lasts about a century, so there is no way immediately to reduce levels, only to slow their increase, we are thus in for significant global warming; the only debate is how much and how serous the effects will be**. As the newspaper stories quoted above show, **we are already experiencing** the effects of 1-2 degree warming in more **violent storms, spread of disease, mass die offs of plants and animals, species extinction, and** threatened **inundation of low-lying countries** like the Pacific nation of Kiribati and the Netherlands at a warming of 5 degrees or less **the Greenland and West Antarctic ice sheets could disintegrate, leading to a sea level of rise of 20 feet** that would cover North Carolina’s outer banks, swamp the southern third of Florida, and inundate Manhattan up to the middle of Greenwich Village. **Another catastrophic effect would be the collapse of the Atlantic thermohaline circulation that keeps the winter weather in Europe far warmer than its latitude would otherwise allow**. Economist William Cline once estimated the damage to the United States alone from moderate levels of warming at 1-6 percent of GDP annually; severe warming could cost 13-26 percent of GDP. But **the most frightening scenario is runaway greenhouse warming, based on positive feedback from the buildup of water vapor in the atmosphere that is both caused by and causes hotter surface temperatures**. Past ice age transitions, associated with only 5-10 degree changes in average global temperatures, took place in just decades, even though no one was then pouring ever-increasing amounts of carbon into the atmosphere. Faced with this specter, the best one can conclude is that “humankind’s **continuing enhancement of the natural greenhouse effect is akin to playing Russian roulette with the earth’s climate and humanity’s life support system**. At worst, says physics professor Marty Hoffert of New York University, “**we’re just going to burn everything up; we’re going to heat the atmosphere to the temperature it was in the Cretaceous when there were crocodiles at the poles, and then everything will collapse**.” During the Cold War, astronomer Carl Sagan popularized a theory of nuclear winter to describe how a thermonuclear war between the Untied States and the Soviet Union would not only destroy both countries but possibly end life on this planet. **Global warming is the** post-Cold War era’s **equivalent of nuclear winter** at least as serious **and considerably better supported scientifically**. Over the long run **it puts dangers form** terrorism and traditional **military challenges to shame. It is a threat** not only to the security and prosperity to the United States, but potentially **to the continued existence of life on this planet**.

**Climate change acts as a conflict multiplier – social unrest, civil war and political crises will all escalate as a result of changes in the environment**

**Brzoska et al 12** [Michael Brzoska - Institute for Peace Research and Security Policy and Klima Campus, University of Hamburg, , Jürgen Scheffran - Research Group Climate Change and Security, Institute of Geography and Klima Campus, University of Hamburg, Grindelberg, Jason Kominek - Institute of Sociology, University of Hamburg, Michael Link - Research Unit Sustainability and Global Change, Center for Earth System Research and Sustainability, University of Hamburg, - Janpeter Schilling - School of Integrated Climate System Sciences, Klima Campus, University of Hamburg, “Climate Change and Violent Conflict”, Science 18 May 2012: 869-871, Chetan]

Long-term historical studies tend to find a coincidence between climate variability and armed conflict, in line with some narratives about the evolution and **collapse of civilizations** [e.g., (8)]. For instance, Zhang and others (9) combine a set of variables for the time period 1500–1800 to identify climate change as a **major driver** of large-scale human crises in the Northern Hemisphere. Tol and Wagner (10) cautiously conclude that, in preindustrial Europe, cooler periods were more likely to be related to periods of violence than warmer phases. Similar findings have been presented for eastern China (11). However, the results have been less conclusive for recent periods. For instance, in one study, a significant correlation between temperature and civil war in Africa between 1981 and 2002 is used to project a substantial climate-induced increase in the incidence of civil war in Africa until 2030 (12). Yet, this result is not robust for an extended time period and alternative definitions of violent conflict (13). Food insecurity has been found to contribute to violence, as exemplified by recent “food riots” (14, 15), but there is little empirical evidence that climate variability is an important driver of violent land-use conflicts—e.g., in the Sahel (16). In Kenya, changing rainfall patterns have the potential to increase resource scarcity as a driver of pastoral conflict (17). However, more conflict in the form of violent livestock theft is reported during the rainy season than during drought (18). Similarly, conflicts over shared river systems have been associated with low-level violence, yet full-scale wars are unlikely [e.g., (19, 20)]. Instead, an increase in international water agreements has been observed (21). Finally, some studies suggest that natural disasters related to extreme weather conditions substantially increase the risk of intrastate conflict (22). In contrast, Bergholt and Lujala (23) find no increased likelihood of armed civil conflict due to weather-related disasters, and Slettebak (24) observes that, in crisis, cooperation frequently prevails. New research is on the way as new databases on nonstate conflicts, low-level violence, social instability events, and geo-referenced spatiotemporal patterns become available (25–27) (table S1). In addition to data needs, it is important to account for complexities in the relation between climate change and conflict. There are multiple pathways and feedbacks between the climate system, natural resources, human security, and societal stability (Fig. 1). Since the 1990s, there has been an extensive scientific debate on how the scarcity of natural resources affects violence and armed conflict (29, 30). More recently, conflict studies pay attention to the vulnerability of natural and social systems to climate impacts (31). Vulnerability can be broken down into three factors: (i) exposure to climate change, (ii) sensitivity to climate change, and (iii) adaptive capacity (32). The last two can be affected by conflict. Many of the world’s poorest people are exposed to various risks to life, health, and well-being. If climate change adds to these risks, it can increase humanitarian crises and aggravate existing conflicts without directly causing them. The question is whether human development, resilience, and adaptive capacity can compensate for increasing exposure and sensitivity to climate change. In previous decades, humanitarian aid, development assistance, and wealth per capita have increased (33), which has contributed to a reduction of global poverty as a possible driver of conflict. International efforts to prevent and manage conflicts have also been strengthened, and the number of armed conflicts has declined since the end of the Cold War (34). In recent years, however, this trend slowed down or is being reversed. While the number of democratic states has grown over the past half-century, the number of fragile states with weak institutions has also increased (35). If the debate on the securitization of climate change provokes military responses and other extraordinary measures, this could reinforce the likelihood of violent conflict. Main aspects of security concern include interventions in fragile states, the securing of borders (e.g., against disaster refugees), and access to resources (e.g., in the Mediterranean or Arctic region) [see (36)]. Other responses to climate change may also become causes of conflict, including bioenergy (as producers compete for land and food-related resources), nuclear power (which can lead to nuclear weapons proliferation), or geoengineering (through disagreements between states). Thus, there is a need for conflict-sensitive mitigation and adaptation strategies that contain conflict and contribute to cooperation via effective institutional frameworks, conflict management, and governance mechanisms. Research Challenges The balance between political and social factors and climate change could shift when the global temperature reaches levels that have been unprecedented in human history. There is reason to believe that such a change might overwhelm adaptive capacities and response mechanisms of both social and natural systems and thus lead to “**tipping points**” toward societal instability and an **increased likelihood** of violent conflict (37). Although some fundamental issues have been raised in previous research, numerous interdisciplinary questions still need to be investigated to understand the feedback loops involved (Table 1). Models of the various linkages can build on a rich set of tools from complexity science, multiagent systems, social-network analysis, and conflict assessment to extend previous data and experiences into future scenarios that cover different social, economic, and political contexts (28). Research across scientific disciplines will be needed to identify opportunities and coherent strategies to address societal challenges related to climate change.

#### Warming is still reversible – consensus of scientists proves

Chestney 12 (Nina, “Global warming close to becoming irreversible-scientists”, 3/26, <http://www.reuters.com/article/2012/03/26/us-climate-thresholds-idUSBRE82P0UJ20120326>)

The world is close to reaching tipping points that will make it irreversibly hotter, making this decade critical in efforts to contain global warming, scientists warned on Monday. Scientific estimates differ but the world's temperature looks set to rise by six degrees Celsius by 2100 if greenhouse gas emissions are allowed to rise uncontrollably. As emissions grow, scientists say the world is close to reaching thresholds beyond which the effects on the global climate will be irreversible, such as the melting of polar ice sheets and loss of rainforests. "This is the critical decade. If we don't get the curves turned around this decade we will cross those lines," said Will Steffen, executive director of the Australian National University's climate change institute, speaking at a conference in London. Despite this sense of urgency, a new global climate treaty forcing the world's biggest polluters, such as the United States and China, to curb emissions will only be agreed on by 2015 - to enter into force in 2020. "We are on the cusp of some big changes," said Steffen. "We can ... cap temperature rise at two degrees, or cross the threshold beyond which the system shifts to a much hotter state." TIPPING POINTS For ice sheets - huge refrigerators that slow down the warming of the planet - the tipping point has probably already been passed, Steffen said. The West Antarctic ice sheet has shrunk over the last decade and the Greenland ice sheet has lost around 200 cubic km (48 cubic miles) a year since the 1990s. Most climate estimates agree the Amazon rainforest will get drier as the planet warms. Mass tree deaths caused by drought have raised fears it is on the verge of a tipping point, when it will stop absorbing emissions and add to them instead. Around 1.6 billion tonnes of carbon were lost in 2005 from the rainforest and 2.2 billion tonnes in 2010, which has undone about 10 years of carbon sink activity, Steffen said. One of the most worrying and unknown thresholds is the Siberian permafrost, which stores frozen carbon in the soil away from the atmosphere. "There is about 1,600 billion tonnes of carbon there - about twice the amount in the atmosphere today - and the northern high latitudes are experiencing the most severe temperature change of any part of the planet," he said. In a worst case scenario, 30 to 63 billion tonnes of carbon a year could be released by 2040, rising to 232 to 380 billion tonnes by 2100. This compares to around 10 billion tonnes of CO2 released by fossil fuel use each year. Increased CO2 in the atmosphere has also turned oceans more acidic as they absorb it. In the past 200 years, ocean acidification has happened at a speed not seen for around 60 million years, said Carol Turley at Plymouth Marine Laboratory. This threatens coral reef development and could lead to the extinction of some species within decades, as well as to an increase in the number of predators. As leading scientists, policy-makers and environment groups gathered at the "Planet Under Pressure" conference in London, opinions differed on what action to take this decade. London School of Economics professor Anthony Giddens favours focusing on the fossil fuel industry, seeing as renewables only make up 1 percent of the global energy mix. "We have enormous inertia within the world economy and should make much more effort to close down coal-fired power stations," he said. Oil giant Royal Dutch Shell favours working on technologies leading to negative emissions in the long run, like carbon capture on biomass and in land use, said Jeremy Bentham, the firm's vice president of global business environment.

**No offense – increase in CO2 will overall lead to decrease in crop production and cause global starvation**

**Strom 7** [Robert Strom, Professor Emeritus of planetary sciences in the Department of Planetary Sciences at the University of Arizona, 2007 (studied climate change for 15 years, the former Director of the Space Imagery Center, a NASA Regional Planetary Image Facility, “Hot House”, SpringerLink, p. 211-216]

Agriculture is critical to **the survival of civilization**. Crops feed not only us but also the domestic animals we use for food. Any disruption in food production means a disruption of the economy, government, and health. The increase in CO2 will result in **some growth** of crops, and rising temperatures will open new areas to crop production at higher latitudes and over longer growing seasons; however, **the overall result** will be **decreased crop production** in most parts of the world. A 1993 study of the effects of a doubling of CO2 (550 ppm) above pre-industrial levels shows that there will be **substantial decreases** in the world food supply (Rosenzweig et al., 1993). In their research they studied the effects of global warming on four crops (wheat, rice, protein feed, and coarse grain) using four scenarios involving various adaptations of crops to temperature change and CO2 abundance. They found that the amount of world food reduction ranged from 1 to 27%. However, the optimistic value of 1% is almost certainly much too low, because it assumed that the amount of degradation would be offset by more growth from "CO2 fertilization." We now know that this is not the case, as explained below and in Chapter 7. The most probable value is a worldwide food reduction between 16 and 27%. These scenarios are based on temperature and CO2 rises that may be too low, as discussed in Chapter 7. However, even a decrease in world food production of 16% would lead to large-scale starvation in many regions of the world. Large-scale experiments called Free-Air Concentration Enrichment have shown that the effects of higher CO2 levels on crop growth is about 50% less than experiments in enclosure studies (Long et al., 2006). This shows that the projections that conclude that rising CO2 will fully offset the losses due to higher temperatures are wrong. The downside of climate change will far outweigh the benefits of increased CO2 and longer growing seasons. One researcher (Prof. Long) from the University of Illinois put it this way: Growing crops much closer to real conditions has shown that increased levels of carbon dioxide in the atmosphere will have roughly half the beneficial effects previously hoped for in the event of climate change. In addition, ground-level ozone, which is also predicted to rise but has not been extensively studied before, has been shown to result in a loss of photosynthesis and 20 per cent reduction in crop yield. Both these results show that we need to seriously re-examine our predictions for future global food production, as they are likely to be far lower than previously estimated. Also, studies in Britain and Denmark show that only a few days of hot temperatures can severely reduce the yield of major food crops such as wheat, soy beans, rice, and groundnuts if they coincide with the flowering of these crops. This suggests that there are certain thresholds above which crops become very vulnerable to climate change. The European heat wave in the summer of 2003 provided a large-scale experiment on the behavior of crops to increased temperatures. Scientists from several European research institutes and universities found that the growth of plants during the heat wave was reduced by nearly a third (Ciais et al., 2005). In Italy, the growth of corn dropped by about 36% while oak and pine had a growth reduction of 30%. In the affected areas of the mid- west and California the summer heat wave of 2006 resulted in a 35% loss of crops, and in California a 15% decline in dairy production due to the heat-caused death of dairy cattle. It has been projected that a 2 °C rise in local temperature will result in a $92 million loss to agriculture in the Yakima Valley of Washington due to the reduction of the snow pack. A 4'C increase will result in a loss of about $163 million. For the first time, the world's grain harvests have fallen below the consumption level for the past four years according to the Earth Policy Institute (Brown, 2003). Furthermore, the shortfall in grain production increased each year, from 16 million tons in 2000 to 93 million tons in 2003. These studies were done in industrialized nations where agricultural practices are the best in the world. In developing nations the impact will be much more severe. It is here that the impact of global warming on crops and domestic animals will be most felt. In general, the world's most crucial staple food crops could fall by as much as one-third because of resistance to flowering and setting of seeds due to rising temperatures. Crop ecologists believe that many crops grown in the tropics are near, or at, their thermal limits. Already research in the Philippines has linked higher night-time temperatures to a reduction in rice yield. It is estimated that for rice, wheat, and corn, the grain yields are likely to decline by 10% for every local 1 °C increase in temperature. With a decreasing availability of food, malnutrition will become more frequent accompanied by damage to the immune system. This will result in a greater susceptibility to spreading diseases. For an extreme rise in global temperature (> 6 'C), it is likely that worldwide crop failures will lead to mass starvation, and political and economic chaos with all their ramifications for civilization.

#### And only a rapid and global expansion of nuclear power can help us reach carbon targets

Harvey 12 [Fiona Harvey – Environmental Correspondent for the Guardian, “Nuclear power is only solution to climate change” – citing Jeffrey Sachs: Director of the Earth Institute and professor of sustainable development at Columbia, May 3rd, 2012, <http://www.guardian.co.uk/environment/2012/may/03/nuclear-power-solution-climate-change>, Chetan]

Combating climate change will **require** an expansion of nuclear power, respected economist Jeffrey Sachs said on Thursday, in remarks that are likely to dismay some sections of the environmental movement. Prof Sachs said atomic energy was needed because it provided a low-carbon source of power, while renewable energy was not making up enough of the world's energy mix and new technologies such as carbon capture and storage were not progressing fast enough. "We won't meet the carbon targets if nuclear is taken off the table," he said. He said coal was likely to continue to be cheaper than renewables and other low-carbon forms of energy, unless the effects of the climate were taken into account. "Fossil fuel prices will remain low enough to wreck [low-carbon energy] unless you have incentives and [carbon] pricing," he told the annual meeting of the Asian Development Bank in Manila. A group of four prominent UK environmentalists, including Jonathon Porritt and former heads of Friends of the Earth UK Tony Juniper and Charles Secrett, have been campaigning against nuclear power in recent weeks, arguing that it is unnecessary, dangerous and too expensive. Porritt told the Guardian: "It [nuclear power] cannot possibly deliver – primarily for economic reasons. Nuclear reactors are massively expensive. They take a long time to build. And even when they're up and running, they're nothing like as reliable as the industry would have us believe." But Sachs, director of the Earth Institute and professor of sustainable development at Columbia University in the US, said the world had no choice because the threat of climate change had grown so grave. He said greenhouse gas emissions, which have continued to rise despite the financial crisis and deep recession in the developed world, were "nowhere near" falling to the level that would be needed to avert dangerous climate change. He said: "Emissions per unit of energy need to fall by a factor of six. That means electrifying everything that can be electrified and then making electricity largely carbon-free. It requires renewable energy, nuclear and carbon capture and storage – these are all very big challenges. We need to understand the scale of the challenge." Sachs warned that "nice projects" around the world involving renewable power or energy efficiency would not be enough to stave off the catastrophic effects of global warming – a wholesale change and overhaul of the world's energy systems and economy would be needed if the world is to hold carbon emissions to 450 parts per million of the atmosphere – a level that in itself may be inadequate. "We are nowhere close to that – as wishful thinking and corporate lobbies are much more powerful than the arithmetic of climate scientists," he said.

#### Try or die – without nuclear power warming is inevitable

Lynas 9-14 [Mark Lynas – Climate Scientist for The Guardian, “Without nuclear, the battle against global warming is as good as lost”, September 14th, 2012, <http://www.guardian.co.uk/environment/2012/sep/14/nuclear-global-warming>, Chetan]

Let me be very clear. **Without nuclear, the battle against global warming is as good as lost.** Even many greens now admit this in private moments. We are already witnessing the first signs of the collapse in the biosphere this entails – with the Arctic in full-scale meltdown, more solar radiation is being captured by the dark ocean surface, and the weather systems of the entire northern hemisphere are being thrown into chaos. **With nuclear, there is a chance that global warming this century can be limited to 2C; without nuclear, I would guess we are heading for 4C or above. That will devastate ecosystems and societies worldwide on a scale which is unimaginable.**

#### SMR development offsets oil and gas burned in electricity production, renewables can’t provide a stable baseload or provide localized power generation – only SMRs solve warming

Loudermilk 11 [Micah K. Loudermilk, Contributor Micah J. Loudermilk is a Research Associate for the Energy & Environmental Security Policy program with the Institute for National Strategic Studies at National Defense University, contracted through ASE Inc, “Small Nuclear Reactors and US Energy Security: Concepts, Capabilities, and Costs”, http://www.ensec.org/index.php?option=com\_content&view=article&id=314:small-nuclear-reactors-and-us-energy-security-concepts-capabilities-and-costs&catid=116:content0411&Itemid=375, May 31, 2011, Chetan]

Lastly, and often ignored, is the ability of small reactors to bring a secure energy supply to locations detached from the grid. Small communities across Canada, Alaska, and other places have expressed immense interest in this opportunity. Additionally, the incorporation of small reactors may be put to productive use in energy-intensive operations including the chemical and plastics industries, oil refineries, and shale gas extraction. Doing so, especially in the fossil fuels industry would free up the immense amounts of oil and gas currently burned in the extraction and refining process. All told, small reactors possess numerous direct and indirect cost benefits which may alter thinking on the monetary competitiveness of the technology. Nuclear vs. Alternatives: a realistic picture When discussing the energy security contributions offered by small nuclear reactors, it is not enough to simply compare them with existing nuclear technology, but also to examine how they measure up against other electricity generation alternatives—renewable energy technologies and fossil fuels. Coal, natural gas, and oil currently account for 45%, 23% and 1% respectively of US electricity generation sources. Hydroelectric power accounts for 7%, and other renewable power sources for 4%. These ratios are critical to remember because idealistic visions of providing for US energy security are not as useful as realistic ones balancing the role played by fossil fuels, nuclear power, and renewable energy sources. Limitations of renewables Renewable energy technologies have made great strides forward during the last decade. In an increasingly carbon emissions and greenhouse gas (GHG) aware global commons, the appeal of solar, wind, and other alternative energy sources is strong, and many countries are moving to increase their renewable electricity generation. However, despite massive expansion on this front, renewable sources struggle to keep pace with increasing demand, to say nothing of decreasing the amount of energy obtained from other sources. The continual problem with solar and wind power is that, lacking efficient energy storage mechanisms, it is difficult to contribute to baseload power demands. Due to the intermittent nature of their energy production, which often does not line up with peak demand usage, electricity grids can only handle a limited amount of renewable energy sources—a situation which Germany is now encountering. Simply put, nuclear power provides virtually carbon-free baseload power generation, and renewable options are unable to replicate this, especially not on the scale required by expanding global energy demands. Small nuclear reactors, however, like renewable sources, can provide enhanced, distributed, and localized power generation. As the US moves towards embracing smart grid technologies, power production at this level becomes a critical piece of the puzzle. Especially since renewable sources, due to sprawl, are of limited utility near crowded population centers, small reactors may in fact prove instrumental to enabling the smart grid to become a reality. Pursuing a carbon-free world Realistically speaking, a world without nuclear power is not a world full of increased renewable usage, but rather, of fossil fuels instead. The 2007 Japanese Kashiwazaki-Kariwa nuclear outage is an excellent example of this, as is Germany’s post-Fukushima decision to shutter its nuclear plants, which, despite immense development of renewable options, will result in a heavier reliance on coal-based power as its reactors are retired, leading to a 4% increase in annual carbon emissions. On the global level, without nuclear power, carbon dioxide emissions from electricity generation would rise nearly 20% from nine to eleven billion tons per year. When examined in conjunction with the fact that an estimated 300,000 people per year die as a result of energy-based pollutants, the appeal of nuclear power expansion grows further. As the world copes simultaneously with burgeoning power demand and the need for clean energy, nuclear power remains the one consistently viable option on the table. With this in mind, it becomes even more imperative to make nuclear energy as safe as possible, as quickly as possible—a capacity which SMRs can fill with their high degree of safety and security. Additionally, due to their modular nature, SMRs can be quickly constructed and deployed widely.

**Small reactor designs enable nuke power to offset as much CO2 as every car in America**

**Whitman 12** [Christine Todd Whitman CASEnergy Co-Chair, Former EPA Administrator and New Jersey Governor, “Nuclear Power Garners Bipartisan Support”, August 13th, 2012, <http://energy.nationaljournal.com/2012/08/finding-the-sweet-spot-biparti.php>, Chetan]

This support is founded in the fact that **nuclear energy**, safely managed, **provides an efficient, reliable source of energy**. In fact, **nuclear power is the only baseload source of carbon-free electricity. It provides nearly two-thirds of the nation’s low-carbon electricity, and will** continue to **be an important source of energy** well into the future **given the advent of** innovative large and **small reactor designs. The use of nuclear energy prevents more than 613 million metric tons of carbon dioxide every year – as much CO2 as is emitted by every passenger car in America.**

#### Nuclear power is comparably better than any renewable option – solar and wind do more environmental damage and cost trillions

**Eerkens, 6 –** adjunct research professor, Nuclear Science and Engineering Institute at the University of Missouri in Columbia,

(Jeff W., “The Nuclear Imperative: a critical look at the approaching energy crises,” Springer Press)

For the USA, replacement of primary oil and coal requires an investment of $35 trillion for solar, $25 trillion for wind, and $6 trillion for nuclear power, Besides these capital cost disincentives, the enormous land areas needed for solar and wind energy cause a disturbance of local ecologies and will spoil many scenic landscapes. Exclusive use of these sources for prime energy would make them very unpopular with environmentalists, Aside from capital costs, one must consider maintenance costs. Solar cells require constant cleaning to remove dust or bird droppings, and must be replaced every ten to twenty years due to erosion and deterioration (sand storms, etc). They are made of gallium-arsenide or copper­indium-diselenide, requiring toxic silanes, arsenic, etc. for their manufacture. Toxic wastes generated in producing solar cells for global use, dwarf the amount of nuclear fuel and waste for the nuclear option. For wind-power generation, the mechanical maintenance of thousands of turbines and protective measures to avoid killing thousands of birds, seriously effects its economics. The secret of controlled nuclear power is that it is a thousand times more concentrated than any non-nuclear method .

#### SMRs spur renewable development, and integrate all energy sources into the grid

Ruth et al 11 [Mark Ruth, Mark Antkowiak, and Scott Gossett – The Joint Institute for Strategic Energy Analysis: on behalf of the U.S. Department of Energy’s National Renewable Energy Laboratory, the University of Colorado-Boulder, the Colorado School of Mines, the Colorado State University, the Massachusetts Institute of Technology, and Stanford University - A Report Prepared for the United States Department of Energy, “Nuclear and Renewable Energy Synergies Workshop: Report of Proceedings”, December 2011, <http://www.nrel.gov/docs/fy12osti/52256.pdf>, Chetan]

The U.S. Energy Freedom Center represents the end-state vision of the Initiative that closes the nuclear and carbon fuels cycles. The Center is planned as an SMR development and demonstration complex that will utilize nuclear process heat to produce hydrocarbon, synthetic, and alternative fuels, and will spawn energy related manufacturing and other supply chain vendors in the surrounding region. Together, the Center and surrounding manufacturing facilities are intended to create sustainable manufacturing and energy production jobs in the “regional energy corridor.” 2.5 Small Reactors for Energy Supply: Islanded Generation and Load Management Philip O. Moor of High Bridge Associates, with the help of his colleague Bruce Alatary, introduced the advantages that SMRs provide for the challenges and threats of the modern power system. Moor stated that one of the challenges is that mismatches between generation and load cause frequency mismatches and require a variety of sources to generate and store power (Moor and Alatary 2011). Another challenge that Moor identified is managing disruptions. The current power system includes baseload generation, spinning reserve with rapid ramp up, and other fast-start units like simple gas turbines. Any disruption to this electricity supply chain can be costly and require long recovery times. These disruptions include natural threats like earthquakes and severe weather, as well as manmade threats such as vandalism, cyberattacks, and terrorism. Furthermore, existing energy storage options only provide short-term solutions for grid disruptions. Moor defined the Smart Grid as a collective term for communication and control enhancements to the electricity grid using digital information and advanced controls technology. It dynamically optimizes grid operations and resources to get power where it is needed, when it is needed, while minimizing peaks and spinning reserve requirements. Moor identified the challenge of protection from increased susceptibility to cyberattack due to advanced computer technology. Moor advocated for SMRs as an alternative, non-fossil fuel generation source to enhance system reliability. SMRs offer secure multi-year operation that can be run independent of the grid if desired. Like other nuclear options, SMR operations are free of greenhouse gas emissions. Like other nuclear power technologies, thermal energy from SMRs can be used for ancillary purposes like district heating and industrial process heat to enhance cycle efficiency. In addition, SMRs are compatible with renewable resources like wind, solar, biomass, and tidal power. SMRs could also form the basis of a localized or “islanded” grid that is isolated from the larger power grid either geographically or by design. Moor described hypothetical micro-grids based on paired SMRs with backup diesel generators used to guarantee power to essential services. He stated that while water-cooled SMRs require automated systems, liquid-metal cooled and gascooled SMRs inherently follow load. Thus they have advantages in an islanded grid. When electricity demand is low, the SMR could provide energy to ancillary services like water purification, district heating, and hydrogen production.

#### Specifically, the plan is able to integrate into smaller electrical markets

King et al 11 [Marcus King • LaVar Huntzinger • Thoi Nguyen – CNA Environment and Energy Team - Resource Analysis Division, “Feasibility of Nuclear Power on US Military Installations”, March 2011, <http://www.cna.org/sites/default/files/research/Nuclear%20Power%20on%20Military%20Installations%20D0023932%20A5.pdf>, Chetan]

**SMRs have** potential **advantages over larger plants because they provide** owners **more flexibility in financing**, **siting, sizing,** and end-use applications. SMRs can reduce an owner's initial capital outlay or investment because of the lower plant capital cost. **Modular components and factory fabrication** can reduce construction costs and schedule duration. Additional modules can be added incrementally as demand for power increases. SMRs **can provide power for applications where large plants are not needed or may not have the necessary infrastructure to support a large unit such as smaller electrical markets, isolated areas, smaller grids, or restricted water or acreage sites. Several domestic utilities have expressed** considerable **interest in SMRs as potential replacements** for aging fossil plants to increase their fraction of non-carbon-emitting generators. Approximately 80 percent of the 1174 total operating **U.S. coal plants have power outputs of less than 500 MWe**; 100 percent of coal plants that are more than 50 years old have capacities below 500 MWe [3]. **SMRs would be a viable replacement option for these plants.**

#### This allows for global energy transition– ideally suited for developing countries

Solan et al 10 **–** Assistant Professor of Public Policy & Administration and Director of the Energy Policy Institute at Boise State University (David, June. “Economic and Employment Impacts of Small Modular Nuclear Reactors.” Energy Policy Institute, Center for Advanced Energy Studies. http://epi.boisestate.edu/media/3494/economic%20and%20employment%20impacts%20of%20smrs.pdf)

**The primary obstacle for many developing countries lies in their lack of available resources to build a large scale nuclear reactor that costs billions of dollars and requires at least several years to construct**. Aside from costs, **other key factors may inhibit the production of conventional nuclear reactors or larger fossil fuel plants within these countries** (IAEA, 2007). **Electrical grids with limited capacity are susceptible to operation and stability issues when power variations in excess of 10% of the total grid capacity occur**. **In certain countries**, regardless of whether the population is concentrated in urban areas or dispersed in remote regions, **the grid is not well developed or robust** (Carelli et al., 2010). As a result, **SMRs may be an attractive alternative due to their ability to be used as both incremental and distributed generation sources**. With this potential, however, come security concerns regarding transport and emplacement of SMRs in remote areas of some developing countries.

**1AC – Plan**

**Plan: The United States federal government should substantially increase production cost incentives for domestic deployment of small modular nuclear reactors**.

**1AC – Solvency**

**Contention 3 is Solvency –**

**Lack of financing is the biggest obstacle to plant construction**

Domenici and Meserve 10[Pete V. Domenici and Dr. Richard Meserve – Bipartisan Policy Center, “Letter to Chairman Jaczko – Chairman of the Nuclear Regulatory Commission”, April 6th, 2010, <http://bipartisanpolicy.org/sites/default/files/NRC%20Licensing%20Review.pdf>, Chetan]

In summary, we found that, while many of the stakeholders have encountered some problems in maneuvering through the licensing process, there was a **near-unanimous** view that all parties have acted appropriately and in good faith to resolve any problems. The NRC was not seen to have needlessly delayed or extended the licensing process. Based on our interviews, we believe that the difficulty of obtaining **financing is a bigger obstacle** to nuclear plant construction at the moment than licensing issues.

#### The DOE spent 450 million dollars on SMR’s this year and Obama has taken credit- takes out any perception or funding disads

Energy.gov 12(Energy.gov, “Obama Administration Announces $450 Million to Design and Commercialize U.S. Small Modular Nuclear Reactors”, <http://energy.gov/articles/obama-administration-announces-450-million-design-and-commercialize-us-small-modular>, March 22, 2012)

**Obama** Administration **Announces $450 Million to** Design and Commercialize U.S. **Small Modular Nuclear Reactors**. Today, **as** President **Obama went to Ohio State University to discuss the all-out, all-of-the-above strategy for American energy**, **the White House announced new funding to advance the development of American-made** small modular reactors (**SMRs**), **an important element of the President’s energy strategy. A total of $450 million will be made available to support** first-of-its-kind **engineering**, design certification and licensing for up to two **SMR designs over five years**, subject to congressional appropriations. Manufacturing these reactors domestically will offer the United States important export opportunities and will advance our competitive edge in the global clean energy race. Small modular reactors, which are approximately one-third the size of current nuclear plants, have compact, scalable designs that are expected to offer a host of safety, construction and economic benefits. **“The Obama Administration and the Energy Department are committed to an all-of-the-above energy strategy that develops every source of American energy, including nuclear power**, and strengthens our competitive edge in the global clean energy race,” said Energy Secretary Steven Chu. “**Through the funding for small modular nuclear reactors announced today, the Energy Department and private industry are working to position America as the leader in advanced nuclear energy technology and manufacturing.”** Through cost-share agreements with private industry, **the Department will solicit proposals for promising SMR projects that have the potential to be licensed by the Nuclear Regulatory Commission and achieve commercial operation by 2022**. These cost-share agreements will span a five-year period and, subject to congressional appropriations, will provide a total investment of approximately $900 million, with at least 50 percent provided by private industry. SMRs can be made in factories and transported to sites where they would be ready to “plug and play” upon arrival, reducing both capital costs and construction times. The smaller size also makes SMRs ideal for small electric grids and for locations that cannot support large reactors, offering utilities the flexibility to scale production as demand changes. **Today’s announcement builds on the Obama Administration’s efforts to help jumpstart America’s nuclear energy industry that include: · In 2010,** **the Department signed a conditional commitment for $8 billion in loan guarantees to support the Vogtle project, where the Southern Company and Georgia Power are building two new nuclear reactors**, helping to create new jobs and export opportunities for American workers and businesses. · **The Energy Department has also supported the Vogtle project and the development of the next generation of nuclear reactors by providing more than $200 million through a cost-share agreement to support the licensing reviews for Westinghouse’s AP1000 reactor design certification.** The Vogtle license is the first for new nuclear power plant construction in more than three decades. · **Promoting a sustainable nuclear industry in the U.S. also requires cultivating the next generation of scientists and engineers. Over the past three years, the Department has invested $170 million in research grants at more than 70 universities, supporting R&D into a full spectrum of technologies, from advanced reactor concepts to enhanced safety design.**

**Government incentives are vital – only route to commercialization of SMRs**

**Rosner and Goldberg 11** (William E. Wrather Distinguished Service Professor in the Departments of Astronomy and Astrophysics and Physics at the University of Chicago, and Special Assistant to the Director at the Argonne National Laboratory (Robert and Stephen, November. “Small Modular Reactors – Key to Future Nuclear Power Generation in the U.S.” <https://epic.sites.uchicago.edu/sites/epic.uchicago.edu/files/uploads/EPICSMRWhitePaperFinalcopy.pdf>)

Assuming that early SMR deployments will carry cost premiums (until the benefits of learning are achieved), the issue is whether federal government incentives are needed to help overcome this barrier. Some may argue that commercial deployment will occur, albeit at a slower pace, as the cost of alternatives increases to a level that makes initial SMR deployments competitive. Others may argue that SMR vendors should market initial modules at market prices and absorb any losses until a sufficient number of modules are sold that will begin to generate a profit. However, the combination of the large upfront capital investment, the long period before a return on capital may be achieved, and the large uncertainty in the potential level of return on investment make it **unlikely that SMRs will be commercialized without some form of government incentive**. The present analysis assumes that government incentives will be essential to **bridging this gap** and **accelerating private sector investment,,,** (see Appendix D). It is the study team’s understanding that DOE has proposed to share the cost of certain SMR design and licensing study activities. This section analyzes possible options for government incentives for early deployments (LEAD and FOAK plants) in addition to federal cost sharing for the design and licensing effort. The present analysis considers several alternative approaches to providing such incentives, either in the form of direct or indirect government financial incentives, or through market transformation actions that will **spur demand** for FOAK plants in competitive applications. The study team’s approach is to identify targeted, least-cost incentives that could form the basis for further dialogue between stakeholders and policy makers.

**Providing production cost incentives solves and alleviates cost overruns**

**Rosner and Goldberg 11** (William E. Wrather Distinguished Service Professor in the Departments of Astronomy and Astrophysics and Physics at the University of Chicago, and Special Assistant to the Director at the Argonne National Laboratory (Robert and Stephen, November. “Small Modular Reactors – Key to Future Nuclear Power Generation in the U.S.” <https://epic.sites.uchicago.edu/sites/epic.uchicago.edu/files/uploads/EPICSMRWhitePaperFinalcopy.pdf>)

Production Cost Incentive: A production cost incentive is a performance-based incentive. With a production cost incentive, the government incentive would be triggered only when the project successfully operates. The project sponsors would assume full responsibility for the upfront capital cost and would assume the full risk for project construction. The production cost incentive would establish a target price, a so-called “market-based benchmark.” Any savings in energy generation costs over the target price would accrue to the generator. Thus, a production cost incentive would provide a **strong motivation** for cost control and learning improvements, since any gains greater than target levels would enhance project net cash flow. Initial SMR deployments, without the benefits of learning, will have significantly higher costs than fully commercialized SMR plants and thus would benefit from production cost incentives. Because any production cost differential would decline rapidly due to the combined effect of module manufacturing rates and learning experience, the financial incentive could be set at a declining rate, and the level would be determined on a plant-by-plant basis, based on the achievement of cost reduction targets. The key design parameters for the incentive include the following: 1. The magnitude of the deployment incentive should decline with the number of SMR modules and should phase out after the fleet of LEAD and FOAK plants has been deployed. 2. The incentive should be market-based rather than cost-based; the incentive should take into account not only the cost of SMRs but also the cost of competing technologies and be set accordingly. 3. The deployment incentive could take several forms, including a direct payment to offset a portion of production costs or a production tax credit. The Energy Policy Act of 2005 authorized a production tax credit of $18/MWh (1.8¢/kWh) for up to 6,000 MW of new nuclear power plant capacity. To qualify, a project must commence operations by 2021. Treasury Department guidelines further required that a qualifying project initiate construction, defined as the pouring of safetyrelated concrete, by 2014. Currently, two GW-scale projects totaling 4,600 MW are in early construction; consequently, as much as 1,400 MW in credits is available for other nuclear projects, including SMRs. The budgetary cost of providing the production cost incentive depends on the learning rate and the market price of electricity generated from the SMR project. Higher learning rates and higher market prices would decrease the magnitude of the incentive; lower rates and lower market prices would increase the need for production incentives. Using two scenarios (with market prices based on the cost of natural gas combined-cycle generation) yields the following range of estimates of the size of production incentives required for the FOAK plants described earlier.

**Federal action is crucial to encourage private investing by controlling risk factors that cause regulatory delays**

**Gale et al 9** (Kelley Michael, Finance Department Chair – Latham & Watkins, “Financing the Nuclear Renaissance: The Benefits and Potential Pitfalls of Federal & State Government Subsidies and the Future of Nuclear Power in California,” Energy Law Journal, Vol. 30, p. 497-552, <http://www.felj.org/docs/elj302/19gale-crowell-and-peace.pdf>)

In a similar fashion, regulatory risk insurance and loan guarantees provided by the federal government should **encourage private financing** of domestic nuclear power projects because the government providing the guarantees also **controls many of the risk factors** //which could give rise to regulatory delays in commencing commercial operation of a new nuclear project. Further, in the nuclear power industry, the federal government is reviewing development applications and reactor designs, and is equipped with a team of experts in nuclear technologies, so that if the federal government has skin in the game, so to speak, private lenders may take **additional comfort** that the government has performed a certain level of due diligence on a particular project and determined that there are no major flaws from its vantage point. Section II.D.3 below discusses the risks covered by federally provided regulatory risk insurance and the ways in which it can be adapted to best encourage private sector financing for nuclear energy.

#### Federal investment key to ensure investor confidence in the licensing process

**Wallace, 5** –President, Constellation Generation Group (Mike, 4/26. CQ Congressional Testimony, “NUCLEAR POWER 2010 INITIATIVE” Lexis)

The Department of Energy's Nuclear Power 2010 program is a necessary, but not sufficient, step toward new nuclear plant construction. We must address other challenges as well. Our industry is not yet at the point where we can announce specific decisions to build. We are not yet at the point where we can take a $1.5 billion to $2 billion investment decision to our boards of directors. We do yet not have fully certified designs that are competitive, for example. We do not know the licensing process will work as intended: That is why we are working systematically through the ESP and COL processes. We must identify and contain the risks to make sure that nothing untoward occurs after we start building. We cannot make a $1.5 $2 billion investment decision and end up spending twice that because the licensing process failed us. The industry believes federal investment is necessary and appropriate to offset some of the risks I've mentioned. We recommend that the federal government's investment include the incentives identified by the Secretary of Energy Advisory Board's Nuclear Energy Task Force in its recent report. That investment stimulus includes: 1. secured loans and loan guarantees; 2. transferable investment tax credits that can be taken as money is expended during construction; 3. transferable production tax credits; 4. accelerated depreciation. This portfolio of incentives is necessary because it's clear that no single financial incentive is appropriate for all companies, because of differences in company-specific business attributes or differences in the marketplace - namely, whether the markets they serve are open to competition or are in a regulated rate structure. The next nuclear plants might be built as unregulated merchant plants, or as regulated rate-base projects. The next nuclear plants could be built by single entities, or by consortia of companies. Business environment and project structure have a major impact on which financial incentives work best. Some companies prefer tax-related incentives. Others expect that construction loans or loan guarantees will enable them to finance the next nuclear plants. It is important to preserve both approaches. We must maintain as much flexibility as possible. It's important to understand why federal investment stimulus and investment protection is necessary and appropriate. Federal investment stimulus is necessary to offset the higher first-time costs associated with the first few nuclear plants built. Federal investment protection is necessary to manage and contain the one type of risk that we cannot manage, and that's the risk of some kind of regulatory failure (including court challenges) that delays construction or commercial operation. The new licensing process codified in the 1992 Energy Policy Act is conceptually sound. It allows for public participation in the process at the time when that participation is most effective - before designs and sites are approved and construction begins. The new process is designed to remove the uncertainties inherent in the Part 50 process that was used to license the nuclear plants operating today. In principle, the new licensing process is intended to reduce the risk of delay in construction and commercial operation and thus the risk of unanticipated cost increases. The goal is to provide certainty before companies begin construction and place significant investment at risk. In practice, until the process is demonstrated, the industry and the financial community cannot be assured that licensing will proceed in a disciplined manner, without unfounded intervention and delay. Only the successful licensing and commissioning of several new nuclear plants (such as proposed by the NuStart and Dominion-led consortia) can demonstrate that the licensing issues discussed above have been adequately resolved. Industry and investor concern over these potential regulatory impediments may require techniques like the standby default coverage and standby interest coverage contained in S. 887, introduced by Senators Hagel, Craig and others. Let me also be clear on two other important issues: 1. The industry is not seeking a totally risk-free business environment. It is seeking government assistance in containing those risks that are beyond the private sector's control. The goal is to ensure that the level of risk associated with the next nuclear plants built in the U.S. generally approaches what the electric industry would consider normal commercial risks. The industry is fully prepared to accept construction management risks and operational risks that are properly within the private sector's control. 2. The industry's financing challenges apply largely to the first few plants in any series of new nuclear reactors. As capital costs decline to the "nth-of-a-kind" range, as investors gain confidence that the licensing process operates as intended and does not represent a source of unpredictable risk, follow-on plants can be financed more conventionally, without the support necessary for the first few projects. What is needed limited federal investment in a limited number of new plants for a limited period of time to overcome the financial and economic hurdles facing the first few plants built. In summary, we believe the industry and the federal government should work together to finance the first-of-a-kind design and engineering work and to develop an integrated package of financial incentives to stimulate construction of new nuclear power plants. Any such package must address a number of factors, including the licensing/regulatory risks; the investment risks; and the other business issues that make it difficult for companies to undertake capital-intensive projects. Such a cooperative industry/government financing program is a necessary and appropriate investment in U.S. energy security.

#### SMRs can be built in 2-3 years with half the cost of large reactors

Bosselman 9 [Professor Kent Bosselman – Chicago Kent: Illinois Institute of Technology, “The Future of Small and Medium Sized Nuclear Reactors 2009 and Beyond”, 2009, <http://www.kentlaw.edu/faculty/fbosselman/classes/energyF09/Coursedocs/Small%20Reactor%20Presentation.pdf>, Chetan]

SMR vs. Large: Cost of Construction/Operation SMRs:

Private companies are estimating that **new units built on site will cost between $23 to $30 million dollars. Add** the extra costs and you approach $50 million per unit

**2-3 years to construct SMRs:**

**Large Reactors**: To build a large reactor in the U.S. today several costs are involved: Construction costs Operating cost Waste disposal cost Decommissioning costs When combined, large reactors **end up costing between $6 to $10 billion dollars 7-10 years to construct**

#### Natural gas won’t block nuclear – prices increase coming now, only nuclear can provide stable rates

Somsel 10-13 [Joseph Somsel is a nuclear engineer with 35 years in the commercial nuclear power business, “Obama’s War on Nuclear Power” October 13th, 2012, http://www.americanthinker.com/2012/10/obamas\_war\_on\_nuclear\_power.html, Chetan]

Yet as of this writing, only four reactors have just begun physical construction, with permit approval in the spring of 2012. The rest have been either abandoned or suspended. Of course, the drop in natural gas prices had something to do with it, but investing in nuclear electricity-generation is a long-term bet against fossil fuel volatility. In other words, don't expect natural gas prices to stay this low for long. With the rapid spread of fracking and horizontal drilling technologies, a bubble of natural gas supply has hit the market, driving prices down. Current prices do not appear to support the long-term average cost of natural gas production causing financial difficulties for large producers like Chesapeake Energy. With an eventual normalization of costs to prices and the opening of export markets for America's gas, we can expect prices to show an upward climb over time. Nuclear, on the other hand, once built, is little troubled by uranium cost swings and can produce electricity at relatively stable rates. And stable electric rates have a intrinsic value to the customers by reducing the volatility of electric bills.

#### Shale gas is declining and studies don’t assume increased production

Berman 12 (Art, Former Editor – Oil and Gas Journal, Geological Consultant – American Association of Petroleum Geologists, “After the Gold Rush: A Perspective on Future U.S. Natural Gas Supply and Price,” Oil Drum, 2-8, <http://www.theoildrum.com/node/8914>)

For several years, we have been asked to believe that less is more, that more oil and gas can be produced from shale than was produced from better reservoirs over the past century. We have been told more recently that the U.S. has enough natural gas to last for 100 years. We have been presented with an improbable business model that has no barriers to entry except access to capital, that provides a source of cheap and abundant gas, and that somehow also allows for great profit. Despite three decades of experience with tight sandstone and coal-bed methane production that yielded low-margin returns and less supply than originally advertised, we are expected to believe that poorer-quality shale reservoirs will somehow provide superior returns and make the U.S. energy independent. Shale gas advocates point to the large volumes of produced gas and the participation of major oil companies in the plays as indications of success. But advocates rarely address details about profitability and they never mention failed wells. Shale gas plays are an important and permanent part of our energy future. We need the gas because there are fewer remaining plays in the U.S. that have the potential to meet demand. A careful review of the facts, however, casts doubt on the extent to which shale plays can meet supply expectations except at much higher prices. One Hundred Years of Natural Gas The U.S. does not have 100 years of natural gas supply. There is a difference between resources and reserves that many outside the energy industry fail to grasp. A resource refers to the gas or oil in-place that can be produced, while a reserve must be commercially producible. The Potential Gas Committee (PGC) is the standard for resource assessments because of the objectivity and credentials of its members, and its long and reliable history. In its biennial report released in April 2011, three categories of technically recoverable resources are identified: probable, possible and speculative. The President and many others have taken the PGC total of all three categories (2,170 trillion cubic feet (Tcf) of gas) and divided by 2010 annual consumption of 24 Tcf. This results in 90 and not 100 years of gas. Much of this total resource is in accumulations too small to be produced at any price, is inaccessible to drilling, or is too deep to recover economically. More relevant is the Committee’s probable mean resources value of 550 (Tcf) of gas (Exhibit 4). If half of this supply becomes a reserve (225 Tcf), the U.S. has approximately 11.5 years of potential future gas supply at present consumption rates. When proved reserves of 273 Tcf are included, there is an additional 11.5 years of supply for a total of almost 23 years. It is worth noting that proved reserves include proved undeveloped reserves which may or may not be produced depending on economics, so even 23 years of supply is tenuous. If consumption increases, this supply will be exhausted in less than 23 years. Revisions to this estimate will be made and there probably is more than 23 years but based on current information, 100 years of gas is not justified. Shale Gas Plays May Not Provide Sustainable Supply Several of the more mature shale gas plays are either in decline or appear to be approaching peak production. Exhibit 5 shows that total Barnett Shale production is approximately 5.7 Bcf per day (Bcf/d) and cumulative gas production is more than 10 trillion cubic feet (Tcf) of gas. It also shows that production may be approaching a peak at current gas prices despite the constant addition of new wells. Exhibit 5. Barnett Shale Total Production. Source: HPDI. The Haynesville Shale surpassed the Barnett during 2011 as the most productive gas play in North America, with present daily rates of almost 7 Bcf/d and cumulative production of 3.5 Tcf (Exhibit 6). This play is most responsible for the current over-supply of gas with the average well producing 3.3 million cubic feet per day (Mcf/d) compared to only 0.4 Mdf/d in the Barnett. It is too early to say for sure, but the Haynesville Shale may also be approaching peak production. The Marcellus Shale is presently producing 2.4 Bcf/d and has produced a total of about 0.8 Tcf (Exhibit 7). In this play, production shows no sign of leveling off, as it does in the Barnett and Haynesville, and production in the Fayetteville Shale may also be approaching a peak (Exhibit 8). The Woodford Shale is already in decline (Exhibit 9). If some existing shale gas plays are approaching peak production after only a few years since the advent of horizontal drilling and multi-stage hydraulic fracturing, what is the basis for long-term projections of abundant gas supply?

#### SMRs avoid major licensing problems.

**Cunningham,** Policy Analyst for Energy and Climate at the American Security Project, **12** (Nick, October, American Security Project, Small Modular Reactors: A Possible Path Forward for Nuclear Power” <http://americansecurityproject.org/featured-items/2012/report-small-modular-reactor/>)

Another major drawback for conventional large reactors is the lack of standardization. This leads to long, expensive, and uncertain time periods for licensing and siting. SMRs can overcome this hurdle with standardized designs, standardized components, and enhanced safety from reduced reactor size, all of which are not easy to accomplish with large reactors. 31 Small Modular Reactors, as their name suggests, can be “modularized”. SMRs can be constructed in factories and actually shipped to site. Factory construction allows for greater quality control, predictability and scheduling. In contrast, large reactors are designed and built uniquely for each project, which can lead to delays and inflated costs. 3

#### Even new proliferators have smaller arsenals other risks make them more destabilizing

Feaver 97 (Peter, Ass Prof. Pol. Sci. – Duke, Security Studies, “Neooptimists and the Enduring Problem of Nuclear Proliferation”, 6:4, p. 102-103)

Are small and simple arsenals really more responsive in a crisis? Neooptimists dismiss some of the most damning near-nuclear accidents from the cold war era as merely a consequence of the rigid and complex standard operating procedures associated with the large superpower arsenals. Seng claims, with rather unjustified enthusiasm, that smaller arsenals should be able to "spin on a dime."27 He overstates his case. Given a certain level of operational skill, it is easier to improvise with a smaller than a larger arsenal. Will minor proliferators, however, have the kind of military that is proficient enough to improvise at all? Some will and some will not. Doctrinal skill varies widely across different militaries and even within different subelements of the same military.28 Of course, the nuclear operators may be the better trained elements of the minor proliferator, but not under conditions of opacity. Improvisation and operational flexibility are not simply a matter of size; they must be trained into military units. This argument points to a limitation of small-N comparative static analyses. Holding everything constant and then varying the size of the arsenal yields an expectation that command and control problems will ease. If you take the exact same country with the exact same deployment and skill profile, it will find controlling a smaller arsenal easier than controlling a larger arsenal. Counterfactual reasoning supports this logic, but since there are so few cases of nuclear proliferation to study we cannot be very confident of the magnitude of the effect.29 Since the purpose of neooptimism is to assuage us on the safeness of minor proliferators, it is not sufficient to know whether a certain kind of proliferation is relatively safer than another. We must also know how much safer—that is, whether it is safe enough to compensate for other problems. One must also examine whether the factor that is driving the smallness will also result in changes in other relevant parameters, for instance the alert level of the arsenal or the reliability of the weapon's design. One must also have some sense of the magnitude of effect and of other necessary conditions; the smaller size may only afford a meaningful improvement in nuclear command and control during a crisis if it is coupled with a competent military. Weighing all the factors in the U.S. case, for instance, it is not at all certain that nuclear operations were safer in the late-1950s than in the late-1960s; the arsenal was smaller in the earlier period, but the advantages of size were offset by a variety of unsafe operational practices including airborne alerts, a relatively wide scope of predelegated authority, an absence of use-control devices, and a general ignorance among top-level civilian leaders about operational realities. In sum, neooptimists have helpfully fleshed out the ways in which small size facilitates command and control. In so doing, however, they may be overstating both the virtues of smallness and simplicity and the likelihood that minor proliferators will adopt the specific kinds of small and simple arsenals necessary for the rosy scenario.