### Plan

Plan: The Department of Defense should initiate power-purchase agreements of Small Modular Reactors in the United States.

### Advantage 1 is Warming

#### Coal is increasing globally now- only nuclear solves warming

Tat ‘12 (Chee Hong Tat, Chief Executive, Energy Market Authority of Singapore, “Singapore International Market Week Publication”, “SECURING OUR ENERGY FUTURE APRIL 2012”, LEQ)

Nuclear Faces The Long Road Back For the nuclear industry, recovery will depend on turning around public opinion u For the nuclear industry, Fukushima will stand as the fault line dividing two eras. Before the catastrophic events of March 2011, nuclear energy had been reborn as the clean energy of choice, having emerged from decades as the pariah of the energy family. But the earthquake and tsunami that ripped through the Fukushima Daiichi nuclear power plant changed all of that, radically altering the energy landscape. For the atomic energy sector, it will be a long, hard and expensive road back. "Since the Fukushima disaster in Japan, the EU has begun to carry out comprehensive stress tests at its nuclear power plants," European Commissioner for Energy Mr GÜnther Oettinger said in a video pre- recorded for the Singapore International Energy Week (SIEW) 2011. "It [also] aims to put in place the most advanced legal framework for the sustainable use of nuclear energy." If anything, the Fukushima disaster has shown that nuclear power cannot operate in isolation, requiring instead a comprehensive and global approach to safety. "To strengthen nuclear safety world- wide, we would welcome other countries operating nuclear power plants to carry out similar assessments as soon as pos- sible," Mr Oettinger added. The International Energy Agency (IEA) has painted a gloomy picture of a world with what it calls a "low nuclear case". A reduced nuclear output will lead to "increased import bills, heightened energy security concerns, and make it harder and more expensive to combat climate change." In the immediate aftermath of the Fukushima disaster, Germany, Europe's biggest economy, closed eight of its 17 reactors permanently. It later formally announced plans to shut down its nuclear programme within 11 years. While nuclear has made a muted comeback since Fukushima – the US recently reaffirmed its commitment to nuclear by opening two new nuclear units, the first in 15 years, experts see continuing challenges that will make it very difficult for the nuclear power industry to expand beyond a small handful of reactor projects. China promises that nuclear can be made safer. In particular, its research into safer thorium fuel cycle technology has been applauded by the nuclear lobby. Despite this, experts say nuclear programmes worldwide are set to contract rather than expand. The low nuclear case foresees the total amount of nuclear power capacity fall- ing from 393GW at the end of 2010 to 335GW in 2035, a little more than half the levels previously set out in IEA's New Policies Scenario. New Policies Scenario The share of nuclear power in total gen- eration will drop from 13 per cent in 2010 to just seven per cent in 2035, with implications for energy security, diversity of the fuel mix, spending on energy imports, and energy-related CO2 emissions. "It is clear now that without nuclear, we cannot meet CO2 reduction targets," said IEA's former Executive Director, Mr Nobuo Tanaka, when he opened SIEW 2011 with his keynote lecture. Or, as the agency’s Chief Economist, Dr Fatih Birol, posits – make power in general "viciously more expensive" and close the door to 2°C forever. A shift away from nuclear power "would definitely be bad news for energy security, for climate change and also for the eco- A shift away from nuclear power would definitely be bad news for energy security, for climate change, and also for the economics of the electricity price nomics of the electricity price," he added. Research into small modular reactors (SMR) is still in its infancy although the reduced cost of a 10MW modular unit that could power about 7,000 homes, compared with the one million homes from a conven- tional reactor, is receiving attention. ThE EvEr- ShriNkiNG piE The drastically-altered landscape can be seen in IEA projections for nuclear. Under its 2010 outlook, there was to be a 90 per cent increase in nuclear capacity. This compares with its latest projection of 60 per cent for the same period from 2011. While there will now be heavy reliance on the lighter emissions of gas to meet green house targets, the nuclear disaster has been an unexpected fillip for the renewables and alternative energy sector. The rise was driven by the solar power industry, where the value of transac- tions jumped by 56 per cent to $15.8 billion, to account for almost one-third of take-overs, according to advisory firm PricewaterhouseCoopers. Nevertheless, analysts say any surge in renewable energy is likely to be eclipsed by a return to coal, with a powerfully negative effect on CO2 emissions. Even before the Japanese earthquake, the nuclear industry was struggling. Weak power demand due to the reces-sion and cheaper alternatives such as gas and coal made it difficult to justify the hefty investment in reactors. Only those plants with strong government backing were going ahead. With nuclear-agnostic countries dropping plans for civil nuclear indus- tries, China remains the last hope of the beleaguered sector. While China froze approvals of new nuclear plants follow- ing Fukushima, it has already restarted its programme and the country is set to dominate the nuclear landscape. The PRC's 2020 target of reaching 80,000MW of nuclear capacity, from 10,000MW last year, may have been reduced due to delays caused by Fukush- ima. Nevertheless, its ambitious projects are putting most of the other countries' nuclear plans in the shade. Meanwhile, other emerging econo- mies, including India and the United Arab Emirates, are also planning signifi- cant investments in new reactors. Nuclear’s share of electricity generation is also likely to slip as other forms of generation grow more quickly. In the developed world, the emphasis is on finding alternatives to nuclear power. In Japan, which derived some 30 per cent of its electricity from nuclear power plants prior to Fukushima, efforts to regain public support for restarting the re- actors have made little headway. Since the tsunami, 52 out of the nation's 54 reactors have been offline as of March 2012. One important litmus of the industry's health has been companies that service the nuclear energy marketplace. They, too, have been repositioning themselves in an increasingly unattractive market. Shaw, the US civil engineering com- pany, has sold its 20 per cent stake in nuclear engineering group Westinghouse Electric Company to Toshiba of Japan. Toshiba, for its part, plans to sell the holding to another investor. General Electric, the US industrial group that is one of the world's lead- ing nuclear engineers through its joint venture with Hitachi of Japan, has said it does not hold out much hope for market growth in the immediate future. It now expects nuclear power to decline in importance as other parts of the business grow more rapidly.

#### SMR’s are the vital internal link into jump-starting the industry- DOD solves stigma and market barriers

Loudermilk and Andres ’10 (Richard B. Andres is a Senior Fellow at the Institute for National Strategic Studies at National Defense University and a Professor of National Security Strategy at the National War College, Micah J. Loudermilk is a researcher at the Institute for National Strategic Studies at National Defense University, “Small Reactors and the Military's Role in Securing America's Nuclear Industry”, <http://sitrep.globalsecurity.org/articles/100823646-small-reactors-and-the-militar.htm>, April 23, 2010, LEQ)

Faced with the dual-obstacles of growing worldwide energy demand and a renewed push for clean energy, the stage is set for a vibrant revival of the nuclear power industry in the United States. During his 2008 campaign, President Barack Obama committed to setting the country on the road to a clean, secure, and independent energy future - and nuclear power can play a vital role in that. With abundant energy resources available and near-zero emission levels, nuclear power offers a domestically-generated, clean, and long-term solution to America's energy dilemma. While countries around the world are building new reactors though, the U.S. nuclear power industry has remained dormant - and even borders on extinction - as no new plants have been approved for construction in the more than three decades following the Three Mile Island accident in 1979. Although Congress and the Executive Branch have passed laws and issued proclamations over the years, little actual progress has been made in the nuclear energy realm. A number of severe obstacles face any potential entrant into the reactor market - namely the Nuclear Regulatory Commission (NRC), which lacks the budget and manpower necessary to seriously address nuclear power expansion. Additionally, public skepticism over the safety of nuclear power plants has impeded serious attempts at new plant construction. However, despite the hurdles facing private industry, the U.S. military is in a position to take a leading role in the advancement of nuclear reactor technology through the integration of small reactors on its domestic bases. While the Obama Administration has pledged $8 billion in federal loan guarantees to the construction of two new reactors in Georgia and an additional $36 billion in new guarantees to the nuclear industry, this comes on top of $18.5 billion budgeted, but unspent, dollars. Despite this aid, it is still improbable that the U.S. will see any new large reactors now or in the foreseeable future as enormous cost, licensing, construction, and regulatory hurdles must be overcome. In recent years though, attention in the nuclear energy sphere has turned in a new direction: small-scale reactors. These next-generation reactors seek to revolutionize the nuclear power industry and carry a host of benefits that both separate them from their larger cousins and provide a legitimate opportunity to successfully reinvigorate the American nuclear industry. When compared to conventional reactors, small reactors have a number of advantages. First, the reactors are both small and often scalable - meaning that sites can be configured to house one to multiple units based on power needs. Although they only exist on paper and the military has yet to embrace a size or design, the companies investing in these technologies are examining a range of possibilities. Hyperion, for example, is working on a so-called "nuclear battery" - a 25 MWe sealed and transportable unit the size of a hot tub. Similarly, Babcock & Wilcox - the company which built many of the Navy's reactors - is seeking licensing for its mPower reactor, which is scalable and produces 125 MWe of power per unit. Other designs, such as Westinghouse's International Reactor Innovative and Secure (IRIS) model, have a generating capacity of up to 335 MWe. Second, large reactors come with enormous price tags - often approaching $10 billion in projected costs. The costs associated with building new reactors are so astronomical that few companies can afford the capital outlay to finance them. Additionally, the risks classically associated with the construction of nuclear reactors serve as an additional deterrent to interested utilities. As a result, companies must be willing to accept significant financial risks since ventures could potentially sink them or result in credit downgrades - as evidenced by the fact that 40 of 48 utilities issuing debt to nuclear projects suffered downgrades following the accident at Three Mile Island. All of this adds up to an environment that is not conducive to the sponsorship of new reactor plants. On the other hand, small reactors are able to mostly circumvent the cost hurdles facing large reactors. During the construction of large reactors, utilities face "single-shaft risk" - forced to invest and tie up billions of dollars in a single plant. However, small reactors present the opportunity for utilities to buy and add reactor capacity as needed or in a step-by-step process, as opposed to an all-or-nothing approach. Small reactors are also factory-constructed and shipped, not custom-designed projects, and can be built and installed in half the time - all of which are cost-saving measures. Additionally, despite concerns from critics over the proliferation and safety risks that a cadre of small reactors would potentially pose, the reality is considerably different. On the safety side, the new designs boast a number of features - including passive safety measures and simpler designs, thus reducing the number of systems to monitor and potential for system failure, enhancing the safety of the reactors. Small reactors can often be buried underground, are frequently fully contained and sealed (complete with a supply of fuel inside), can run longer between refueling cycles, and feature on-site waste storage - all of which serve to further insulate and secure the units. Finally, due to their small size, the reactors do not require the vast water resources needed by large reactors and in the event of an emergency, are far easier to isolate, shut off, and cool down if necessary. Notwithstanding all of these benefits, with a difficult regulation environment, anti-nuclear lobbying groups, and skeptical public opinion, the nuclear energy industry faces an uphill - and potentially unwinnable - battle in the quest for new reactors in the United States. Left to its own devices it is unlikely, at best, that private industry will succeed in bringing new reactors to the U.S. on its own. However, a route exists by which small reactors could potentially become a viable energy option: the U.S. military. Since 1948, the U.S. Navy has deployed over 500 reactors and possesses a perfect safety record in managing them. At the same time, grave concern exists over the fact that U.S. military bases are tied to and entirely dependent upon the civilian electric grid - from which they receive 99% of their power. Recently, attention has turned to the fact that the civilian grid, in addition to accidents, is vulnerable to cyber or terrorist attacks. In the event of a deliberate attack on the United States that knocks out all or part of the electric grid, the assets housed at the affected bases would be unavailable and U.S. global military operations potentially jeopardized. The presence of small-scale nuclear reactors on U.S. military bases would enable these facilities to effectively become "islands" - insulating them from the civilian grid and even potentially deterring attacks if the opponent knows that the military network would be unaffected. Unlike private industry, the military does not face the same regulatory and congressional hurdles to constructing reactors and would have an easier time in adopting them for use. By integrating small nuclear reactors as power sources for domestic U.S. military bases, three potential energy dilemmas are solved at the same time. First, by incorporating small reactors at its bases, the military addresses its own energy security quandary. The military has recently sought to "island" its bases in the U.S. -protecting them from grid outages, be they accidental or intentional. The Department of Defense has promoted this endeavor through lowering energy consumption on bases and searching for renewable power alternatives, but these measures alone will prove insufficient. Small reactors provide sufficient energy output to power military installations and in some cases surrounding civilian population centers. Secondly, as the reactors become integrated on military facilities, the stigma on the nuclear power industry will ease and inroads will be created for the adoption of small-scale reactors as a viable source of energy. Private industry and the public will see that nuclear reactors can indeed be utilized safely and effectively, resulting in a renewed push toward the expansion of nuclear power. Although many of the same hurdles will still be in place, a shift in public opinion and a stronger effort by utilities, coupled with the demonstrated success of small reactors on military bases, could prove the catalysts necessary for the federal government and the NRC to take more aggressive action. Finally, while new reactors are not likely in the near future, the military's actions will preserve, for a while longer, the badly ailing domestic nuclear energy industry. Nuclear power is here to stay around the globe, and the United States has an opportunity to take a leading role in supplying the world's nuclear energy and reactor technology. With the U.S. nuclear industry dormant for three decades, much of the attention, technology, and talent have concentrated overseas in countries with a strong interest in nuclear technology. Without the United States as a player in the nuclear energy market, it has little say over safety regulations of reactors or the potential risks of proliferation from the expansion of nuclear energy. If the current trend continues, the U.S. will reach a point where it is forced to import nuclear technology and reactors from other countries. Action by the military to install reactors on domestic bases will both guarantee the survival of the American nuclear industry in the short term, and work to solidify support for it in the long run. Ultimately, between small-scale nuclear reactors and the U.S. military, the capability exists to revitalize America's sleeping nuclear industry and promoting energy security and clean energy production. The reactors offer the ability to power domestic military bases, small towns, and other remote locations detached from the energy grid. Furthermore, reactor sites can house multiple units, allowing for greater energy production - rivaling even large reactors. Small reactors offer numerous benefits to the United States and a path initiated by the military presents a realistic route by which their adoption can be achieved.

#### SMR’s 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, LEQ)

Economies of Scale Reversed? Safety aside, one of the biggest issues associated with reactor construction is their enormous costs—often approaching up to $10 billion apiece. The outlay costs associated with building new reactors are so astronomical that few companies can afford the capital required to finance them. Additionally, during the construction of new reactors, a multi-year process, utilities face “single-shaft risk”—forced to tie up billions of dollars in a single plant with no return on investment until it is complete and operational. When this is coupled with the risks and difficulties classically associated with reactor construction, the resulting environment is not conducive to the sponsorship of new plants. Conventional wisdom says that SMRs cannot be cost-competitive with large reactors due to the substantial economies of scale loss transitioning down from gigawatt-sized reactors to ones producing between 25MW and 300 MW, but, a closer examination may result in a different picture. To begin with, one of the primary benefits of SMRs is their modularity. Whereas conventional reactors are all custom-designed projects and subsequently often face massive cost overruns, SMRs are factory-constructed—in half the time of a large reactor—making outlay costs largely fixed. Moreover, due to their scalability, SMRs at a multi-unit site can come online as installed, rather than needing to wait for completion of the entire project, bringing a faster return on invested capital and allowing for capacity additions as demand increases over time. Other indirect cost-saving measures further increase the fiscal viability of small nuclear reactors. Due to the immense power output of conventional reactors, they also require special high-power transmission lines. In contrast, small reactor output is low enough to use existing transmission lines without overloading them. This allows for small reactors to serve as “drop-in” replacements at existing old fossil fuel-based power plants, while utilizing the transmission lines, steam turbines, and other infrastructure already in place. In fact, the Tennessee Valley Authority (TVA) hopes to acquire two Babcock & Wilcox small reactors for use in this manner—perhaps precipitating a movement whereby numerous fossil fuel plants could be converted. 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. While this is not to say that small reactors should supplant large ones, the US would benefit from diversification and expansion of the nation’s nuclear energy portfolio. Path forward: Department of Defense as first-mover Problematically, despite the immense energy security benefits that would accompany the wide-scale adoption of small modular reactors in the US, with a difficult regulatory environment, anti-nuclear lobbying groups, skeptical public opinion, and of course the recent Fukushima accident, the nuclear industry faces a tough road in the battle for new reactors. While President Obama and Energy Secretary Chu have demonstrated support for nuclear advancement on the SMR front, progress will prove difficult. However, a potential route exists by which small reactors may more easily become a reality: the US military. The US Navy has successfully managed, without accident, over 500 small reactors on-board its ships and submarines throughout 50 years of nuclear operations. At the same time, serious concern exists, highlighted by the Defense Science Board Task Force in 2008, that US military bases are tied to, and almost entirely dependent upon, the fragile civilian electrical grid for 99% of its electricity consumption. To protect military bases’ power supplies and the nation’s military assets housed on these domestic installations, the Board recommended a strategy of “islanding” the energy supplies for military installations, thus ensuring their security and availability in a crisis or conflict that disrupts the nation’s grid or energy supplies. DOD has sought to achieve this through decreased energy consumption and renewable technologies placed on bases, but these endeavors will not go nearly far enough in achieving the department’s objectives. However, by placing small reactors on domestic US military bases, DOD could solve its own energy security quandary—providing assured supplies of secure and constant energy both to bases and possibly the surrounding civilian areas as well. Concerns over reactor safety and security are alleviated by the security already present on installations and the military’s long history of successfully operating nuclear reactors without incident. Unlike reactors on-board ships, small reactors housed on domestic bases would undoubtedly be subject to Nuclear Regulatory Commission (NRC) regulation and certification, however, with strong military backing, adoption of the reactors may prove significantly easier than would otherwise be possible. Additionally, as the reactors become integrated on military facilities, general fears over the use and expansion of nuclear power will ease, creating inroads for widespread adoption of the technology at the private utility level. Finally, and perhaps most importantly, action by DOD as a “first mover” on small reactor technology will preserve America’s badly struggling and nearly extinct nuclear energy industry. The US possesses a wealth of knowledge and technological expertise on SMRs and has an opportunity to take a leading role in its adoption worldwide. With the domestic nuclear industry largely dormant for three decades, the US is at risk of losing its position as the global leader in the international nuclear energy market. If the current trend continues, the US will reach a point in the future where it is forced to import nuclear technologies from other countries—a point echoed by Secretary Chu in his push for nuclear power expansion. Action by the military to install reactors on domestic bases will guarantee the short-term survival of the US nuclear industry and will work to solidify long-term support for nuclear energy. Conclusions In the end, small modular reactors present a viable path forward for both the expansion of nuclear power in the US and also for enhanced US energy security. Offering highly safe, secure, and proliferation-resistant designs, SMRs have the potential to bring carbon-free baseload distributed power across the United States. Small reactors measure up with, and even exceed, large nuclear reactors on questions of safety and possibly on the financial (cost) front as well. SMRs carry many of the benefits of both large-scale nuclear energy generation and renewable energy technologies. At the same time, they can reduce US dependence on fossil fuels for electricity production—moving the US ahead on carbon dioxide and GHG reduction goals and setting a global example. While domestic hurdles within the nuclear regulatory environment domestically have proven nearly impossible to overcome since Three Mile Island, military adoption of small reactors on its bases would provide energy security for the nation’s military forces and may create the inroads necessary to advance the technology broadly and eventually lead to their wide-scale adoption.

**Other countries model our technology- global demonstration**

**Traub 12/14** (James, fellow of the Centre on International Cooperation. He writes Terms of Engagement for Foreign Policy,” “Transforming the future lies in our hands,” <http://gulfnews.com/opinions/columnists/transforming-the-future-lies-in-our-hands-1.1118704>, December 14, 2012)

**Despite** President Barack **Obama’s vow**, in his first post-reelection press conference, **to take** decisive **action** on climate change, the global climate talks in **Doha dragged to a close** with the US, as usual, a target of activists’ wrath. The Obama administration has shown no interest in submitting to a binding treaty on carbon emissions and refuses to increase funding to help developing countries reduce their own emissions, even as **the US continues to be**have as **a global scofflaw on climate** change. Actually, that is not true — the last part, anyway. According to the International Energy Agency, US emissions have dropped 7.7 per cent since 2006 — “the largest reduction of all countries or regions”. Yes, you read that correctly. The US, which has refused to sign the Kyoto Accords establishing binding targets for emissions, has reduced its carbon footprint faster than the greener-than-thou European countries. The reasons for this have something to do with climate change itself (warm winters mean less heating oil — something to do with market forces — the shift from coal to natural gas in power plants) and something to do with policy at the state and regional levels. And in the coming years, as both new gas-mileage standards and new power-plant regulations, championed by the Obama administration kick in, policy will drive the numbers further downwards. US emissions are expected to fall 23 per cent between 2002 and 2020. Apparently, Obama’s record on climate change is not quite as calamitous as reputation would have it. The West has largely succeeded in bending downwards the curve of carbon emissions. However, the developing world has not. Last year, China’s emissions rose 9.3 per cent; India’s, 8.7 per cent. China is now the world’s No 1 source of carbon emissions, followed by the US, the European Union (EU) and India. The emerging powers have every reason to want to emulate the energy-intensive economic success of the West — even those, like China, who have taken steps to increase energy efficiency, are not prepared to do anything to harm economic growth. The real failure of **US policy** has been, first, that it **is still much too timid**; **and** second, that it **has not acted** in such a way as **to persuade developing nations to** **take the** truly difficult decisions which would put the world on a **sustainable path**. There is a useful analogy with the nuclear nonproliferation regime. In an earlier generation, the nuclear stockpiles of the US and the Soviet Union posed the greatest threat to global security. Now, the threat comes from the proliferation of weapons to weak or rogue states or to non-state actors. However, the only way that Washington can persuade other governments to join in a tough nonproliferation regime is by taking the lead in reducing its own nuclear stockpile — which the Obama administration has sought to do, albeit with very imperfect success. In other words, where power is more widely distributed, **US action** matters less in itself, but **carries great weight as a demonstration model** — or anti-demonstration model. Logic would thus dictate that the US bind itself in a global compact to reduce emissions, as through the Nuclear Nonproliferation Treaty (NPT) it has bound itself to reduce nuclear weapons. However, the Senate would never ratify such a treaty. And even if it did, would China and India similarly bind themselves? Here the nuclear analogy begins to break down because the NPT mostly requires that states submit to inspections of their nuclear facilities, while a climate change treaty poses what looks very much like a threat to states’ economic growth. Fossil fuels are even closer to home than nukes. Is it any wonder that only EU countries and a few others have signed the Kyoto Accords? A global version of Kyoto is supposed to be readied by 2015, but a growing number of climate change activists — still very much a minority — accept that this may not happen and need not happen. So **what can Obama do**? It is possible that **much tougher action** on emissions **will help persuade China, India and others that energy efficiency need not hinder** economic **growth**. As Michael Levi, a climate expert at the Council on Foreign Relations points out, **the US gets little credit abroad for reducing emissions** largely — **thanks to “serendipitous” events**. Levi argues, as do virtually all policy thinkers and advocates, that the US must increase the cost of fossil fuels, whether through a “carbon tax” or cap-and-trade system, so that both energy efficiency and alternative fuels become more attractive and also to free-up money to be invested in new technologies. This is what Obama’s disappointed supporters thought he would do in the first term and urge him to do now. Obama is probably not going to do that. In his post-election news conference, he insisted that he would find “bipartisan” solutions to climate change and congressional Republicans are only slightly more likely to accept a sweeping change in carbon pricing than they are to ratify a climate-change treaty. The president also said that any reform would have to create jobs and growth, which sounds very much like a signal that he will avoid new taxes or penalties (even though advocates of such plans insist that they would spur economic growth). All these prudent political calculations are fine when you can afford to fail. But we cannot afford to fail. **Global temperatures** have already **increased 0.7 degrees** Celsius. **Disaster** really **strikes at** a **2** degree Celsius increase, which leads to large-scale drought, wildfires, decreased food production and coastal flooding. However, **the current** global **trajectory** of coal, oil and gas consumption **means** that, according to Fatih Birol, the International Energy Agency’s chief economist, “**the door to a 2 degree** Celsius **trajectory is about to close**.” That is how dire things are. What, then, can Obama do that is equal to the problem? He can invest. Once the fiscal cliff negotiations are behind him, and after he has held his planned conversation with “scientists, engineers and elected officials,” he can tell the **America**n people that they **have a once-in-a-lifetime opportunity to transform the future** — for themselves and for people everywhere. He can propose — as he hoped to do as part of the stimulus package of 2009 — that the US build a “smart grid” to radically improve the efficiency of electricity distribution. He can argue for large-scale investments in research and development of new sources of energy and energy-efficient construction technologies and lots of other whiz-bang things. This, too, was part of the stimulus spending; it must become bigger and permanent. The reason Obama should do this is, first, because the American people will (or could) rally behind a visionary programme in a way that they never will get behind the dour mechanics of carbon pricing. Second, because the way to get to a carbon tax is to use it as a financing mechanism for such a plan. Third, because oil and gas are in America’s bloodstream; as Steven Cohen, executive director of the Earth Institute, puts it: “**The only thing that’s going to drive fossil fuels off the market is cheaper renewable energy**.” Fourth, the US cannot afford to miss out on the gigantic market for green technology. Finally, there’s leverage. China and India may not do something sensible but painful, like adopting carbon pricing, because the US does so, but they **will adopt new tech**nologies **if the US can prove** that **they work** without harming economic growth. Developing countries have already made major investments in reducing air pollution, halting deforestation and practising sustainable agriculture. They are just too modest. It is here, above all, that **the US can serve as a demonstration model** — the world’s most egregious carbon consumer showing the way to a low-carbon future. Global warming-denial is finally on the way out. Three-quarters of Americans now say they believe in global warming and more than half believe that humans are causing it and want to see a US president take action. President Obama does not have to do the impossible. He must, however, do the possible.

#### It’s real and human-induced

-now is key

-AR4 = IPCC

Somerville 11 – Professor of Oceanography @ UCSD

Richard Somerville, Distinguished Professor Emeritus and Research Professor at Scripps Institution of Oceanography at the University of California, San Diego, Coordinating Lead Author in Working Group I for the 2007 Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 3-8-2011, “CLIMATE SCIENCE AND EPA'S GREENHOUSE GAS REGULATIONS,” CQ Congressional Testimony, Lexis

1n early 2007, at the time of the publication of WG1 of AR4, the mainstream global community of climate scientists already understood from the most recent research that the latest observations of climate change were disquieting. In the words of a research paper published at the same time as the release of AR4 WG1, a paper for which I am a co-author, "observational data underscore the concerns about global climate change. Previous projections, as summarized by IPCC, have not exaggerated but may in some respects even have underestimated the change" (Rahmstorf et al. 2007). Now, in 2011, more recent research and newer observations have demonstrated that climate change continues to occur, and in several aspects the magnitude and rapidity of observed changes frequently exceed the estimates of earlier projections, including those of AR4. In addition, the case for attributing much observed recent climate change to human activities is even stronger now than at the time of AR4. Several recent examples, drawn from many aspects of climate science, but especially emphasizing atmospheric phenomena, support this conclusion. These include temperature, atmospheric moisture content, precipitation, and other aspects of the hydrological cycle. Motivated by the rapid progress in research, a recent scientific synthesis, The Copenhagen Diagnosis (Allison et al. 2009), has assessed recent climate research findings, including: -- Measurements show that the Greenland and Antarctic ice-sheets are losing mass and contributing to sea level rise. -- Arctic sea-ice has melted far beyond the expectations of climate models. -- Global sea level rise may attain or exceed 1 meter by 2100, with a rise of up to 2 meters considered possible. -- In 2008, global carbon dioxide emissions from fossil fuels were about 40% higher than those in 1990. -- At today's global emissions rates, if these rates were to be sustained unchanged, after only about 20 more years, the world will no longer have a reasonable chance of limiting warming to less than 2 degrees Celsius, or 3.6 degrees Fahrenheit, above 19th-century pre-industrial temperature levels, This is a much- discussed goal for a maximum allowable degree of climate change, and this aspirational target has now been formally adopted by the European Union and is supported by many other countries, as expressed, for example, in statements by both the G-8 and G-20 groups of nations. The Copenhagen Diagnosis also cites research supporting the position that, in order to have a reasonable likelihood of avoiding the risk of dangerous climate disruption, defined by this 2 degree Celsius (or 3.6 degree Fahrenheit) limit, global emissions of greenhouse gases such as carbon dioxide must peak and then start to decline rapidly within the next five to ten years, reaching near zero well within this century.

#### Extinction- we’re on the tipping point

Dyer ‘12 -- London-based independent journalist, PhD from King's College London, citing UC Berkeley scientists (Gwynne, "Tick, tock to mass extinction date," The Press, 6-19-12, l/n, accessed 8-15-12, mss)

Meanwhile, a team of respected scientists warn that life on Earth may be on the way to an irreversible "**tipping point"**. Sure. Heard that one before, too. Last month one of the world's two leading scientific journals, Nature, published a paper, "Approaching a state shift in Earth's biosphere," pointing out that more than 40 per cent of the Earth's land is already used for human needs. With the human population set to grow by a further two billion by 2050, that figure could soon exceed 50 per cent. "It really will be a new world, biologically, at that point," said the paper's lead author, Professor Anthony Barnofsky of the University of California, Berkeley. But Barnofsky doesn't go into the details of what kind of new world it might be. Scientists hardly ever do in public, for fear of being seen as panic-mongers. Besides, it's a relatively new hypothesis, but it's a pretty convincing one, and it should be more widely understood. Here's how bad it could get. The scientific consensus is that we are still on track for 3 degrees C of warming by 2100, but that's just warming caused by human greenhouse- gas emissions. The problem is that +3 degrees is well past the point where the major feedbacks kick in: natural phenomena triggered by our warming, like melting permafrost and the loss of Arctic sea-ice cover, that will add to the heating and that we cannot turn off. The trigger is actually around 2C (3.5 degrees F) higher average global temperature. After that we lose control of the process: ending our own carbon- dioxide emissions would no longer be enough to stop the warming. We may end up trapped on an escalator heading up to +6C (+10.5F), with no way of getting off. And +6C gives you the **mass extinction**. There have been five mass extinctions in the past 500 million years, when 50 per cent or more of the species then existing on the Earth vanished, but until recently the only people taking any interest in this were paleontologists, not climate scientists. They did wonder what had caused the extinctions, but the best answer they could come up was "climate change". It wasn't a very good answer. Why would a warmer or colder planet kill off all those species? The warming was caused by massive volcanic eruptions dumping huge quantities of carbon dioxide in the atmosphere for tens of thousands of years. But it was very gradual and the animals and plants had plenty of time to migrate to climatic zones that still suited them. (That's exactly what happened more recently in the Ice Age, as the glaciers repeatedly covered whole continents and then retreated again.) There had to be a more convincing kill mechanism than that. The paleontologists found one when they discovered that a giant asteroid struck the planet 65 million years ago, just at the time when the dinosaurs died out in the most recent of the great extinctions. So they went looking for evidence of huge asteroid strikes at the time of the other extinction events. They found none. What they discovered was that there was indeed major warming at the time of all the other extinctions - and that the warming had radically changed the oceans. The currents that carry oxygen- rich cold water down to the depths shifted so that they were bringing down oxygen- poor warm water instead, and gradually the depths of the oceans became anoxic: the deep waters no longer had any oxygen. When that happens, the sulfur bacteria that normally live in the silt (because oxygen is poison to them) come out of hiding and begin to multiply. Eventually they rise all the way to the surface over the whole ocean, killing all the oxygen-breathing life. The ocean also starts emitting enormous amounts of lethal hydrogen sulfide gas that destroy the ozone layer and directly poison land- dwelling species. This has happened many times in the Earth's history.

#### Extinction will be rapid and quick

**Light 12** (Malcolm, PhD, University of London – Earth science and climate consultant, “Global Extinction within one Human Lifetime as a Result of a Spreading Atmospheric Arctic Methane Heat wave and Surface Firestorm,” http://arctic-news.blogspot.com/p/global-extinction-within-one-human.html)

Although the sudden high rate Arctic methane increase at Svalbard in late 2010 data set applies to only a short time interval, similar sudden methane concentration peaks also occur at Barrow point and the effects of a major methane build-up has been observed using all the major scientific observation systems. Giant fountains/torches/plumes of methane entering the atmosphere up to 1 km across have been seen on the East Siberian Shelf. This methane eruption data is so consistent and aerially extensive that when combined with methane gas warming potentials, Permian extinction event temperatures and methane lifetime data it paints a **frightening picture** of the beginning of the now **uncontrollable global warming** induced destabilization of the subsea Arctic methane hydrates on the shelf and slope which started in late 2010. This process of methane release will **accelerate exponentially**, release huge quantities of methane into the atmosphere and lead to the **demise** **of all life on earth** before the middle of this century. Introduction The 1990 global atmospheric mean temperature is assumed to be 14.49 oC (Shakil, 2005; NASA, 2002; DATAWeb, 2012) which sets the 2 oC anomaly above which humanity will lose control of her ability to limit the effects of global warming on major climatic and environmental systems at 16.49 oC (IPCC, 2007). The major Permian extinction event temperature is 80 oF (26.66 oC) which is a temperature anomaly of 12.1766 oC above the 1990 global mean temperature of 14.49 oC (Wignall, 2009; Shakil, 2005). Results of Investigation Figure 1 shows a huge sudden atmospheric spike like increase in the concentration of atmospheric methane at Svalbard north of Norway in the Arctic reaching 2040 ppb (2.04 ppm)(ESRL/GMO, 2010 - Arctic - Methane - Emergency - Group.org). The cause of this sudden anomalous increase in the concentration of atmospheric methane at Svalbard has been seen on the East Siberian Arctic Shelf where a recent Russian - U.S. expedition has found widespread, continuous powerful methane seepages into the atmosphere from the subsea methane hydrates with the methane plumes (fountains or torches) up to 1 km across producing an atmospheric methane concentration 100 times higher than normal (Connor, 2011). Such high methane concentrations could produce local temperature anomalies of more than 50 oC at a conservative methane warming potential of 25. Figure 2 is derived from the Svalbard data in Figure 1 and the methane concentration data has been used to generate a Svalbard atmospheric temperature anomaly trend using a methane warming potential of 43.5 as an example. The huge sudden anomalous spike in atmospheric methane concentration in mid August, 2010 at Svalbard is clearly evident and the methane concentrations within this spike have been used to construct a series of radiating methane global warming temperature trends for the entire range of methane global warming potentials in Figure 3 from an assumed mean start temperature of -3.575 degrees Centigrade for Svalbard (see Figure 2) (Norwegian Polar Institute; 2011). Figure 3 shows a set of radiating Arctic atmospheric methane global warming temperature trends calculated from the steep methane atmospheric concentration gradient at Svalbard in 2010 (ESRL/GMO, 2010 - Arctic-Methane-Emergency-Group.org). The range of extinction temperature anomalies above the assumed 1990 mean atmospheric temperature of 14.49 oC (Shakil, 2005) are also shown on this diagram as well as the 80 oF (26.66 oC) major Permian extinction event temperature (Wignall, 2009). Sam Carana (pers. com. 7 Jan, 2012) has described large December 2011 (ESRL-NOAA data) warming anomalies which exceed 10 to 20 degrees centigrade and cover vast areas of the Arctic at times. In the centres of these regions, which appear to overlap the Gakkel Ridge and its bounding basins, the temperature anomalies may exceed 20 degrees centigrade. See this site:<http://www.esrl.noaa.gov/psd/map/images/fnl/sfctmpmero1a30frames.fnl.anim.html> The temperature anomalies in this region of the Arctic for the period from September 8 2011 to October 7, 2011 were only about 4 degrees Centigrade above normal (Carana, pers. com. 2012) and this data set can be seen on this site: <http://arctic-newsblogspot.com/p/arctic-temperatures.html> Because the Svalbard methane concentration data suggests that the major spike in methane emissions began in late 2010 it has been assumed for calculation purposes that the 2010 temperature anomalies peaked at 4 degrees Centigrade and the 2011 anomalies at 20 degrees Centigrade in the Gakkel Ridge region. The assumed 20 degree Centigrade temperature anomaly trend from 2010 to 2011 in the Gakkel Ridge region requires a methane gas warming potential of about 1000 to generate it from the Svalbard methane atmospheric concentration spike data in 2010. Such high methane warming potentials could only be active over a very short time interval (less than 5.7 months) as shown when the long methane global warming potential lifetimes data from the IPCC (2007; 1992) and Dessus, Laponte and Treut (2008 ) are used to generate a global warming potential growth curve with a methane global warming potential of 100 with a lifespan of 5 years. Because of the high methane global warming potential (1000) of the 2011, 20 oC temperature anomalies in the Gakkel Ridge region, the entire methane global warming potential range from 5 to 1000 has been used to construct the radiating set of temperature trends shown in Figure 3. The 50, 100, 500 and 1000 methane global warming potential (GWP) trends are red and in bold. The choice of a high temperature methane peak with a global warming potential near 1000 is in fact very conservative because the 16 oC increase is assumed to occur over a year. The observed ESRL-NOAA Arctic temperature anomalies varied from 4 to 20 degrees over less than a month in 2011 (Sam Carana, pers. comm. 2012). […] . This very narrow temperature range includes all the mathematically and visually determined extinction times and their means for the northern and southern hemispheres which were calculated quite separately (Figure 7; Table 1). Once the world's ice caps have completely melted away at temperatures above 22.49 oC and times later than 2051.3, the Earth's atmosphere will heat up at an extremely fast rate to reach the Permian extinction event temperature of 80oF (26.66 oC)(Wignall, 2009) by which time **all life** on Earth **will have been completely extinguished**. The position where the latent heat of ice melting curve intersects the 8 oC extinction line (22.49 oC) at 2051.3 represents the time when 100 percent of all the ice on the surface of the Earth will have melted. If we make this point on the latent heat of ice melting curve equal to 1 we can determine the time of melting of any fraction of the Earth's icecaps by using the time\*temperature function at each time from 2051.3 back to 2015, the time the average Arctic atmospheric temperature curve is predicted to exceed 0 oC. The process of melting 1 kg of ice and heating the produced water up to a certain temperature is a function of the sum of the latent heat of melting of ice is 334 kilo Joules/kg and the final water temperature times the 4.18 kilo Joules/Kg.K (Wikipedia, 2012). This however represents the energy required over a period of one second to melt 1 kg of ice to water and raise it to the ambient temperature. Therefore the total energy per mass of ice over a certain time period is equal to (334 +(4.18\*Ambient Temperature)\*time in seconds that the melted water took to reach the ambient temperature. From the fractional time\*temperature values at each ambient temperature the fractional amounts of melting of the total global icecaps have been calculated and are shown on Figure 9. The earliest calculated fractional volume of melting of the global ice caps in 2016 is 1.85\*10^-3 of the total volume of global ice with an average yearly rate of ice melting of 2.557\*10^-3 of the total volume of global ice. This value is remarkably similar to, but slightly less than the average rate of melting of the Arctic sea ice measured over an 18 year period of 2.7\*10^-3 (1978 to 1995; 2.7% per decade - IPCC 2007).This close correlation between observed rates of Arctic ice cap and predicted rates of global ice cap melting indicates that average rates of Arctic ice cap melting between 1979 and 2015 (which represents the projected time the Arctic will lose its ice cover - Masters, 2009) will be continued during the first few years of melting of the global ice caps after the Arctic ice cover has gone in 2015 as the mean Arctic atmospheric temperature starts to climb above 0 oC. However from 2017 the rate of melting of the global ice will start to accelerate as will the atmospheric temperature until by 2049 it will be more than 9 times as fast as it was around 2015 (Table 2). The mean rate of melting of the global icecap between 2017 and 2049 is some 2\*10^-2, some 7.4 times the mean rate of melting of the Arctic ice cap (Table 2). In concert with the increase in rate of global ice cap melting between 2017 and 2049, the acceleration in the rate of melting also increases from 7\*10^-4 to 9.9\*10^-4 with a mean value close to 8.6\*10^-4 (Table 2). The ratio of the acceleration in the rate of global ice cap melting to the Arctic ice cap melting increases from 3.4 in 2017 to 4.8 by 2049 with a mean near 4.2. This fast acceleration in the rate of global ice cap melting after 2015 compared to the Arctic sea ice cap melting before 2015 is because the mean Arctic atmospheric temperature after 2017 is spiraling upward in temperature above 0 oC adding large amounts of additional energy to the ice and causing it to melt back more quickly. The melt back of the Arctic ice cap is a symptom of the Earth's disease but not its cause and it is the cause that has to be dealt with if we hope to bring about a cure. Therefore a massive cut back in carbon dioxide emissions should be mandatory for all developed nations (and some developing nations as well). Total destruction of the methane in the Arctic atmosphere is also mandatory if we are to survive the effects of its now catastrophic rate of build up in the atmospheric methane concentration However cooling of the Arctic using geoengineering methods is also vitally important to reduce the effects of the ice cap melting further enhancing the already out of control destabilization of the methane hydrates on the Arctic shelf and slope. · Developed (and some developing) countries must cut back their carbon dioxide emissions by a very large percentage (50% to 90%) by 2020 to immediately precipitate a cooling of the Earth and its crust. If this is not done the earthquake frequency and methane emissions in the Arctic will continue to grow exponentially **leading to our** **inexorable demise** between 2031 to 2051. · Geoenginering must be used immediately as a cooling method in the Arctic to counteract the effects of the methane buildup in the short term. However these methods will lead to further pollution of the atmosphere in the long term and will not solve the earthquake induced Arctic methane buildup which is going to lead to our annihilation. · The United States and Russia must immediately develop a net of powerful radio beat frequency transmission stations around the Arctic using the critical 13.56 MHZ beat frequency to break down the methane in the stratosphere and troposphere to nanodiamonds and hydrogen (Light 2011a) . Besides the elimination of the high global warming potential methane, the nanodiamonds may form seeds for light reflecting noctilucent clouds in the stratosphere and a light coloured energy reflecting layer when brought down to the Earth by snow and rain (Light 2011a). HAARP transmission systems are able to electronically vibrate the strong ionospheric electric current that feeds down into the polar areas and are thus the least evasive method of directly eliminating the buildup of methane in those critical regions (Light 2011a). The warning about **extinction** **is stark**. It is remarkable that global scientists had not anticipated a giant buildup of methane in the atmosphere when it had been so clearly predicted 10 to 20 years ago and has been shown to be critically linked to extinction events in the geological record (Kennett et al. 2003). Furthermore all the experiments should have already been done to determine which geoengineering methods were the most effective in oxidising/destroying the methane in the atmosphere in case it should ever build up to a concentration where it posed a **threat to humanity**. Those methods need to be applied immediately if there is **any faint hope of reducing the catastrophic heating effects** of the fast building atmospheric methane concentration.

Warming causes nuclear conflict

The Guardian, 2-22-2004 “Now the Pentagon tells Bush: climate change will destroy us” http://www.guardian.co.uk/environment/2004/feb/22/usnews.theobserver

Climate change over the next 20 years could result in a global catastrophe costing millions of lives in wars and natural disasters.. A secret report, suppressed by US defence chiefs and obtained by The Observer, warns that major European cities will be sunk beneath rising seas as Britain is plunged into a 'Siberian' climate by 2020. Nuclear conflict, mega-droughts, famine and widespread rioting will erupt across the world. The document predicts that abrupt climate change could bring the planet to the edge of anarchy as countries develop a nuclear threat to defend and secure dwindling food, water and energy supplies. The threat to global stability vastly eclipses that of terrorism, say the few experts privy to its contents. 'Disruption and conflict will be endemic features of life,' concludes the Pentagon analysis. 'Once again, warfare would define human life.' The findings will prove humiliating to the Bush administration, which has repeatedly denied that climate change even exists. Experts said that they will also make unsettling reading for a President who has insisted national defence is a priority. The report was commissioned by influential Pentagon defence adviser Andrew Marshall, who has held considerable sway on US military thinking over the past three decades. He was the man behind a sweeping recent review aimed at transforming the American military under Defence Secretary Donald Rumsfeld. Climate change 'should be elevated beyond a scientific debate to a US national security concern', say the authors, Peter Schwartz, CIA consultant and former head of planning at Royal Dutch/Shell Group, and Doug Randall of the California-based Global Business Network. An imminent scenario of catastrophic climate change is 'plausible and would challenge United States national security in ways that should be considered immediately', they conclude. As early as next year widespread flooding by a rise in sea levels will create major upheaval for millions.

### Advantage 2 is Expertise

#### DOD SMR are key to keeping nuclear expertise in the US – that boosts US nuclear labs

Andres and Breetz ‘11 (Richard B. Andres is professor of National Security Strategy at the National War College and a Senior Fellow and Energy and Environmental Security and Policy chair in the Center for Strategic Research, Institute for National Strategic Studies, at the National Defense University, Hanna L. Breetz is a doctoral candidate in the Department of Political Science at the Massachusetts Institute of Technology, “Small Nuclear Reactors for Military Installations: Capabilities, Costs, and Technological Implications”, February 16, 2011, LEQ)

DoD as first Mover Thus far, this paper has reviewed two of DOD’s most pressing energy vulnerabilities—grid insecurity and fuel convoys—and explored how they could be addressed by small reactors. We acknowledge that there are many un- certainties and risks associated with these reactors. On the other hand, failing to pursue these technologies raises its own set of risks for DOD, which we review in this section: first, small reactors may fail to be commercialized in the United States; second, the designs that get locked in by the private market may not be optimal for DOD’s needs; and third, expertise on small reactors may become concentrated in foreign countries. By taking an early “first mover” role in the small reactor market, DOD could mitigate these risks and secure the long-term availability and appropriateness of these technologies for U.S. military applications. The “Valley of Death.” Given the promise that small reactors hold for military installations and mo- bility, DOD has a compelling interest in ensuring that they make the leap from paper to production. How- ever, if DOD does not provide an initial demonstration and market, there is a chance that the U.S. small reactor industry may never get off the ground. The leap from the laboratory to the marketplace is so difficult to bridge that it is widely referred to as the “Valley of Death.” Many promising technologies are never commercialized due to a variety of market failures— including technical and financial uncertainties, information asymmetries, capital market imperfections, transaction costs, and environmental and security externalities—that impede financing and early adoption and can lock innovative technologies out of the mar- ketplace.28 In such cases, the Government can help a worthy technology to bridge the Valley of Death by accepting the first mover costs and demonstrating the technology’s scientific and economic viability.29 Historically, nuclear power has been “the most clear-cut example . . . of an important general-purpose technology that in the absence of military and defense- related procurement would not have been developed at all.”30 Government involvement is likely to be crucial for innovative, next-generation nuclear technology as well. Despite the widespread revival of interest in nuclear energy, Daniel Ingersoll has argued that radically innovative designs face an uphill battle, as “the high capital cost of nuclear plants and the painful lessons learned during the first nuclear era have created a pre- vailing fear of first-of-a-kind designs.”31 In addition, Massachusetts Institute of Technology reports on the Future of Nuclear Power called for the Government to provide modest “first mover” assistance to the private sector due to several barriers that have hindered the nuclear renaissance, such as securing high up-front costs of site-banking, gaining NRC certification for new technologies, and demonstrating technical viability.32 It is possible, of course, that small reactors will achieve commercialization without DOD assistance. As discussed above, they have garnered increasing attention in the energy community. Several analysts have even ar- gued that small reactors could play a key role in the sec- ond nuclear era, given that they may be the only reactors within the means of many U.S. utilities and developing countries.33 However, given the tremendous regulatory hurdles and technical and financial uncertainties, it appears far from certain that the U.S. small reactor industry will take off. If DOD wants to ensure that small reactors are available in the future, then it should pursue a leadership role now. Technological Lock-in. A second risk is that if small reactors do reach the market without DOD assistance, the designs that succeed may not be optimal for DOD’s applications. Due to a variety of positive feedback and increasing returns to adoption (including demonstration effects, technological interdependence, net- work and learning effects, and economies of scale), the designs that are initially developed can become “locked in.”34 Competing designs—even if they are superior in some respects or better for certain market segments— can face barriers to entry that lock them out of the market. If DOD wants to ensure that its preferred designs are not locked out, then it should take a first mover role on small reactors. It is far too early to gauge whether the private market and DOD have aligned interests in reactor designs. On one hand, Matthew Bunn and Martin Malin argue that what the world needs is cheaper, safer, more secure, and more proliferation-resistant nuclear reactors; presumably, many of the same broad qualities would be favored by DOD.35 There are many varied market niches that could be filled by small reactors, because there are many different applications and settings in which they can be used, and it is quite possible that some of those niches will be compatible with DOD’s interests.36 On the other hand, DOD may have specific needs (transportability, for instance) that would not be a high priority for any other market segment. Moreover, while DOD has unique technical and organizational capabilities that could enable it to pursue more radically innovative reactor lines, DOE has indicated that it will focus its initial small reactor deployment efforts on LWR designs.37 If DOD wants to ensure that its preferred reactors are developed and available in the future, it should take a leadership role now. Taking a first mover role does not necessarily mean that DOD would be “picking a winner” among small reactors, as the market will probably pursue multiple types of small reactors. Nevertheless, DOD leadership would likely have a profound effect on the industry’s timeline and trajectory. Domestic Nuclear Expertise. From the perspective of larger national security issues, if DOD does not catalyze the small reactor industry, there is a risk that expertise in small reactors could become dominated by foreign companies. A 2008 Defense Intelligence Agency report warned that the United States will become totally dependent on foreign governments for future commercial nuclear power unless the military acts as the prime mover to reinvigorate this critical energy technology with small, distributed power reactors. 38 Several of the most prominent small reactor concepts rely on technologies perfected at Federally funded laboratories and research programs, including the Hyperion Power Module (Los Alamos National Laboratory), NuScale (DOE-sponsored research at Oregon State University), IRIS (initiated as a DOE-sponsored project), Small and Transportable Reactor (Lawrence Livermore National Laboratory), and Small, Sealed, Transportable, Autonomous Reactor (developed by a team including the Argonne, Lawrence Livermore, and Los Alamos National Laboratories). However, there are scores of competing designs under development from over a dozen countries. If DOD does not act early to support the U.S. small reactor industry, there is a chance that the industry could be dominated by foreign companies.

#### Only an unconditional federal commitment sends the signal necessary to revitalize interest in nuclear engineering

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The decades-long hiatus in construction of new nuclear energy facilities has contributed to this workforce decline, of course. As the marketplace became less interested in nuclear energy, fewer students entered the discipline, reducing enrollment and forcing the closure of university and skills-based programs. Reversing this trend will require building confidence among individuals in the target demographic that the nuclear renaissance is real and long term. The nuclear energy industry can only go so far in making critical workforce investments without a clear signal from the Federal government. Spurred by both industry and political considerations, President Obama and Secretary of Energy Steven Chu have begun the task of promoting green and high-tech jobs in the U.S. In August 2008, while still the director of the Lawrence Berkeley National Laboratory, Dr. Chu and other National Laboratory Directors signed a statement calling for a federal commitment. “For example, the government should establish and fund a nuclear energy workforce development program at universities and colleges to meet the expected [workforce] need.” 11 As the American Nuclear Society stated, “America’s university based [nuclear science and engineering] programs cannot continue to be leaders in the field without an active [NRC] university program.” Both the total number of nuclear engineering programs and the enrollment in those programs has fallen precipitously since the 1980s.12 The Time is New Increasing the use of nuclear energy—building new facilities and expanding or relicensing existing ones—will maintain or create tens of thousands of high-paying jobs for American workers. But two key ingredients for a true nuclear energy renaissance are missing. First, the federal government must demonstrate a long term commitment to a resurgent nuclear energy industry. This means expanding the NRC university program, funding and issuing loan guarantees, and other concrete actions. If we want people to stake their education and career choices on nuclear expansion, they deserve a clear signal that the government supports the industry with more than just words. Second, companies must commit to a continued investment in their own workforces, through research to understand the labor supply environment, through training, and through partnerships with organized labor. Ultimately, the government and industry must act together to both provide career opportunities and also ensure that a trained workforce will be available to fill the demand.

Nuclear expertise solves nuclear deterrence and treaty verification

Drell 9 ([American](http://en.wikipedia.org/wiki/United_States) [theoretical physicist](http://en.wikipedia.org/wiki/Theoretical_physics) and [arms control](http://en.wikipedia.org/wiki/Arms_control) expert. He is a [professor emeritus](http://en.wikipedia.org/wiki/Professor) at the [Stanford Linear Accelerator Center](http://en.wikipedia.org/wiki/SLAC_National_Accelerator_Laboratory) (SLAC) and a senior fellow at [Stanford University](http://en.wikipedia.org/wiki/Stanford_University)'s [Hoover Institution](http://en.wikipedia.org/wiki/Hoover_Institution). Drell is a noted contributor in the field of [quantum electrodynamics](http://en.wikipedia.org/wiki/Quantum_electrodynamics) and [particle physics](http://en.wikipedia.org/wiki/Particle_physics). The [Drell–Yan process](http://en.wikipedia.org/wiki/Drell%E2%80%93Yan_process) is partially named after him. He was one of the winners of the 2000 [Enrico Fermi Award](http://en.wikipedia.org/wiki/Enrico_Fermi_Award). He can also make a mean tuna sandwich. Strategic Weapons in the 21st Century: Hedging Against Uncertainty January 29, 2009 “Forces, Infrastructure, Science and Technology: The Future of Stockpile Stewardship” http://www.lanl.gov/conferences/sw/2010/docs/stockpile\_stewardship.pdf)

Since the end of the Cold War and up to the present, the United States has succeeded in maintaining a strong nuclear deterrent by developing an effective Stockpile Stewardship Program (SSP). When I say successful, I am referring to two fundamental measures. First, it has discovered causes for serious concerns in the stockpile, which is what it should do if such causes exist. Second, it has successfully addressed these concerns with well executed Life Extension Programs (LEPs) and conscientious follow-up to Significant Finding Investigations (SFIs). I believe that the most important component of a responsive infrastructure that can maintain a safe, secure and reliable nuclear weapons enterprise is personnel with the requisite expertise. This includes experts in surveillance, dismantlement, manufacturing, design, assessment, system integration, including replacement parts for limited life components into an operating system, and basic science. Expert personnel constitute more of a deterrent to evolving threats than do facilities or even existing weapons. Given sufficient resources, people with the appropriate expertise can respond quickly to unanticipated problems or changes in requirements and can provide confidence in the solutions they produce. Without such people, no amount of resources will yield timely solutions in which confidence is justified. Expert personnel have always been important to the complex. Although we no longer call for new designs for new military missions, we still rely on the expertise of designers to assess and solve potential problems as they are identified over time. They 3 must devise and assess possible solutions that can be developed and employed with confidence without relying on nuclear explosive testing. This is a challenge that demands both innovation and adherence to change discipline so as not to introduce more unknowns that could result in lower confidence in the redesigned weapon. Moreover, there is an increasingly broad spectrum of national-security problems that also require nuclear-weapons expertise. I have in mind the increasing need to assess proliferation risks under a variety of scenarios; the need for “nuclear forensics” to help identify the origins of nuclear material, radiological dispersion devices, and nuclear explosive devices, whether obtained before or sampled after explosions; the need for a capability to disarm and disable interdicted devices; and a growing need to verify treaties and monitor nuclear weapons-related technologies. Expertise will also be needed to train the relevant inspectors. These additional requirements further underscore the need for expert personnel as the foundation of a nuclear-weapons complex that can respond to a changing world. They must have resources and support enabling them to retain and hone their expertise while providing the tools necessary for appropriate responses to surprises and policy changes. Experimental science and data are critically important; so is a strong program of Research, Discovery, and Development. This need has been recognized, by and large, as a substitute for UGTs since President George H.W. Bush initiated a moratorium on such tests in 1992. It has been supported by the development of super-computers to perform high fidelity simulations and model building and advanced scientific instruments of great power; i.e., DARHT at Los Alamos, NIF at Livermore. However, significant budget cuts in the weapons program at the labs over the past two years have raised serious concerns for the continuing health of this program that must be addressed as we look forward.

#### START’s working, but continued verification measures key to include China in arms control

Wuest 12 (C.R, Scientist, Lawrence Livermore National Laboratory. The Challenge for Arms Control Verification in the Post-New START Worldhttps://e-reports-ext.llnl.gov/pdf/620000.pdf)

While the question of the appropriate level of cuts to U.S. nuclear forces is being actively debated, a key issue continues to be whether verification procedures are strong enough to ensure that both the U.S. and Russia are fulfilling their obligations under the current New Start treaty and any future arms reduction treaties. A recent opinion piece by Henry Kissinger and Brent Scowcroft (2012) raised a number of issues with respect to governing a policy to enhance strategic stability, including: …in deciding on force levels and lower numbers, verification is crucial. Particularly important is a determination of what level of uncertainty threatens the calculation of stability. At present, that level is well within the capabilities of the existing verification systems. We must be certain that projected levels maintain — and when possible, reinforce — that confidence. The strengths and weaknesses of the New START verification regime should inform and give rise to stronger regimes for future arms control agreements. These future arms control agreements will likely need to include other nuclear weapons states and so any verification regime will need to be acceptable to all parties. Currently, China is considered the most challenging party to include in any future arms control agreement and China’s willingness to enter into verification regimes such as those implemented in New START may only be possible when it feels it has reached nuclear parity with the U.S. and Russia. Similarly, in keeping with its goals of reaching peer status with the U.S. and Russia, Frieman (2004) suggests that China would be more willing to accept internationally accepted and applied verification regimes rather than bilateral ones. The current verification protocols specified in the New START treaty are considered as the baseline case and are contrasted with possible alternative verification protocols that could be effective in a post-New START era of significant reductions in U.S. and other countries’ nuclear stockpiles. Of particular concern is the possibility of deception and breakout when declared and observed numbers of weapons are below the level considered to pose an existential threat to the U.S. In a regime of very low stockpile numbers, “traditional” verification protocols as currently embodied in the New START treaty might prove less than adequate. I introduce and discuss a number of issues that need to be considered in future verification protocols, many of which do not have immediate solutions and so require further study. I also discuss alternatives and enhancements to traditional verification protocols, for example, confidence building measures such as burden sharing against the common threat of weapon of mass destruction (WMD) terrorism, joint research and development and sharing of new verification technologies,2 and even exploring exchanges of sensitive nuclear weapons data to provide the necessary level of trust enhancement to allow nations to reduce their stockpiles to very few or zero nuclear weapons in a stable manner.

#### That prevents a South Asian arms race via accession to the INF, and causes Russian TNW cuts

Weitz 12 (Richard Weitz is a senior fellow and director of the Center for Political-Military Affairs at Hudson Institute. He analyzes mid- and long-term national and international political-military issues, including by employing scenario-based planning. His current areas of research include defense reform, counterterrorism, homeland security, and U.S. policies towards Europe, the former Soviet Union, Asia, and the Middle East.Global Insights: Factoring China Into U.S.-Russian Nuclear Arms Control http://www.worldpoliticsreview.com/articles/11927/global-insights-factoring-china-into-u-s-russian-nuclear-arms-control)

Meanwhile, China’s continued absence from strategic nuclear arms control negotiations is already impeding U.S.-Russian progress in this area. Beijing has traditionally resisted participating in formal nuclear arms control agreements. During the Cold War, Chinese leaders correctly perceived superpower nonproliferation initiatives partly as an attempt to prevent Beijing from developing its own nuclear deterrent. Since then, Chinese officials have kept their distance from bilateral Russian-American strategic arms talks, arguing that both countries’ nuclear arsenals dwarf that of China. Yet, the substantial decrease in Russian and U.S. nuclear forces is narrowing this gap. Whereas U.S. officials want the next major nuclear arms reduction agreement to include only Russia and the United States, Russian negotiators want China and other nuclear weapons states to participate. In particular, Russian representatives insist they cannot reduce [their major holdings of nonstrategic, or tactical, nuclear weapons](http://www.worldpoliticsreview.com/articles/8792/global-insights-u-s-nato-ponder-tactical-nuclear-arms-control-with-russia) without considering China’s growing military potential. Involving China in certain U.S.-Russian arms control processes could facilitate progress between Moscow and Washington in these areas and yield ancillary benefits for related issues. For example, securing the accession of China, India and Pakistan to the Intermediate-Range Nuclear Forces (INF) Treaty would reduce the unpredictability of the South Asian arms race.

#### Russian TNW cause nuclear war

Pomper, et al, 2009, Miles A. Pomper, editor of Arms Control Today, William Potter, Institute Professor and Director of the James Martin Center for Nonproliferation Studies, and Nikolai Sokov, Senior Research Associate at CNS, December 2009 (The James Martin Center for Nonproliferation Studies, Prepared for Unit for Policy Planning and Research Finnish Ministry for Foreign Affairs, Reducing and Regulating Tactical (Nonstrategic) Nuclear Weapons in Europe, <http://74.125.47.132/search?q=cache:V1M7IiY8mNIJ:cns.miis.edu/opapers/pdfs/tnw_europe.pdf+%22tactical+nuclear+weapons%22&cd=34&hl=en&ct=clnk&gl=us>)

The absence of any degree of transparency with regard to warheads that are stored adjacent to delivery vehicles fosters crisis instability because each party could expand its nuclear arsenal on short notice without the knowledge of the other. In this regard, the overwhelming superiority of Russia in the TNW category presents a serious problem. Yet, even a much smaller TNW arsenal of the United States, especially the ability to equip SLCMs with nuclear warheads, is regarded as a potential security challenge by Russia. Furthermore, employment of TNW is closely associated with conventional forces: both the American extended deterrence and the Russian de escalation strategies foresee conflicts that start as conventional ones that more or less quickly **transcend the threshold into limited use of nuclear weapons**. The theoretical scenarios of employment of TNW argue for the **pre delegation of launch authority** to combatant commanders in the early stages of or perhaps even in the run up to a conventional war with further decrease of crisis stability, diminished control by political leaders, and the lowering of the nuclear threshold. Thus, in a very direct and tangible way the continued existence of TNW in national arsenals **enhances the probability of nuclear war**, **whether** **intentional or by accident**, and represents a threat to international security.

#### South Asian arms race leads to extinction

Hundley 12 (Tom Hundley is senior editor at the [Pulitzer Center on Crisis Reporting](http://pulitzercenter.org/). This article for Foreign Policy is part of the Pulitzer Center's [Gateway project](http://pulitzercenter.org/going-nuclear) on nuclear security. [Race to the End](http://www.foreignpolicy.com/articles/2012/09/05/race_to_the_end) http://www.foreignpolicy.com/articles/2012/09/05/race\_to\_the\_end?page=0,3)

The arms race could make a loose nuke more likely. After all, Pakistan's assurances that its nuclear arsenal is safe and secure rest heavily on the argument that its warheads and their delivery systems have been uncoupled and stored separately in heavily guarded facilities. It would be very difficult for a group of mutinous officers to assemble the necessary protocols for a launch and well nigh impossible for a band of terrorists to do so. But that calculus changes with the deployment of mobile battlefield weapons. The weapons themselves, no longer stored in heavily guarded bunkers, would be far more exposed. Nevertheless, military analysts from both countries still say that a nuclear exchange triggered by miscalculation, miscommunication, or panic is far more likely than terrorists stealing a weapon -- and, significantly, that the odds of such an exchange increase with the deployment of battlefield nukes. As these ready-to-use weapons are maneuvered closer to enemy lines, the chain of command and control would be stretched and more authority necessarily delegated to field officers. And, if they have weapons designed to repel a conventional attack, there is obviously a reasonable chance they will use them for that purpose. "It lowers the threshold," said Hoodbhoy. "The idea that tactical nukes could be used against Indian tanks on Pakistan's territory creates the kind of atmosphere that greatly shortens the distance to apocalypse." Both sides speak of the possibility of a limited nuclear war. But even those who speak in these terms seem to understand that this is fantasy -- that once started, a nuclear exchange would be almost impossible to limit or contain. "The only move that you have control over is your first move; you have no control over the nth move in a nuclear exchange," said Carnegie's Tellis. The first launch would create hysteria; communication lines would break down, and events would rapidly cascade out of control. Some of the world's most densely populated cities could find themselves under nuclear attack, and an estimated 20 million people could die almost immediately. What's more, the resulting firestorms would put 5 million to 7 million metric tons of smoke into the upper atmosphere, according to a [new model](http://www.scientificamerican.com/article.cfm?id=local-nuclear-war) developed by climate scientists at Rutgers University and the University of Colorado. Within weeks, skies around the world would be permanently overcast, and the condition vividly described by Carl Sagan as "nuclear winter" would be upon us. The darkness would likely last about a decade. The Earth's temperature would drop, agriculture around the globe would collapse, and a billion or more humans who already live on the margins of subsistence could starve. This is the real nuclear threat that is festering in South Asia. It is a threat to all countries, including the United States, not just India and Pakistan. Both sides acknowledge it, but neither seems able to slow their dangerous race to annihilation.

### Last is Solvency

DOD is key—power purchase agreements solve the industry

Andres and Breetz ‘11 (Richard B. Andres is professor of National Security Strategy at the National War College and a Senior Fellow and Energy and Environmental Security and Policy chair in the Center for Strategic Research, Institute for National Strategic Studies, at the National Defense University, Hanna L. Breetz is a doctoral candidate in the Department of Political Science at the Massachusetts Institute of Technology, “Small Nuclear Reactors for Military Installations: Capabilities, Costs, and Technological Implications”, February 16, 2011, LEQ)

DoD as first Mover Thus far, this paper has reviewed two of DOD’s most pressing energy vulnerabilities—grid insecurity and fuel convoys—and explored how they could be addressed by small reactors. We acknowledge that there are many un- certainties and risks associated with these reactors. On the other hand, failing to pursue these technologies raises its own set of risks for DOD, which we review in this section: first, small reactors may fail to be commercialized in the United States; second, the designs that get locked in by the private market may not be optimal for DOD’s needs; and third, expertise on small reactors may become concentrated in foreign countries. By taking an early “first mover” role in the small reactor market, DOD could mitigate these risks and secure the long-term availability and appropriateness of these technologies for U.S. military applications. The “Valley of Death.” Given the promise that small reactors hold for military installations and mo- bility, DOD has a compelling interest in ensuring that they make the leap from paper to production. How- ever, if DOD does not provide an initial demonstration and market, there is a chance that the U.S. small reactor industry may never get off the ground. The leap from the laboratory to the marketplace is so difficult to bridge that it is widely referred to as the “Valley of Death.” Many promising technologies are never commercialized due to a variety of market failures— including technical and financial uncertainties, information asymmetries, capital market imperfections, transaction costs, and environmental and security externalities—that impede financing and early adoption and can lock innovative technologies out of the mar- ketplace.28 In such cases, the Government can help a worthy technology to bridge the Valley of Death by accepting the first mover costs and demonstrating the technology’s scientific and economic viability.29 Historically, nuclear power has been “the most clear-cut example . . . of an important general-purpose technology that in the absence of military and defense- related procurement would not have been developed at all.”30 Government involvement is likely to be crucial for innovative, next-generation nuclear technology as well. Despite the widespread revival of interest in nuclear energy, Daniel Ingersoll has argued that radically innovative designs face an uphill battle, as “the high capital cost of nuclear plants and the painful lessons learned during the first nuclear era have created a pre- vailing fear of first-of-a-kind designs.”31 In addition, Massachusetts Institute of Technology reports on the Future of Nuclear Power called for the Government to provide modest “first mover” assistance to the private sector due to several barriers that have hindered the nuclear renaissance, such as securing high up-front costs of site-banking, gaining NRC certification for new technologies, and demonstrating technical viability.32 It is possible, of course, that small reactors will achieve commercialization without DOD assistance. As discussed above, they have garnered increasing attention in the energy community. Several analysts have even ar- gued that small reactors could play a key role in the sec- ond nuclear era, given that they may be the only reactors within the means of many U.S. utilities and developing countries.33 However, given the tremendous regulatory hurdles and technical and financial uncertainties, it appears far from certain that the U.S. small reactor industry will take off. If DOD wants to ensure that small reactors are available in the future, then it should pursue a leader- ship role now.

#### DOD purchasing agreements are key to just-start the industry and determining optimal configurations

Madia ’12 (William Madia, Stanford Energy Journal, Dr. Madia serves as Chairman of the Board of Overseers and Vice President for the SLAC National Accelerator Laboratory at Stanford University. Previously, he was the Laboratory Director at the Oak Ridge National Laboratory from 2000-2004 and the Pacific Northwest National Laboratory from 1994-1999., “SMALL MODULAR REACTORS: A POTENTIAL GAME-CHANGING TECHNOLOGY”, <http://energyclub.stanford.edu/index.php/Journal/Small_Modular_Reactors_by_William_Madia>, Spring 2012, LEQ)

There is a new type of nuclear power plant (NPP) under development that has the potential to be a game changer in the power generation market: the small modular reactor (SMR). Examples of these reactors that are in the 50-225 megawatt electric (MW) range can be found in the designs being developed and advanced by Generation mPower (http://generationmpower.com/), NuScale (http://nuscale.com/), the South Korean SMART reactor (http://smart.kaeri.re.kr/) and Westinghouse (http://www.westinghousenuclear.com/smr/index.htm/). Some SMR concepts are up to 20 times smaller than traditional nuclear plants Today’s reactor designers are looking at concepts that are 5 to 20 times smaller than more traditional gigawatt-scale (GW) plants. The reasons are straightforward; the question is, “Are their assumptions correct?” The first assumption is enhanced safety. GW-scale NPPs require sophisticated designs and cooling systems in case of a total loss of station power, as happened at Fukushima due to the earthquake and tsunami. These ensure the power plant will be able to cool down rapidly enough, so that the nuclear fuel does not melt and release dangerous radioactive fission products and hydrogen gas. SMRs are sized and designed to be able to cool down without any external power or human actions for quite some time without causing damage to the nuclear fuel. The second assumption is economics. GW-scale NPPs cost $6 billion to $10 billion to build. Very few utilities can afford to put this much debt on their balance sheets. SMRs offer the possibility of installing 50-225 MW of power per module at a total cost that is manageable for most utilities. Furthermore, modular configurations allow the utilities to deploy a more tailored power generation capacity, and that capacity can be expanded incrementally. In principle, early modules could be brought on line and begin producing revenues, which could then be used to fund the addition of more modules, if power needs arise. The third assumption is based on market need and fit. Utilities are retiring old fossil fuel plants. Many of them are in the few hundred MW range and are located near load centers and where transmission capacity currently exists. SMRs might be able to compete in the fossil re-power markets where operators don’t need a GW of power to serve their needs. This kind of “plug and play” modality for NPPs is not feasible with many of the current large-scale designs, thus giving carbon-free nuclear power an entry into many of the smaller markets, currently not served by these technologies. There are numerous reasons why SMRs might be viable today. Throughout the history of NPP development, plants grew in size based on classic “economies of scale” considerations. Bigger was cheaper when viewed on a cost per installed kilowatt basis. The drivers that caused the industry to build bigger and bigger NPPs are being offset today by various considerations that make this new breed of SMRs viable. Factory manufacturing is one of these considerations. Most SMRs are small enough to allow them to be factory built and shipped by rail or barge to the power plant sites. Numerous industry “rules of thumb” for factory manufacturing show dramatic savings as compared to “on-site” outdoor building methods. Significant schedule advantages are also available because weather delay considerations are reduced. Of course, from a total cost perspective, some of these savings will be offset by the capital costs associated with building multiple modules to get the same total power output. Based on analyses I have seen, overnight costs in the range of $5000 to $8000 per installed kilowatt are achievable. If these analyses are correct, it means that the economies of scale arguments that drove current designs to GW scales could be countered by the simplicity and factory-build possibilities of SMRs. No one has yet obtained a design certification from the Nuclear Regulatory Commission (NRC) for an SMR, so we must consider licensing to be one of the largest unknowns facing these new designs. Nevertheless, since the most developed of the SMRs are mostly based on proven and licensed components and are configured at power levels that are passively safe, we should not expect many new significant licensing issues to be raised for this class of reactor. Still, the NRC will need to address issues uniquely associated with SMRs, such as the number of reactor modules any one reactor operator can safely operate and the size of the emergency planning zone for SMRs. To determine if SMRs hold the potential for changing the game in carbon-free power generation, it is imperative that we test the design, engineering, licensing, and economic assumptions with some sort of public-private development and demonstration program. Instead of having government simply invest in research and development to “buy down” the risks associated with SMRs, I propose a more novel approach. Since the federal government is a major power consumer, it should commit to being the “first mover” of SMRs. This means purchasing the first few hundred MWs of SMR generation capacity and dedicating it to federal use. The advantages of this approach are straightforward. The government would both reduce licensing and economic risks to the point where utilities might invest in subsequent units, thus jumpstarting the SMR industry. It would then also be the recipient of additional carbon-free energy generation capacity. This seems like a very sensible role for government to play without getting into the heavy politics of nuclear waste, corporate welfare, or carbon taxes. If we want to deploy power generation technologies that can realize near-term impact on carbon emissions safely, reliably, economically, at scale, and at total costs that are manageable on the balance sheets of most utilities, we must consider SMRs as a key component of our national energy strategy.

#### And a purchase-power agreement solves best- it incentivizes private market action while reducing overhead cost of electricity– creates a win/win market

Rosner, Goldberg, and Hezir ’11 (Robert Rosner, Robert Rosner is an astrophysicist and founding director of the Energy Policy Institute at Chicago. He was the director of Argonne National Laboratory from 2005 to 2009, and Stephen Goldberg, Energy Policy Institute at Chicago, The Harris School of Public Policy Studies, Joseph S. Hezir, Principal, EOP Foundation, Inc., Many people have made generous and valuable contributions to this study. Professor Geoff Rothwell, Stanford University, provided the study team with the core and supplemental analyses and very timely and pragmatic advice. Dr. J’Tia Taylor, Argonne National Laboratory, supported Dr. Rothwell in these analyses. Deserving special mention is Allen Sanderson of the Economics Department at the University of Chicago, who provided insightful comments and suggested improvements to the study. Constructive suggestions have been received from Dr. Pete Lyons, DOE Assistant Secretary of Nuclear Energy; Dr. Pete Miller, former DOE Assistant Secretary of Nuclear Energy; John Kelly, DOE Deputy Assistant Secretary for Nuclear Reactor Technologies; Matt Crozat, DOE Special Assistant to the Assistant Secretary for Nuclear Energy; Vic Reis, DOE Senior Advisor to the Under Secretary for Science; and Craig Welling, DOE Deputy Office Director, Advanced Reactor Concepts Office, as well as Tim Beville and the staff of DOE’s Advanced Reactor Concepts Office. The study team also would like to acknowledge the comments and useful suggestions the study team received during the peer review process from the nuclear industry, the utility sector, and the financial sector. Reviewers included the following: Rich Singer, VP Fuels, Emissions, and Transportation, MidAmerican Energy Co.; Jeff Kaman, Energy Manager, John Deere; Dorothy R. Davidson, VP Strategic Programs, AREVA; T. J. Kim, Director—Regulatory Affairs & Licensing, Generation mPower, Babcock & Wilcox; Amir Shahkarami, Senior Vice President, Generation, Exelon Corp.; Michael G. Anness, Small Modular Reactor Product Manager, Research & Technology, Westinghouse Electric Co.; Matthew H. Kelley and Clark Mykoff, Decision Analysis, Research & Technology, Westinghouse Electric Co.; George A. Davis, Manager, New Plant Government Programs, Westinghouse Electric Co.; Christofer Mowry, President, Babcock & Wilcox Nuclear Energy, Inc.; Ellen Lapson, Managing Director, Fitch Ratings; Stephen A. Byrne, Executive Vice President, Generation & Transmission Chief Operating Officer, South Carolina Electric & Gas Company; Paul Longsworth, Vice President, New Ventures, Fluor; Ted Feigenbaum, Project Director, Bechtel Corp.; Kennette Benedict, Executive Director, Bulletin of the Atomic Scientist; Bruce Landrey, CMO, NuScale; Dick Sandvik, NuScale; and Andrea Sterdis, Senior Manager of Strategic Nuclear Expansion, Tennessee Valley Authority. The authors especially would like to acknowledge the discerning comments from Marilyn Kray, Vice-President at Exelon, throughout the course of the study, “Small Modular Reactors – Key to Future Nuclear Power”, <http://epic.uchicago.edu/sites/epic.uchicago.edu/files/uploads/SMRWhite_Paper_Dec.14.2011copy.pdf>, November 2011, LEQ)

6.2 GOVERNMENT SPONSORSHIP OF MARKET TRANSFORMATION INCENTIVES Similar to other important energy technologies, such as energy storage and renewables, “market pull” activities coupled with the traditional “technology push” activities would significantly increase the likelihood of timely and successful commercialization. Market transformation incentives serve two important objectives. They facilitate demand for the off-take of SMR plants, thus reducing market risk and helping to attract private investment without high risk premiums. In addition, if such market transformation opportunities could be targeted to higher price electricity markets or higher value electricity applications, they would significantly reduce the cost of any companion production incentives. There are three special market opportunities that may provide the additional market pull needed to successfully commercialize SMRs: the federal government, international applications, and the need for replacement of existing coal generation plants. 6.2.1 Purchase Power Agreements with Federal Agency Facilities Federal facilities could be the initial customer for the output of the LEAD or FOAK SMR plants. The federal government is the largest single consumer of electricity in the U.S., but its use of electricity is widely dispersed geographically and highly fragmented institutionally (i.e., many suppliers and customers). Current federal electricity procurement policies do not encourage aggregation of demand, nor do they allow for agencies to enter into long-term contracts that are “bankable” by suppliers. President Obama has sought to place federal agencies in the vanguard of efforts to adopt clean energy technologies and reduce greenhouse gas emissions. Executive Order 13514, issued on October 5, 2009, calls for reductions in greenhouse gases by all federal agencies, with DOE establishing a target of a 28% reduction by 2020, including greenhouse gases associated with purchased electricity. SMRs provide one potential option to meet the President’s Executive Order. One or more federal agency facilities that can be cost effectively connected to an SMR plant could agree to contract to purchase the bulk of the power output from a privately developed and financed LEAD plant. 46 A LEAD plant, even without the benefits of learning, could offer electricity to federal facilities at prices competitive with the unsubsidized significant cost of other clean energy technologies. Table 4 shows that the LCOE estimates for the LEAD and FOAK-1plants are in the range of the unsubsidized national LCOE estimates for other clean electricity generation technologies (based on the current state of maturity of the other technologies). All of these technologies should experience additional learning improvements over time. However, as presented earlier in the learning model analysis, the study team anticipates significantly greater learning improvements in SMR technology that would improve the competitive position of SMRs over time. Additional competitive market opportunities can be identified on a region-specific, technology-specific basis. For example, the Southeast U.S. has limited wind resources. While the region has abundant biomass resources, the estimated unsubsidized cost of biomass electricity is in the range of $90-130 per MWh (9-13¢/kWh), making LEAD and FOAK plants very competitive (prior to consideration of subsidies). 47 Competitive pricing is an important, but not the sole, element to successful SMR deployment. A bankable contractual arrangement also is required, and this provides an important opportunity for federal facilities to enter into the necessary purchase power arrangements. However, to provide a “bankable” arrangement to enable the SMR project sponsor to obtain private sector financing, the federal agency purchase agreement may need to provide a guaranteed payment for aggregate output, regardless of actual generation output. 48 Another challenge is to establish a mechanism to aggregate demand among federal electricity consumers if no single federal facility customer has a large enough demand for the output of an SMR module. The study team believes that highlevel federal leadership, such as that exemplified in E.O. 13514, can surmount these challenges and provide critical initial markets for SMR plants.

**DOD solves regulations**

**King et. al. ’11** (Marcus King , LaVar Huntzinger , Thoi Nguyen, CNA Think Tank, Environment and Energy Team, “Feasibility of Nuclear Power on U.S. Military Installations”, March 31, 2011, LEQ)

Certification and licensing issues The most basic licensing issue relates to whether NRC will have jurisdiction over potential nuclear reactor sites or whether DoD could be self-regulating. Our conversations with NRC indicate it is the only possible licensing authority for reactors that supply power to the com- mercial grid. However, DOE and DoD are authorized to regulate mission critical nuclear facilities under Section 91b of the Atomic Energy Act. There is some historical precedent for DoD exercising this authority. For example, the Army Nuclear Program was granted exception under this rule with regard to the reactor that operated aboard the Sturgis barge in the 1960s and 1970s.