**1AC – Nuke Leadership**

**US nuclear leadership and competitiveness is in terminal decline –countries are looking to expand nuclear energy projects but won’t look to the United States for regulatory guidance. Federal action to revitalize our domestic industry is the only way to manage new reactor security and proliferations 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 busines**s 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 reactor design and manufacturing and recapture competitiveness in nuclear technology

**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.**

**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, useless 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 new nuclear power plants risk nuclear anarchy – 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.

**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 disagreeat 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 should 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.

#### Nuclear leadership is crucial to overall economic competitiveness

**Barton 10** (Charles Barton, Nuclear Green "Keeping up with China: The Economic Advantage of Molten Salt Nuclear Technology," <http://theenergycollective.com/charlesbarton/47933/keeping-china-economic-advantage-molten-salt-nuclear-technology> 12/1/10)

American and European nuclear development can either proceed by following the cost lowering paths being pioneered in Asia, or begin to develop low cost innovative nuclear plans. Since low labor costs, represent the most significant Chinese and Indian cost advantage, it is unlikely that European and American reactor manufacturers will be able to compete with the Asians on labor costs. Labor costs for conventional reactors can be lowered by factory construction of reactor componant moduels, but the Chinese are clearly ahead of the West in that game. Yet the weakness of the Chinese system is the relatively large amount of field labor that the manufacture of large reactors requires.¶ The Chines system is to introduce labor saving devices where ever and when ever possible, but clearly shifting labor from the field to a factory still offers cost advantages. The more labor which can be performed in the factory, the more labor cost savings are possible. Other savings advantages are possible by simplifying reactor design, and lowering materials input. Building a reactor with less materials and fewer parts lowers nuclear costs directly and indirectly. Decreasing core size per unit of power output also can contribute a cost advantage. Direct saving relate to the cost of parts and matetials, but fewer parts and less material also means less labor is required to put things together, since there is less to put together. In addition a small reactor core structure, would, all other things being equal, require a smaller housing. Larger cores mean more structural housing expenses.¶ While the Pebel Bed Modular Reactor has a relatively simple core design, the actual core is quite large, because of the cooling inefficiency of helium. Thus, the simplisity of the PBMR core is ballanced by its size, its total materials input, and the size of its housing. The large core and housing requirements of the PBMR also adds to its labor costs, especially its field labor cost. Thus while the simplisity of the PBMR core design would seem to suggest a low cost, this expectation is unlikely to br born out in practice.¶ Transportation limits ability to shift production from the field to the factory. An analysis preformed by the University of Tennessee's, and the Massachusettes Institute of Technology's Departments of Nuclear Engineering looked at the 335 MW Westinghouse IRIS reactor. The analysis found,¶ A rough estimate of the weight for a 1000 MWt modular reactor and its secondary system, similar to the Westinghouse IRIS plant, is taken as the summation of all of the major components in the analysis. Many of the smaller subcomponents have been neglected. The containment structure contributes ~2.81E6 kg (3100 tons). The primary reactor vessel and the turbo-generator contribute ~1.45E6 kg (1600 tons) each. The heat exchange equipment and piping contribute ~6.78E5 kg (747 tons). Therefore, the total weight of the major plant components is~ 6.39E6 kg (7047 tons).¶ The weight and width of the IRIS would place constraints of barge transportation of the IRIS on the Tennessee and Ohio Rivers. The report stated,¶ The Westinghouse barge mounted IRIS reactor modules were limited in size based on input from the University of Tennessee. The barge dimension limitations were established to be 30 meters (98’-5”) wide, 100 meters (328’-1”) long, with a 2.74 meter (9’) draft. These dimensions establish the barge maximum displacement at 8,220 metric tons. In addition, the barge(s) are limited to ~20 meters (65’-7”) in height above the water surface, so that they fit under crossing bridges and can be floated up the Mississippi, Ohio, and Tennessee Rivers as far as the city of Chattanooga, Tennessee. Further movement above Chattanooga is currently limited by the locks at the Chickamauga Reservoir dam.¶ The above barge displacement limitation will impose severe limits on how much structural support and shield concrete can be placed in the barge modules at the shipyard. For example, the estimated weight of concrete in the IRIS containment and the surrounding cylindrical shield structure alone greatly exceeds the total allowable barge displacement. This however does not mean that barge- mounted pressurized water reactors (PWRs) are not feasible. It does mean that barge-mounted PWRs need to employ steel structures that are then used as the forms for the addition of needed concrete after the barge has been floated into its final location and founded.¶ Thus for the IRIS, barge transportation presented problems, and rail transportation was unthinkable. The core of the 125 MW B&W mPower reactor is rail transportable, but final onsite mPower assembly/construction became a significant undertaking, with a consequent increase in overall cost. The core unit does include a pressure vessel and heat exchange mounted above the actual reactor, but many other mPower component modules must be transported seperately and assembled on site.¶ The IIRIS project demonstrates the unlikelihood of whole small reactors being transported to the field ready for energy production without some field construction. This might be possible, however, for mini reactors that are two small to be viewed as a plausible substitute for the fossil fuel powered electrical plants currently supplying electricity for the grid. This then leaves us with¶ with a gap between the cost savings potential of factory manufacture, and the costly process of onsite assembly. B&W the manufacturers of the small 125 MW MPower reactor still has not clarified what percentage of the manufacturing process would be factory based. It is clear, however that B&W knows where it is comming from and what its problems are, as Rod Adams tells us:¶ I spoke in more detail to Chris Mowry and listened as he explained how his company's research on the history of the nuclear enterprise in the US had revealed that 30% of the material and labor cost of the existing units came from the supplied components while 70% was related to the site construction effort. He described how the preponderance of site work had influenced the cost uncertainty that has helped to discourage new nuclear plant construction for so many years.¶ What Mowey did not tell Adams is what percentage of the materials and labor costs will be shifted to the factory as mPower reactors are produced. There have been hints that a significant percentage of the mPower manufacturing process, perhaps as much as 50% will still take place on site. B&W still is working on the design of their manufacturing process, and thus do not yet know all of the details. Clearly then more work needs to be done on controlling onsite costs.¶ Finally, a shift to advanced technology will can lower manufacturing costs. Compared to Light Water reactors, Liquid metal cooled reactors use less material and perhaps less labor, but pool type liqiod metal reactors are not compact. Compared to Liquid Metal cooled reactors, Molten Salt cooled reactor will have more compact cores. Shifting to closed cycle gas turbines will decrease construction costs. The added safety of Molten Salt cooled reactors will increase reactor simplification, and thus further lower labor and materials related construction costs.¶ The recycling of old power plant locations will also offer some savings. Decreasing manufacturing time will lower interest costs. ¶ All in all there are a lot of reasons to expect lower nuclear manufacturing costs with Generation IV nuclear power plants, and at present no one has come up with a good reason for expecting Molten Salt cooled reactors to cost more than traditional NPPs. The argument, however, is not iron clad. Even if no one has pointed out plasuible errors in it, we need to introduce the caviot that expectations frenquently are not meet. It is possible, for example that the NRC might impose unreasonable expectations on molten salt cooled reactors. Demanding, for example, that they include the same safety features as LWRs, even though they do not have many LWR safety problems. But the potential savings on the cost of energy by adopting molten salt nuclear technology is substantial, and should not be ignored. ¶ To return to the problem posed by Brian Wang, the problem of lower Asian nuclear construction costs. If Europe and the United States cannot meet the Asican energy cost challenge, their economies will encounter a significant decline. Because of Labor cost advantages, it is unlikely that Generation III nuclear plants will ever cost less to build in the United States or Europe than in Asia. in order to keep the American and European economies competitive, the United States and Europe must adopt a low cost, factory manufactured nuclear technology. Molten Salt nuclear technology represents the lowest cost approach, and is highly consistent with factory manufacture and other cost lowering approaches. Couple to that the outstanding safety of molten salt nuclear technology, the potential for dramatically lowering the creation of nuclear waste, and the obsticles to nuclear proliferation posed by molten salt nuclear rechnology, and we see a real potential for keeping the American and European economies competitive, at least as far as energy costs are concerned.

#### And that prevents multiple flashpoints for nuclear war

Friedberg and Schoenfeld 8 (“The Dangers of a Diminished America” October 21, 2008, <http://online.wsj.com/article/SB122455074012352571.html>, Mr. Friedberg is a professor of politics and international relations at Princeton University's Woodrow Wilson School. Mr. Schoenfeld, senior editor of Commentary, is a visiting scholar at the Witherspoon Institute in Princeton, N.J.)

One immediate implication of the crisis that began on Wall Street and spread across the world is that the primary instruments of U.S. foreign policy will be crimped. The next president will face an entirely new and adverse fiscal position. Estimates of this year's federal budget deficit already show that it has jumped $237 billion from last year, to $407 billion. With families and businesses hurting, there will be calls for various and expensive domestic relief programs. In the face of this onrushing river of red ink, both Barack Obama and John McCain have been reluctant to lay out what portions of their programmatic wish list they might defer or delete. Only Joe Biden has suggested a possible reduction -- foreign aid. This would be one of the few popular cuts, but in budgetary terms it is a mere grain of sand. Still, Sen. Biden's comment hints at where we may be headed: toward a major reduction in America's world role, and perhaps even **a new era of financially-induced isolationism**. Pressures to cut defense spending, and to dodge the cost of waging two wars, already intense before this crisis, are likely to mount. Despite the success of the surge, the war in Iraq remains deeply unpopular. Precipitous withdrawal -- attractive to a sizable swath of the electorate before the financial implosion -- might well become even more popular with annual war bills running in the hundreds of billions. Protectionist sentiments are sure to grow stronger as jobs disappear in the coming slowdown. Even before our current woes, calls to save jobs by restricting imports had begun to gather support among many Democrats and some Republicans. In a prolonged recession, gale-force winds of protectionism will blow. Then there are the dolorous consequences of a potential collapse of the world's financial architecture. For decades now, Americans have enjoyed the advantages of being at the center of that system. The worldwide use of the dollar, and the stability of our economy, among other things, made it easier for us to run huge budget deficits, as we counted on foreigners to pick up the tab by buying dollar-denominated assets as a safe haven. Will this be possible in the future? Meanwhile, traditional foreign-policy challenges are multiplying. The threat from al Qaeda and Islamic terrorist affiliates has not been extinguished. Iran and North Korea are continuing on their bellicose paths, while Pakistan and Afghanistan are progressing smartly down the road to chaos. Russia's new militancy and China's seemingly relentless rise also give cause for concern. **If America now tries to pull back** from the world stage, **it will leave a dangerous power vacuum.** The stabilizing effects of our presence in Asia, our continuing commitment to Europe, and our position as defender of last resort for Middle East energy sources and supply lines could all be placed at risk. In such a scenario there are shades of the 1930s, when global trade and finance ground nearly to a halt, the peaceful democracies failed to cooperate, and aggressive powers led by the remorseless fanatics who rose up on the crest of economic disasterexploited their divisions. **Today we run the risk that rogue states may choose to become ever more reckless with their nuclear toys, just at our moment of maximum vulnerability.**

**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 fundamentals 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.

#### The status quo guarantees 4C warming – limiting warming to 2C is key to solve – adaptation above this threshold is impossible

Washington Post citing the World Bank 11/19 (environmental journalist Brad Plumer, referencing a recent study by the World Bank, 11/19/12 “We’re on pace for 4°C of global warming. Here’s why that terrifies the World Bank.” http://www.washingtonpost.com/blogs/wonkblog/wp/2012/11/19/were-on-pace-for-4c-of-global-warming-heres-why-the-world-bank-is-terrified/)

Over the years at the U.N. climate talks, the goal has been to keep future global warming below 2°C. But as those talks have faltered, emissions have kept rising, and that 2°C goal is now looking increasingly out of reach. Lately, the conversation has shifted toward how to deal with 3°C of warming. Or 4°C. Or potentially more. And that topic has made a lot of people awfully nervous. Case in point: The World Bank just commissioned an analysis (pdf) by scientists at the Potsdam Institute looking at the consequences of a 4°C rise in global temperatures above pre-industrial levels by 2100. And the report appears to have unnerved many bank officials. “The latest predictions on climate change should shock us into action,” wrote World Bank President Jim Yong Kim in an op-ed after the report was released Monday. So what exactly has got the World Bank so worried? Partly it’s the prospect that a 4°C world could prove difficult—perhaps impossible—for many poorer countries to adapt to. Let’s take a closer look at the report: 1) The world is currently on pace for around 3°C to 4°C of global warming by the end of the century. In recent years, a number of nations have promised to cut their carbon emissions. The United States and Europe are even on pace to meet their goals. But those modest efforts can only do so much, especially as emissions in China and India keep rising. Even if all current pledges get carried out, the report notes, ”the world [is] on a trajectory for a global mean warming of well over 3°C.” And current climate models still suggest a 20 percent chance of 4°C warming in this emissions scenario. 2) The direct consequences of a 4°C rise in global temperatures could be stark. Four degrees may not sound like much. But, the report points out, the world was only about 4°C to 7°C cooler, on average, during the last ice age, when large parts of Europe and the United States was covered by glaciers. Warming the planet up in the opposite direction could bring similarly drastic changes, such as three feet or more of sea-level rise by 2100, more severe heat waves, and regional extinction of coral reef ecosystems. 3) Climate change would likely hit poorer countries hardest. The World Bank focuses on poverty reduction, so its climate report spends most of its time looking at how developing countries could struggle in a warmer world. For instance, a growing number of studies suggest that agricultural production could take a big hit under 3°C or 4°C of warming. Countries like Bangladesh, Egypt, Vietnam, and parts of Africa would also see large tracts of farmland made unusable by rising seas. “It seems clear,” the report concludes, “that climate change in a 4°C world could seriously undermine poverty alleviation in many regions.” 4) Yet the effects of 4°C warming haven’t been fully assessed — they could, potentially, be more drastic than expected. Perhaps the most notable bit of the World Bank report is its discussion of the limits of current climate forecasts. Many models, it notes, make predictions in a fairly linear fashion, expecting the impacts of 4°C of warming to be roughly twice as severe as those from 2°C of warming. But this could prove to be wrong. Different effects could combine together in unexpected ways: For example, nonlinear temperature effects on crops are likely to be extremely relevant as the world warms to 2°C and above. However, most of our current crop models do not yet fully account for this effect, or for the potential increased ranges of variability (for example, extreme temperatures, new invading pests and diseases, abrupt shifts in critical climate factors that have large impacts on yields and/or quality of grains). What’s more, the report points out that there are large gaps in our understanding of what 4°C of warming might bring: “For instance,” it notes, “there has not been a study published in the scientific literature on the full ecological, human, and economic consequences of a collapse of coral reef ecosystems.” 5) Some countries might not be able to adapt to a 4°C world. At the moment, the World Bank helps many poorer countries build the necessary infrastructure to adapt to a warmer world. That includes dams and seawalls, crop research, freshwater management, and so forth. But, as a recent internal review found, most of these World Bank efforts are focused on relatively small increases in temperature. This new World Bank report is less sure how to prepare for a 4°C world. “[G]iven that uncertainty remains about the full nature and scale of impacts, there is also no certainty that adaptation to a 4°C world is possible.” That’s why, the report concludes, “The projected 4°C warming simply must not be allowed to occur — the heat must be turned down. Only early, cooperative, international actions can make that happen.” So what sorts of actions might that entail? The International Energy Agency recently offered its own set of ideas for curbing greenhouse-gas emissions and keeping future warming below 2°C. That included everything from boosting renewable energy to redesigning the world’s transportation system. But so far, nations have only made small progress on most of these steps.

#### We’ve approached the tipping point – limiting warming to 2C requires a shift to nuclear power now

The Smithsonian 12/16 (2012, Joseph Stromberg, science writer, “Climate Change Tipping Point: Research Shows That Emission Reductions Must Occur by 2020”)

For years, most of us have envisioned climate change as a long-term problem that requires a long-term solution. But as the years pass—and with the calendar soon to flip over to 2013—without any substantial attempts to cut greenhouse gas emissions worldwide, this impression needs to change in a hurry.According to a new paper published today in the journal Nature Climate Change, there’s a startlingly small number we need to keep in mind when dealing with climate change: 8. That’s as in 8 more years until 2020, a crucial deadline for reducing global carbon emissions if we intend to limit warming to 2°C, according to a team of researchers from a trio of research institutions—the International Institute for Applied Systems Analysis and ETH Zurich in Switzerland, along with the National Center for Atmospheric Research in Boulder, Colorado—who authored the paper. They came to the finding by looking at a range of different scenarios for emissions levels in 2020 and projecting outward how much warming each one would cause for the planet as a whole by the year 2100. They found that in order to have a good chance at holding long-term warming to an average of 2°C worldwide—a figure often cited as the maximum we can tolerate without catastrophic impacts—annual emissions of carbon dioxide (or equivalent greenhouse gas) in 2020 can be no higher than 41 to 47 gigatons worldwide. That’s a problem when you consider the fact that we’re currently emitting 50 gigatons annually; if present trends continue, that number will rise to 55 gigatons by 2020. In other words, unless we want catastrophic levels of warming, we need to do something, quickly. The researchers also weighed a number of technological approaches that could help us bring this figure down by 2020: **mass conversion to nuclear power generation**, rapid adoption of energy-efficient appliances and buildings, electric vehicle usage and other means of reducing fossil fuel use. “We wanted to know what **needs to be done by 2020 in order to be able to keep global warming below two degrees Celsius for the entire twenty-first century,**” said Joeri Rogelj, the lead author of the paper, in a statement.

#### It’s try or die – absent nuclear it’s impossible to solve the threshold – renewables alone can’t even come close

Kirsch 9 (Steve, August 18, 2009, consultant on climate change and technology with a Bachelors and Masters in Electrical Engineering and Computer Science from the Massachusetts Institute of Technology, “Add a Gigawatt a Day to Keep the Climate Crisis at Bay” <http://www.huffingtonpost.com/steve-kirsch/add-a-gigawatt-a-day-to-k_b_261728.html>)

You'd think that after all the press coverage that global warming has received that the public would be pretty well educated on exactly how fast we need to install clean power to avert an irreversible climate disaster. But the public has no clue. As far as I know, only one member of the press has asked the right questions to figure it out: Joshua Green, a senior editor of The Atlantic Monthly. Green wrote a great piece in the current issue entitled "The Elusive Green Economy." It's long but it's a great read. Green points out that the IPCC set 450ppm as a level we shouldn't exceed because otherwise climate change becomes both irreversible and catastrophic. But at the very end of his article is the real gem: he points out that we need to develop 13,000 GWe of carbon-free power (within the next 25 years) if we're to limit atmospheric carbon concentration to 450 ppm. Australian climate scientist Barry Brook was kind enough to double check the math and came up with a similar figure. I also ran it by a top scientist at DOE and he didn't even raise an eyebrow when I quoted that figure. It is also about the same as the 11,500 GWe that Saul Griffith derived. Green next points out that current global solar-power production today is only 10 GWe. In fact, in 2008, the peak solar capacity was 13.4GWe, but the average powered delivered was only 2 GWe. Yikes! That's about the capacity of a *single* nuclear plant. Compare that 2 GWe to the 13,000 GWe we need and you get a sense for the magnitude of the task ahead of us. The point is this: after decades of installing renewable power, we are nowhere close to making a small dent in the problem. In other words, if we think we are going to make the goal from solar, wind, and other renewables alone, we must be smoking something. And even if we added the big elephant of clean power, nuclear power, which can be installed in huge capacities relatively quickly when the political winds are blowing in the right direction, this is still an almost insurmountable goal. That's why at the Aspen Energy Forum held earlier this year, all of the renewable experts agreed that every clean power technology, including nuclear, has to play a role in solving the climate crisis. I'd like to give you a sense for what that 13,000 GWe figure means. Let's be generous and assume we have 30 years to install the 13,000 GWe of power we need. If we were to build a large nuclear plant every single day for the next 30 years, that would still not be enough to avert the 450ppm limit. Without nuclear as part of the mix, it's even harder and it's also a lot more expensive to meet the goal. We would have to be installing more than 1,500 large (2 MW, with enormous 100m diameter blades) wind turbines every day for 30 years. If we used desert-based concentrated solar thermal (which is much more efficient than solar photovoltaic), we'd have to install 80,000 huge 37 foot diameter dishes covering over 100 square miles every day for 30 years. Or some combination of those two. And then we'd have to cost-effectively store a lot of that power and deliver it when it is needed so you have reliable base load power all without generating any CO2 emissions. Storage is less of a problem with wind if you have a huge geographic area (which we have in the US), you massively overbuild to account for the unpredictability of wind, and you have a national transmission grid so you can move huge amounts of power when and where it is needed (which we don't have). And even with all of that in place, it's still not a guarantee that you won't have power outages when the wind is particularly low. With solar, to supply base load power, you'd need something like what Ausra is doing where they store power for up to 16 hours. Andasol uses such a thermal storage system and its electricity will cost 38 cents per kWh to produce, which makes it nearly 10 times more expensive than nuclear or coal.

#### 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.

#### 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.

#### DOE approved half-the-cost of initial reactors in November and Obama has taken credit – takes out any perception or funding disads

Koch 11/27 (USA Today, 11/27/12, Wendy Koch, covers Congress for USA Today since 1998. Former investigative reporter and diplomatic correspondent for Hearst Newspapers, and foreign policy writer for the U.S. Voice of America, master's degree, magna cum laude, from Georgetown University's School of Foreign Service, “Nuclear industry looks toward smaller reactors” http://www.usatoday.com/story/news/nation/2012/11/26/nuclear-small-modular-reactors/1727001/)

These small modular reactors (SMRs), about a third the physical size of traditional ones, would be portable and built mostly in factories. They got a boost last week from the Department of Energy, which announced it would pay up to half the cost to design and license the first ones for the U.S. commercial market. "It (DOE funding) lets us put our foot on the accelerator," says Christopher Mowry of Babcock & Wilcox, an energy technology company based in Charlotte, that's been working on the "mPower" design for four years with the Tennessee Valley Authority and Bechtel International. He plans to submit it to the Nuclear Regulatory Commission in mid-2014, aiming for approval in 2017 and construction of up to four reactors at TVA's Clinch River Site in Oak Ridge, Tenn., by October 2021. Citing nuclear energy as "low carbon," Energy Secretary Steven Chu said the award is part of President Obama's push for a broad, "all-of-the-above" energy strategy that reduces greenhouse gas emissions. Chu said DOE will accept funding requests from other companies developing small modular reactors. The B&W one won't come cheap. Mowry expects it will cost more than $1 billion to develop it, of which up to 75% will be spent on design and licensing. Yet he and other advocates say SMRs cost less to build, improve safety and offer flexibility. They say these reactors could be made in U.S. factories and moved, or exported, to remote or small sites that cannot support large reactors.

**Plan solves commercialization**

**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.**

**Solves 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 are key to solve global resource and prolif problems and can be built in 2 years

**Silverstein 1/15** (Ken– Editor-In-Chief for Energy Central's EnergyBiz Insider, research focus in economics and energy policy, MBA, MA “After Fukushima, U.S. Seeks to Advance Small Nuclear Reactors,” 1/15/12, http://www.forbes.com/sites/kensilverstein/2013/01/15/after-fukushima-u-s-seeks-to-advance-small-nuclear-reactors/)

Smaller reactors, though, have a place: They might not only serve niche markets but they could also replace at least some of those bigger and more centralized nuclear generation. The right-sized reactors are expected to operate at high efficiencies and to have built-in advantages, ultimately giving those investments a respectable return. Such units, for example, generally come with a nuclear waste storage containment device. The facilities could also be used to create drinkable water supplies in those countries where such a resource is in short supply. According to the Sandia National Laboratory, these smaller reactors would be factory built and mass-assembled, with potential production of 50 a year. They would all have the exact same design, allowing for easier licensing and deployment than large-scale facilities. Mass production will keep the costs down to between $250 million and $500 million per unit. “This small reactor … could supply energy to remote areas and developing countries at lower costs and with a manufacturing turnaround period of two years as opposed to seven for its larger relatives,” says Tom Sanders, who has been working with Sandia. “It could also be a more practical means to implement nuclear base-load capacity comparable to natural gas-fired generating stations and with more manageable financial demands than a conventional power plant.” In the case of Sandia, the right-sized reactors would generate their own fuel as they operate. They are designed to have an extended operational life and would only need to be refueled a few times during its projected 60-year lifespan. At the same time, the reactor system would have no need for fuel handling, all of which helps to alleviate proliferation concerns. Conventional nuclear power plants in the U.S. have their reactors refueled once every 18 to 24 months.

#### 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.

#### 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

#### \*\*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

#### \*\*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?