# 1NC

### 1NC 1

#### Interpretation –

#### Incentives are direct support for a specific activity

Doris, NREL researcher, 12

(Elizabeth Doris, researcher at the National Renewable Energy Laboratory, “Policy Building Blocks: Helping Policymakers Determine Policy Staging for the Development of Distributed PV Markets,” Paper to be presented at the 2012 World Renewable Energy Forum, 5/13-5/17, <http://www.nrel.gov/docs/fy12osti/54801.pdf>)

3.3 Market Expansion

This stage of policy development targets the development of projects and includes both incentives that attempt to distribute the high first costs of distributed technologies and policies that facilitate project installation. The purpose of this category is to increase the installation of individual projects through monetizing the non-economic benefits of distributed generation for the developer. Because the value of those benefits vary in different contexts, these policies can be politically challenging to put in place and technically challenging to design and implement. There is a large body of literature (encompassing the energy field as well as other fields) that discusses the design and implementation of effective market incentives. Specific policy types include:

• Incentives. In the context of this framework, incentives are defined as direct monetary support for specific project development. Incentives, especially in the current economic environment, can be politically challenging to implement and require detailed design to ensure that they are effectively reaching the intended market at levels that spur development without creating over-subsidization. Because of the complications and expense of these types of policies, they are most used and most cost-effective in environments where the market is prepared for project development. There are three primary types of incentives:

• Investment incentives directly alter the first cost of technologies. These incentives can take the form of grants, rebates, or tax incentives, depending on the market needs. Grants are typically applied to larger scale projects and are paid in advance of development, and so target development that would not take place without advance investment. Rebates are most commonly based on equipment purchases and can be applied at the time of purchase or through a post-purchase mechanism. Tax incentives can be deductions or credits, can be applied to entire installations, and are applied after purchase, annually. Tax incentives target development that does not need direct capital investment, but instead prioritizes reduction in pay-back period.

• Production incentives provide payment for electricity produced from the distributed electricity. These are different from net metering because the aim is not to provide the economic value of electricity sold into the grid, but instead, to monetize the indirect benefits of distributed generation and apply that on a production basis to projects. These incentives do not directly remove the challenge of higher first costs, and so are most effective in situations in which those high first costs can be spread over the course of the project lifetime (e.g., where direct priori investment is not a priority). In the last decade, incentives for distributed generation have tended toward the production type, because it assures the public that the investment is resulting in clean energy development (whereas investment incentives have the potential to be invested in projects that do not materialize).

• Feed-in-Tariffs. This incentive type reduces investment risk by providing fixed payments for projects based on the levelized cost of renewable energy generation. This (among other design characteristics) distinguishes feed-in-tariffs from production-based incentives, which are based on monetizing the value of the electricity to the grid or the value to the electricity purchaser.

#### “For” means the incentive must directly influence energy production

WORDS AND PHRASES 04

(Words and Phrases Permanent Edition, “For,” Volume 17, p. 338-343)

W.D.Tenn. 1942. The Fair Labor Standards Act of 1938 uses the words “production for commerce” as denoting an intention to deal in a restricted way with question of coverage in connection with those employed directly in production of articles to be sold, shipped or transported across state lines in commerce, producing goods “for” a certain purpose implying a direct relation as distinguished from producing something which only “affects” a certain purpose which implies an indirect relation.

#### Energy production of nuclear power is the generation of electricity

US EIA (Energy Information Administration) - October 19, 2011, Annual Energy Review 2010, http://www.eia.gov/totalenergy/data/annual/pdf/aer.pdf

Primary Energy Production: Production of primary energy. The U.S. Energy Information Administration includes the following in U.S. primary energy production: coal production, waste coal supplied, and coal refuse recovery; crude oil and lease condensate production; natural gas plant liquids production; dry natural gas—excluding supplemental gaseous fuels—production; nuclear electricity net generation (converted to Btu using the nuclear heat rates); conventional hydroelectricity net generation (converted to Btu using the fossil-fuels heat rates); geothermal electricity net generation (converted to Btu using the fossil-fuels heat rates), and geothermal heat pump energy and geothermal direct use energy; solar thermal and photovoltaic electricity net generation (converted to Btu using the fossilfuels heat rates), and solar thermal direct use energy; wind electricity net generation (converted to Btu using the fossil-fuels heat rates); wood and wood-derived fuels consumption; biomass waste consumption; and biofuels feedstock.

#### Violation – The aff does not incentivize the process of transformation nuclear energy into electricity, it only supports the creation of fuel that MIGHT produce electricity LATER

#### Vote Neg

#### Predictable Limits – There are hundreds of factors that influence whether nuclear power gets produced – Allowing affs to promote factors of production means they could incentivize students to go into STEM, build waste facilities, or subsidize R&D. Only requiring the aff’s incentive be CONTINGENT on production creates a predictable limit on aff mechanisms

#### Ground – Incentivizing resource product instead of energy production means the aff doesn’t have to defend “production good.” At best they are effectually topical which guts stable CP and DA ground and forces us to concede solvency to get back to square 1.

### 1NC 2

#### Obama is upping pressure to spur congressionally lead comprehensive reform --- leaders are optimistic on passage

Sink, 2/19 (Justin, 2/19/2013, The Hill, “Obama seeks to repair rift with Republicans on immigration reform,” <http://thehill.com/homenews/administration/283877-obama-seeks-to-repair-rift-with-with-gop-on-immigration>))

President Obama reached out to key Senate Republicans on Tuesday in an effort to smooth the waters over immigration reform. Obama placed calls to Sens. Lindsey Graham (R-S.C.), John McCain (R-Ariz.) and Marco Rubio (R-Fla.) Tuesday afternoon after the Republican senators accused the White House of undermining bipartisan negotiations in the Senate with the weekend release of the administration’s own immigration bill. According to White House press secretary Jay Carney, Obama told the senators “that he remains supportive of the effort underway in Congress, and that he hopes that they can produce a bill as soon as possible that reflects shared core principles” of immigration reform. “He thanked the Senators for their leadership, and made clear that he and his staff look forward to continuing to work together with their teams to achieve needed reform,” Carney added in a statement. The president’s outreach came after last weekend’s leak of draft White House legislation depicting the administration’s preferred immigration reform package. That bill did not tie a pathway to citizenship for illegal immigrants to new border security measures and did not create a new visa exit system — two provisions Republicans have insisted on in negotiations. Republican leaders said the release undercut Senate negotiations and threatened to politicize the reform effort. “If actually proposed, the president’s bill would be dead on arrival in Congress, leaving us with unsecured borders and a broken legal immigration system for years to come,” Rubio said in a statement. Republicans also accused the White House of barreling forward on immigration without seeking input from across the aisle. In a statement released earlier Tuesday, Rubio spokesman Alex Conant said that no one in the Florida lawmaker’s office had ever been contacted by the White House to discuss immigration policy. “President Obama and the White House staff are not working with Republicans on immigration reform. Senator Rubio’s office has never discussed immigration policy with anyone in the White House,” Conant said. The White House immediately pushed back on that assertion, with a senior administration official citing at least five instances in which White House officials had met with representatives from a bipartisan group of Senate negotiators. Conant returned fire, saying that while Rubio’s staff had been briefed on administration efforts on behalf of a reform package, their suggestions had never been solicited. Republican support for the immigration package is thought largely to hinge on Rubio, and the phone calls Tuesday appeared to be an effort by the White House to repair relations. The gesture seemed to have paid off, with spokesmen for the Republican senators issuing optimistic statements following the phone calls. “Senator Rubio appreciated receiving President Obama’s phone call to discuss immigration reform late tonight in Jerusalem,” Conant said. Rubio was traveling Tuesday in Israel. “The Senator told the President that he feels good about the ongoing negotiations in the Senate, and is hopeful the final product is something that can pass the Senate with strong bipartisan support.”A spokesman for Graham called the call “short” and “cordial,” but said the South Carolina lawmaker and Obama agreed “it is important we fix our broken immigration system.” A senior Democratic congressional aide close to the bipartisan immigration talks downplayed the criticism from Rubio and other Republicans about the leaked White House bill.The aide suggested it was all part of the complicated political dance that must take place to keep both liberals and conservatives at the table on immigration reform. “I don’t think it hurts the process at all,” the aide said. “It shows the president is serious, and he’s not going to wait forever for Congress to act.”The White House in recent weeks has made a public show of demonstrating that it has learned the lessons of its fight for healthcare reform in 2009. Then, Obama faced criticism for allowing bipartisan Senate talks to drag on for too long, wasting political momentum and allowing opposition to escalate into a firestorm.Now, the White House has offered repeated public reminders that it is prepared to submit its own bill if Congress dawdles, and the leak of parts of it over the weekend could serve as a spur for that process. “I wouldn’t say we were surprised” by the leak, the Democratic aide said. The aide did voice regret that the published proposal did not encompass the entirety of the principles Obama has laid out on immigration reform, which include enhancements to border security and reforms to the legal immigration system. “It’s unfortunate that only a piece of it was leaked out,” the aide said. Janet Murguía, head of the National Council of La Raza, an Hispanic civil-rights group, said there’s “some legitimacy” to Rubio’s criticisms of Obama. But she was quick to add that it’s also “legitimate and appropriate” for the president to remind lawmakers that he’ll push his own reforms if Congress fails to reach a deal on its own. She characterized the partisan barbs as “healthy tensions” that put pressure on both sides to secure comprehensive reforms this year.“Both appear committed,” she said.

#### Congress is fully focused on immigration reform – momentum is building for quick passage and it is key to boosting high skilled immigration

Higgins, 2/6 (John K., 2/6/2013, “Immigration Reform Could Open the Door for IT Talent,” <http://www.ecommercetimes.com/story/77241.html>))

A divided Congress may actually unite when it comes to certain immigration reform efforts, and that includes one aspect of importance to the IT industry: paving the way for more highly skilled tech workers to come to the U.S. Proposed legislation could impact the way H-1B visas and green cards are handed out, but the issue may be tied to comprehensive immigration reforms. Compare Email Marketing Systems The E-Commerce Times comparison engine helps you easily compare email marketing software based on price, customer support, email templates, delivery methods, and more. [Compare Now] The new Congress is now tackling a flurry of general proposals for comprehensive immigration reform, but only one specific, narrowly focused piece of legislation has already been introduced in the Senate: a plan to vastly increase the number of non-citizens who can pursue jobs and education in the U.S. technology sector. The bill, titled the "Immigration Innovation Act of 2013," quickly drew support from the IT community. "High-skilled immigration is a critical component in the broad effort to reform the U.S. immigration system, and this legislation effectively establishes a must-do list to enable U.S. companies to attract and retain the best innovators from around the world," said Ken Wasch, president of the Software and Information Industry Association (SIIA). "Our companies strongly support efforts to improve the U.S. research ecosystem, including efforts to permit foreign Ph. D. and Masters graduates from U.S. universities in science, technology, engineering, and mathematics (STEM) to remain in the United States," said Grant Seiffert, president of the Telecommunications Industry Association (TIA), in a letter to the Senate sponsors of the bill. "In addition, we support your efforts to increase the allotment of H-1B visas and to improve STEM education efforts in the United States." Visa Reform and High-Tech Funding The bill, also referred to as "I-Squared," focuses on three areas related to high tech talent: the expansion of "employment based non-immigrant" permits, known as H-1B visas; increased access to temporary residence "green cards" for high-skilled workers, and the utilization of fees from the issuance of visas and green cards to promote American worker retraining and education in STEM-related activities. A closer look at the bill's sections: H-1B Visas: The H-1B program allows U.S. employers to temporarily employ foreign workers in specialty occupations for an initial period of three years, extendable to six years. The Immigration Innovation Act would increase the limit for such visas from 65,000 to 115,000. If the pace of applications exceeds the cap within certain specified periods, the allotment will automatically be increased with an eventual hard cap of 300,000. The bill would facilitate the mobility of skilled foreign workers by removing current impediments and costs related to changing employers. It would also authorize employment for dependent spouses of H-1B visa holders. Green cards: The bill would increase the number of available employment-based green cards by reaching back to include green card allotments that went unused in prior years and exempting certain categories of applicants, such as STEM advanced degree holders, from counting against the annual cap. The act provides green card eligibility to "persons with extraordinary ability," and "outstanding professors and researchers," as well as to dependents of employment-based immigrant visa recipients. Current country of origin allocation limits would be eliminated. STEM funding: The fees payable to the U.S. government for H-1B and green cards would be increased. Fees vary for the H-1B documents, but the bill sets the basic fee at $2,500 per employee for firms with more than 25 workers. Green card fees would be raised to $1,000 per employee. According to an Intel analysis, the bill raises the current fee structure by 40 percent. Portions of the federal fee revenue would be channeled to a grant program to promote STEM education and worker retraining to be administered by state governments. The revenue could amount to $300 million per year, according to Sen. Amy Klobuchar (D-Minn), a co-sponsor of the bill. President Obama touched on the high tech employment issue in his second inauguration speech. "Right now, there are brilliant students from all over the world sitting in classrooms at our top universities. They're earning degrees in the fields of the future, like engineering and computer science. But once they finish school, once they earn that diploma, there's a good chance they'll have to leave our country. Think about that," he said. "If you're a foreign student who wants to pursue a career in science or technology, or a foreign entrepreneur who wants to start a business with the backing of American investors, we should help you do that here." Costs and Benefits for Tech Sector Support for the bill by the IT community underscores the need for skilled talent, as well as the readiness of firms to absorb the cost of visa/green card fees and associated legal charges. The fees could be considered a cost of doing business, or they could be viewed as an investment. "We view it as both. The fees are not insignificant and so they give reassurance to some that H-1Bs will not be used to provide a 'cheap labor' alternative to U.S. workers," David LeDuc, senior director of public policy at SIIA, told the E-Commerce Times The fees and processing costs are already so high that it usually costs companies significantly more to hire H-1Bs than U.S. workers." The fees and charges for obtaining skilled workers must also be balanced against the cost for businesses of operating without essential talent. "When considering H-1B fees, we think it's most important to remember that the current annual limit on the number of H-1B visas, along with the per-country restrictions, mean that companies simply can't hire the workers they need or that hiring is delayed. This imposes significant costs and inefficiencies on business operations, and it's part of why the whole system needs reform," Danielle Coffey, general counsel and vice-president of public policy at TIA, told the E-Commerce Times. Congressional Hurdles and Outlook How the bill fares in Congress may depend on how an overall comprehensive package of immigration reforms is handled. "The Immigration Innovation Act could stand on its own, but in the current political situation it is unlikely that immigration issues will be handled piecemeal," Bob Sakaniwa, associate director of advocacy at the American Immigration Lawyers Association, told the E-Commerce Times. "The better prospect is that it will be included within a comprehensive package and its fate will be tied to what Congress does on the overall immigration reform effort." The history of congressional immigration debates also indicates that the IT issue should be part of a comprehensive reform effort, LeDuc added. "As much as we might like, or it might seem practical to enact various reform initiatives independently, that's not a political reality at this time."The momentum now exists for comprehensive immigration reform, and issues related to highly skilled workers have already made their way into bipartisan legislative language."We know that the attention of Congress will now be fully focused on achieving comprehensive reform and a complete bill in the next few months," Coffey said. "We're hoping that they succeed, and that's where our focus is."

#### Obama’s capital is key

Shifter, 12/27 --- adjunct professor of Latin American politics at Georgetown University’s School of Foreign Service (12/27/2012, Michael, Revista Ideel, “Will Obama Kick the Can Down the Road?” <http://www.thedialogue.org/page.cfm?pageID=32&pubID=3186>)

There is, however, a notable change in Obama’s style compared to the first term. He is far more confident and is proclaiming clear positions on key issues, such as raising tax rates on the most wealthy. Previously, Obama had been quite passive and would ask the Congress to present him with a proposal. Today, buoyed by a decisive win in November and more enthusiastic and expectant Democratic supporters, Obama is more inclined to take the initiative and draw some clear lines. How the “fiscal cliff” question is managed and ultimately resolved will likely shape the tenor and climate for Obama’s second-term agenda. If it leaves a bitter taste, then the rest of Obama’s domestic priorities will be more difficult to achieve. If both parties think they gained something in the bargain, prospects for results in other areas will improve. Not surprisingly, Obama has been explicit that reforming the US’s shameful and broken immigration system will be a top priority in his second term. There is every indication that he intends to use some of his precious political capital – especially in the first year – to push for serious change. The biggest lesson of the last election was that the “Latino vote” was decisive. No one doubts that it will be even more so in future elections. During the campaign, many Republicans -- inexplicably -- frightened immigrants with offensive rhetoric. But the day after the election, there was talk, in both parties, of comprehensive immigration reform. Despite the sudden optimism about immigration reform, there is, of course, no guarantee that it will happen. It will require a lot of negotiation and deal-making. Obama will have to invest a lot of his time and political capital -- twisting some arms, even in his own party. Resistance will not disappear. There is also a chance that something unexpected could happen that would put off consideration of immigration reform. Following the horrific massacre at a Connecticut elementary school on December 14, for example, public pressure understandably mounted for gun control, at least the ban of assault weapons. But a decision to pursue that measure -- though desperately needed -- would take away energy and time from other priorities like immigration.

#### Nuclear incentives are politically unpopular in current climate

Domenici and Miller, 12 (July 2012, Report Co-chaired by Senator Pete Domenici and Dr. Warren F. “Pete” Miller, “Maintaining U.S. Leadership in Global Nuclear Energy Markets; A Report of the Bipartisan Policy Center’s Nuclear Initiative,” <http://assets.nationaljournal.com/pdf/BPC%20Nuclear%20Initiative%20Report_format7-17.FINAL.pdf>))

Most recent nuclear policy discussions have focused on specific financing and deployment challenges for Generation III+ nuclear reactors. In the current fiscal and political climate, efforts to further increase financial incentives for nuclear energy likely must overcome significant hurdles. BPC’s Nuclear Initiative therefore focused on finding insights into comprehensive approaches to improve federal energy policy so that it can more effectively (1) address the spectrum of challenges facing nuclear power in the United States with the aim of preserving the safe use of nuclear energy as a reliable source of domestic low-carbon electricity and (2) support U.S. technological and diplomatic leadership on international nuclear issues.

#### Immigration reform is key to both hard and soft power

Nye, 12-10 --- Harvard Prof and former US assistant secretary of defense, state and chairman of the US National Intelligence Council (12/10/2013, “Immigration and American Power,” <http://www.project-syndicate.org/commentary/obama-needs-immigration-reform-to-maintain-america-s-strength-by-joseph-s--nye>)

CAMBRIDGE – The United States is a nation of immigrants. Except for a small number of Native Americans, everyone is originally from somewhere else, and even recent immigrants can rise to top economic and political roles. President Franklin Roosevelt once famously addressed the Daughters of the American Revolution – a group that prided itself on the early arrival of its ancestors – as “fellow immigrants.” In recent years, however, US politics has had a strong anti-immigration slant, and the issue played an important role in the Republican Party’s presidential nomination battle in 2012. But Barack Obama’s re-election demonstrated the electoral power of Latino voters, who rejected Republican presidential candidate Mitt Romney by a 3-1 majority, as did Asian-Americans. As a result, several prominent Republican politicians are now urging their party to reconsider its anti-immigration policies, and plans for immigration reform will be on the agenda at the beginning of Obama’s second term. Successful reform will be an important step in preventing the decline of American power.Fears about the impact of immigration on national values and on a coherent sense of American identity are not new. The nineteenth-century “Know Nothing” movement was built on opposition to immigrants, particularly the Irish. Chinese were singled out for exclusion from 1882 onward, and, with the more restrictive Immigration Act of 1924, immigration in general slowed for the next four decades. During the twentieth century, the US recorded its highest percentage of foreign-born residents, 14.7%, in 1910. A century later, according to the 2010 census, 13% of the American population is foreign born. But, despite being a nation of immigrants, more Americans are skeptical about immigration than are sympathetic to it. Various opinion polls show either a plurality or a majority favoring less immigration. The recession exacerbated such views: in 2009, one-half of the US public favored allowing fewer immigrants, up from 39% in 2008. Both the number of immigrants and their origin have caused concerns about immigration’s effects on American culture. Demographers portray a country in 2050 in which non-Hispanic whites will be only a slim majority. Hispanics will comprise 25% of the population, with African- and Asian-Americans making up 14% and 8%, respectively. But mass communications and market forces produce powerful incentives to master the English language and accept a degree of assimilation. Modern media help new immigrants to learn more about their new country beforehand than immigrants did a century ago. Indeed, most of the evidence suggests that the latest immigrants are assimilating at least as quickly as their predecessors. While too rapid a rate of immigration can cause social problems, over the long term, immigration strengthens US power. It is estimated that at least 83 countries and territories currently have fertility rates that are below the level needed to keep their population constant. Whereas most developed countries will experience a shortage of people as the century progresses, America is one of the few that may avoid demographic decline and maintain its share of world population. For example, to maintain its current population size, Japan would have to accept 350,000 newcomers annually for the next 50 years, which is difficult for a culture that has historically been hostile to immigration. In contrast, the Census Bureau projects that the US population will grow by 49% over the next four decades. Today, the US is the world’s third most populous country; 50 years from now it is still likely to be third (after only China and India). This is highly relevant to economic power: whereas nearly all other developed countries will face a growing burden of providing for the older generation, immigration could help to attenuate the policy problem for the US.In addition, though studies suggest that the short-term economic benefits of immigration are relatively small, and that unskilled workers may suffer from competition, skilled immigrants can be important to particular sectors – and to long-term growth. There is a strong correlation between the number of visas for skilled applicants and patents filed in the US. At the beginning of this century, Chinese- and Indian-born engineers were running one-quarter of Silicon Valley’s technology businesses, which accounted for $17.8 billion in sales; and, in 2005, immigrants had helped to start one-quarter of all US technology start-ups during the previous decade. Immigrants or children of immigrants founded roughly 40% of the 2010 Fortune 500 companies. Equally important are immigration’s benefits for America’s soft power. The fact that people want to come to the US enhances its appeal, and immigrants’ upward mobility is attractive to people in other countries. The US is a magnet, and many people can envisage themselves as Americans, in part because so many successful Americans look like them. Moreover, connections between immigrants and their families and friends back home help to convey accurate and positive information about the US. Likewise, because the presence of many cultures creates avenues of connection with other countries, it helps to broaden Americans’ attitudes and views of the world in an era of globalization. Rather than diluting hard and soft power, immigration enhances both. Singapore’s former leader, Lee Kwan Yew, an astute observer of both the US and China, argues that China will not surpass the US as the leading power of the twenty-first century, precisely because the US attracts the best and brightest from the rest of the world and melds them into a diverse culture of creativity. China has a larger population to recruit from domestically, but, in Lee’s view, its Sino-centric culture will make it less creative than the US. That is a view that Americans should take to heart. If Obama succeeds in enacting immigration reform in his second term, he will have gone a long way toward fulfilling his promise to maintain the strength of the US.

#### Decline causes great power wars

Zhang & Shi, Researcher @ The Carnegie Endowment, ’11

[Yuhan Zhang, Researcher at the Carnegie Endowment for International Peace, Lin Shi, Columbia University, Independent consultant for the Eurasia Group, Consultant for the World Bank, “[America’s decline: A harbinger of conflict and rivalry](http://www.eastasiaforum.org/2011/01/22/americas-decline-a-harbinger-of-conflict-and-rivalry/),” January 22nd 2011, <http://www.eastasiaforum.org/2011/01/22/americas-decline-a-harbinger-of-conflict-and-rivalry/>]

Over the past two decades, no other state has had the ability to seriously challenge the US military. Under these circumstances, motivated by both opportunity and fear, many actors have bandwagoned with US hegemony and accepted a subordinate role. Canada, most of Western Europe, India, Japan, South Korea, Australia, Singapore and the Philippines have all joined the US, creating a status quo that has tended to mute great power conflicts. However, [as the hegemony that drew these powers together withers](http://www.cfr.org/publication/23537/belttightening_for_us_foreign_policy.html), so will the pulling power behind the US alliance. The result will be an international order where power is more diffuse, American interests and influence can be more readily challenged, and conflicts or wars may be harder to avoid. As history attests, power decline and redistribution result in military confrontation. For example, in the late 19th century America’s emergence as a regional power saw it launch its first overseas war of conquest towards Spain. By the turn of the 20th century, accompanying the increase in US power and waning of British power, the American Navy had begun to challenge the notion that Britain ‘rules the waves.’ Such a notion would eventually see the US attain the status of sole guardians of the Western Hemisphere’s security to become the order-creating Leviathan shaping the international system with democracy and rule of law. Defining this US-centred system are three key characteristics: enforcement of property rights, constraints on the actions of powerful individuals and groups and some degree of equal opportunities for broad segments of society. As a result of such political stability, free markets, liberal trade and flexible financial mechanisms have appeared. And, with this, many countries have sought opportunities to enter this system, proliferating stable and cooperative relations. However, what will happen to these advances as America’s influence declines? Given that America’s authority, although sullied at times, has benefited people across much of Latin America, Central and Eastern Europe, the Balkans, as well as parts of Africa and, quite extensively, Asia, the answer to this question could affect global society in a profoundly detrimental way. Public imagination and academia have anticipated that a post-hegemonic world would return to the problems of the 1930s: regional blocs, trade conflicts and strategic rivalry. Furthermore, multilateral institutions such as the IMF, the World Bank or the WTO might give way to regional organisations. For example, Europe and East Asia would each step forward to fill the vacuum left by Washington’s withering leadership to pursue their own visions of regional political and economic orders. Free markets would become more politicised — and, well, less free — and major powers would compete for supremacy. Additionally, such power plays have historically possessed a zero-sum element. In the late 1960s and 1970s, US economic power declined relative to the rise of the Japanese and Western European economies, with the US dollar also becoming less attractive. And, as American power eroded, so did international regimes (such as the Bretton Woods System in 1973). A world without American hegemony is one where great power wars re-emerge, the liberal international system is supplanted by an authoritarian one, and trade protectionism devolves into restrictive, anti-globalisation barriers. This, at least, is one possibility we can forecast in a future that will inevitably be devoid of unrivalled US primacy.

### 1NC 3

#### Text: Nuclear Regulatory Commission should remove current licensing regulations for small modular nuclear reactors and establish an alternative licensing pathway that accounts for the unique attributes of small modular reactors.

#### Reform of NRC regulations for Small Modular Reactors key to spur the industry – must reject subsidies

Spencer & Loris, Nuclear Research Fellow @ Thomas Roe Institute, ’11

[Jack Spencer, Research Fellow in Nuclear Energy in the Thomas A. Roe Institute for Economic Policy Studies, Nicolas D. Loris is a Research Associate in the Roe Institute at The Heritage Foundation, “A Big Future for Small Nuclear Reactors?,” February 2nd 2011, http://www.heritage.org/research/reports/2011/02/a-big-future-for-small-nuclear-reactors]

If SMRs Are So Great, Where Is the Construction? While some designs are closer to market introduction than others, the fact is that America’s regulatory and policy environment is not sufficient to support a robust expansion of existing nuclear technologies, much less new ones. New reactor designs are difficult to license efficiently, and the lack of a sustainable nuclear waste management policy causes significant risk to private investment. Many politicians are attempting to mitigate these market challenges by offering subsidies, such as loan guarantees. While this approach still enjoys broad support in Congress and industry, the reality is that it has not worked. Despite a lavish suite of subsidies offered in the Energy Policy Act of 2005, including loan guarantees, insurance against government delays, and production tax credits, no new reactors have been permitted, much less constructed. These subsidies are in addition to existing technology development cost-sharing programs that have been in place for years and defer significant research and development costs from industry to the taxpayer. The problem with this approach is that it ignores the larger systemic problems that create the unstable marketplace to begin with. These systemic problems generally fall into three categories: Licensing. The Nuclear Regulatory Commission (NRC) is ill prepared to build the regulatory framework for new reactor technologies, and no reactor can be offered commercially without an NRC license. In a September 2009 interview, former NRC chairman Dale E. Klein said that small nuclear reactors pose a dilemma for the NRC because the commission is uneasy with new and unproven technologies and feels more comfortable with large light water reactors, which have been in operation for years and has a long safety record.[11] The result is that enthusiasm for building non-light-water SMRs is generally squashed at the NRC as potential customers realize that there is little chance that the NRC will permit the project within a timeframe that would promote near-term investment. So, regardless of which attributes an SMR might bring to the market, the regulatory risk is such that real progress on commercialization is difficult to attain. This then leaves large light water reactors, and to a lesser extent, small ones, as the least risky option, which pushes potential customers toward that technology, which then undermines long-term progress, competition, and innovation. Nuclear Waste Management. The lack of a sustainable nuclear waste management solution is perhaps the greatest obstacle to a broad expansion of U.S. nuclear power. The federal government has failed to meet its obligations under the 1982 Nuclear Waste Policy Act, as amended, to begin collecting nuclear waste for disposal in Yucca Mountain. The Obama Administration’s attempts to shutter the existing program to put waste in Yucca Mountain without having a backup plan has worsened the situation. This outcome was predictable because the current program is based on the flawed premise that the federal government is the appropriate entity to manage nuclear waste. Under the current system, waste producers are able to largely ignore waste management because the federal government is responsible. The key to a sustainable waste management policy is to directly connect financial responsibility for waste management to waste production. This will increase demand for more waste-efficient reactor technologies and drive innovation on waste-management technologies, such as reprocessing. Because SMRs consume fuel and produce waste differently than LWRs, they could contribute greatly to an economically efficient and sustainable nuclear waste management strategy. Government Intervention. Too many policymakers believe that Washington is equipped to guide the nuclear industry to success. So, instead of creating a stable regulatory environment where the market value of different nuclear technologies can determine their success and evolution, they choose to create programs to help industry succeed. Two recent Senate bills from the 111th Congress, the Nuclear Energy Research Initiative Improvement Act (S. 2052) and the Nuclear Power 2021 Act (S. 2812), are cases in point. Government intervention distorts the normal market processes that, if allowed to work, would yield the most efficient, cost-effective, and appropriate nuclear technologies. Instead, the federal government picks winners and losers through programs where bureaucrats and well-connected lobbyists decide which technologies are permitted, and provides capital subsidies that allow investors to ignore the systemic problems that drive risk and costs artificially high. This approach is especially detrimental to SMRs because subsidies to LWRs distort the relative benefit of other reactor designs by artificially lowering the cost and risk of a more mature technology that already dominates the marketplace. How to Fix a Broken System At the Global Nuclear Renaissance Summit on July 24, 2008, then-NRC chairman Dale Klein said that a nuclear renaissance with regard to small reactors will take “decades to unfold.”[12] If Members of Congress and government agencies do not reform their current approach to nuclear energy, this will most certainly be the case. However, a new, market-based approach could lead to a different outcome. Instead of relying on the policies of the past, Congress, the Department of Energy, and the NRC should pursue a new, 21st-century model for small and alternative reactor technologies by doing the following: Reject additional loan guarantees. Loan guarantee proponents argue that high up-front costs of new large reactors make them unaffordable without loan guarantees. Presumably, then, a smaller, less expensive modular option would be very attractive to private investors even without government intervention. But loan guarantees undermine this advantage by subsidizing the capital costs and risk associated with large reactors. A small reactor industry without loan guarantees would also provide competition and downward price pressure on large light water reactors. At a minimum, Congress should limit guarantees to no more than two plants of any reactor design and limit to two-thirds the amount of any expanded loan guarantee program that can support a single technology. Such eligibility limits will prevent support from going only to a single basic technology, such as large light water reactors.[13] Avoid subsidies. Subsidies do not work if the objective is a diverse and economically sustainable nuclear industry. Despite continued attempts to subsidize the nuclear industry into success, the evidence demonstrates that such efforts invariably fail. The nuclear industry’s success stories are rooted in the free market. Two examples include the efficiency and low costs of today’s existing plants, and the emergence of a private uranium enrichment industry. Government intervention is the problem, as illustrated by the government’s inability to meet its nuclear waste disposal obligations. Build expertise at the Nuclear Regulatory Commission. The NRC is built to regulate large light water reactors. It simply does not have the regulatory capability and resources to efficiently regulate other technologies, and building that expertise takes time. Helping the NRC to develop that expertise now would help bring new technologies into the marketplace more smoothly. Congress should direct and resource the NRC to develop additional broad expertise for liquid metal-cooled, fast reactors and high-temperature, gas-cooled reactors. With its existing expertise in light water technology, this additional expertise would position the NRC to effectively regulate an emerging SMR industry. Establish a new licensing pathway. The current licensing pathway relies on reactor customers to drive the regulatory process. But absent an efficient and predictable regulatory pathway, few customers will pursue these reactor technologies. The problem is that the legal, regulatory, and policy apparatus is built to support large light water reactors, effectively discriminating against other technologies. Establishing an alternative licensing pathway that takes the unique attributes of small reactors into consideration could help build the necessary regulatory support on which commercialization ultimately depends.[14] Resolve staffing, security, construction criteria, and fee-structure issues by December 31, 2011. The similarity of U.S. reactors has meant that the NRC could establish a common fee structure and many general regulatory guidelines for areas, such as staffing levels, security requirements, and construction criteria. But these regulations are inappropriate for many SMR designs that often have smaller staff requirements, unique control room specifications, diverse security requirements, and that employ off-site construction techniques. Subjecting SMRs to regulations built for large light water reactors would add cost and result in less effective regulation. The NRC has acknowledged the need for this to be resolved and has committed to doing so, including developing the budget requirements to achieve it. It has not committed to a specific timeline.[15] Congress should demand that these issues be resolved by the end of 2011. Reform waste management. The federal government’s inability to fulfill its legal obligations under the 1982 Nuclear Waste Policy Act has often been cited as a significant obstacle to building additional nuclear power plants. Given nuclear power’s potential to help solve many of the nation’s energy problems, now is the time to break the impasse over managing the nation’s used nuclear fuel. The current system is driven by government programs and politics. There is little connection between used-fuel management programs, economics, and the needs of the nuclear industry. Any successful plan must grow out of the private sector, be driven by sound economics, and provide access to the funds that have been set aside for nuclear waste management.[16] Such an approach would propel the development of SMRs by placing market value on their potential waste management attributes. Transitioning to a New Era of Nuclear Power It is an exciting time for the nuclear industry in the United States and around the world, but that excitement could quickly dwindle if Congress and the White House do not usher in a new path forward for nuclear energy. New technologies have the potential to revolutionize how people produce and consume energy, but if the same bureaucratic approach is taken, it will create the same problems of dependency and stagnation that led to the demise of the commercial nuclear industry decades ago. Congress and the Administration have the opportunity to create a robust, competitive market for nuclear power and should implement the necessary reforms to make this happen.

#### SMRs use less uranium

Tularak & Totev, Argonne National Lab, ’11

[Thitidej, Office of Atoms for Peace, and Dr. Totju, Argonne National Laboratory, “IAEA Fellowship Work Report,” AM]

Reduced spent fuels and waste management obligation: Nuclear waste and spent fuels are another critical part in nuclear industry. They are sensitive in posting threats to people and environment. With most designs offering longer fuel lifetime and smaller amount of nuclear waste and spent fuels, SMRs are able to limit obligation in waste management and spent fuels or even have no spent fuel pool.

#### SMR’s solve warming

Rosner & Goldberg, Physics Prof @ U Chicago, ’11

[Robert Rosner, William E. Wrather, Distinguished Service Professor, Departments of Astronomy and Astrophysics, and Physics at The University of Chicago, Director, Energy Policy Institute, Harris School of Public Policy, Stephen Goldberg, Professor of Law Emeritus at Northwestern Law, “Small Modular Reactors – Key to Future Nuclear Power Generation in the U.S.,” Energy Policy Institute at The University of Chicago, November 2011]

As stated earlier, SMRs have the potential to achieve significant greenhouse gas emission reductions. They could provide alternative baseload power generation to facilitate the retirement of older, smaller, and less efficient coal generation plants that would, otherwise, not be good candidates for retrofitting carbon capture and storage technology. They could be deployed in regions of the U.S. and the world that have less potential for other forms of carbon-free electricity, such as solar or wind energy. There may be technical or market constraints, such as projected electricity demand growth and transmission capacity, which would support SMR deployment but not GW-scale LWRs.

### 1NC 4

#### Reprocessing is techno-utopian – it combines discourse about “inherently safe reactors” with justifications for increased nuclear leadership – this blocks public engagement, driving towards environmental destruction and nuclear extinction

Byrne & Toly 6

(Josh, director of the Center for Energy and Environmental Policy and distinguished professor of energy and climate policy at the University of Delaware, Noah, Associate Professor of Urban Studies and Politics & International Relations, Director of Urban Studies Program at Wheaton, “Energy as a Social Project: Recovering a Discourse”, pgs. 1-32 in Transforming Power: Energy, Environment, and Society in Conflict, eds. Josh Byrne, Noah Toly, and Leigh Glover)

With environmental crisis, social inequality, and military conflict among the significant problems of contemporary energy-society relations, the importance of a social analysis of the modern energy system appears easy to establish. One might, therefore, expect a lively and fulsome debate of the sector’s performance, including critical inquiries into the politics, sociology, and political economy of modern energy. Yet, contemporary discourse on the subject is disappointing: instead of a social analysis of energy regimes, the field seems to be a captive of euphoric technological visions and associated studies of “energy futures” that imagine the pleasing consequences of new energy sources and devices.4 One stream of euphoria has sprung from advocates of conventional energy, perhaps best represented by the unflappable optimists of nuclear power who, early on, promised to invent a “magical fire” (Weinberg, 1972) capable of meeting any level of energy demand inexhaustibly in a manner “too cheap to meter” (Lewis Strauss, cited in the New York Times 1954, 1955). In reply to those who fear catastrophic accidents from the “magical fire” or the proliferation of nuclear weapons, a new promise is made to realize “inherently safe reactors” (Weinberg, 1985) that risk neither serious accident nor intentionally harmful use of high-energy physics. Less grandiose, but no less optimistic, forecasts can be heard from fossil fuel enthusiasts who, likewise, project more energy, at lower cost, and with little ecological harm (see, e.g., Yergin and Stoppard, 2003). Skeptics of conventional energy, eschewing involvement with dangerously scaled technologies and their ecological consequences, find solace in “sustainable energy alternatives” that constitute a second euphoric stream. Preferring to redirect attention to smaller, and supposedly more democratic, options, “green” energy advocates conceive devices and systems that prefigure a revival of human scale development, local self-determination, and a commitment to ecological balance. Among supporters are those who believe that greening the energy system embodies universal social ideals and, as a result, can overcome current conflicts between energy “haves” and “havenots.” 5 In a recent contribution to this perspective, Vaitheeswaran suggests (2003: 327, 291), “today’s nascent energy revolution will truly deliver power to the people” as “micropower meets village power.” Hermann Scheer echoes the idea of an alternative energy-led social transformation: the shift to a “solar global economy... can satisfy the material needs of all mankind and grant us the freedom to guarantee truly universal and equal human rights and to safeguard the world’s cultural diversity” (Scheer, 2002: 34).6 The euphoria of contemporary energy studies is noteworthy for its historical consistency with a nearly unbroken social narrative of wonderment extending from the advent of steam power through the spread of electricity (Nye, 1999). The modern energy regime that now powers nuclear weaponry and risks disruption of the planet’s climate is a product of promises pursued without sustained public examination of the political, social, economic, and ecological record of the regime’s operations. However, the discursive landscape has occasionally included thoughtful exploration of the broader contours of energy-environment-society relations.

#### **Alt text: the judge should vote negative to politicize nuclear science**

#### **It’s try-or-die for a nuclear public sphere – only politicizing nuclear science checks arms races and future weapons development**

Beljac ‘8

(Marko has a PhD from Monash University, “Mission Statement”, http://scisec.net/?page\_id=5)

But it cannot be stated that the mere existence of a faculty of scientific cognition foreordains an extinction event. It is a necessary but not sufficient condition. This is because science and technology are inherently neutral. What matters as well is the social context in which science is pursued especially the link between scientific endeavour and moral agency. As stated above we can consider Hume’s distinction between fact and value, in conjunction with the naturalistic fallacy due to Moore, as a form of argument from the poverty of the stimulus for a faculty of moral cognition. Much interesting work in the cognitive sciences is now exploring the underlying nature of how this innate faculty of the mind operates. We can be thankful that we posses such a faculty. A faculty of scientific cognition without an accompanying system of moral principles would be most calamitous. Without it there would be little break on scientific knowledge being used for nefarious ends and the only way to prevent destruction in the nuclear age would be an appeal to rational self-interest upon the basis of a system of stable strategic deterrence. In other words in a world of states and scientific technique the only means of averting Armageddon would be the perpetual prospect of its unleashing. However, the mere existence of credible deterrent forces poses a small but non-zero probability of accidental nuclear war per annum. This small but non-zero value asymptotically tends to unity over time. Survival in the nuclear age cannot be indefinitely guaranteed by an overarching prospect of Armageddon. What is most striking about the nuclear age is that the underlying basis of the system of scientific and technical innovation lies at the core of the race to destruction. Many former scientific insiders, who turned against the arms race during the cold war, dubbed this the “technological imperative.” The idea was neatly captured by Richard Rhodes in the third installment of his The Arsenals of Folly (p83), In an official oral history of U.S. strategic nuclear policy produced by Sandia National Laboratories, the historian Douglas Lawson of Sandia comments that “the large growth that we saw [in nuclear weapons production] in the 1950s and 1960s was primarily driven by the capacity of the [production] complex and not truly by [military] requirements”. A designer at Sandia, Leon Smith, notes that “it was our policy at that time not to wait for requirements from the military but to find out from the technologies that were available what the art of the possible would be.” The former director of the Lawrence Livermore Laboratory, John S. Foster Jr., adds, “we were making it up as we went along.” Such candid sentiments confirm careful empirical research on technological innovation during the cold war. That is, developments in the nuclear age owed little to external perceptions of threat. There was an underlying internal rationality to the strategic build-up and this underlying rationality by no means has disappeared with the fall of the Berlin Wall. Think for instance of Ballistic Missile Defence and the weaponisation of space. Though such a technological imperative exists it is possible to carry the argument too far into a crude form of technological determinism. More is needed to reach true understanding. This can be found by virtue of what in economic theory is called a positive externality. A positive externality is an instance of market failure. Here an economic agent, most usefully a corporation, would not get the full benefits of investment but rather that the benefit to society would exceed the benefit to the firm. Outsiders would benefit more than the entity making the investment. Given this it would be irrational for the profit seeking firm to subsidize society. Scientific knowledge should properly be seen as a positive externality. In pure market system driven by perfectly rational agents the development of scientific knowledge would be irrational given the presence of positive externalities. The most useful way to deal with market failure due to positive externalities is via state subsidy. This is precisely why scientific knowledge and technological innovation, which enables the formation of high technology industry, has proceeded everywhere upon the basis of large scale state subsidisation. In the United States subsidisation in the presence of positive externalities occurs via the Pentagon system. Technological innovation, including in the strategic sector, did not owe itself in the United States to an external threat because such innovation was a mechanism to obviate wider positive externalities. It still is. So long as scientific knowledge as a type of positive externality is subsidized via the Pentagon system the race to destruction brought about by scientific and technological advance will continue to have an underlying rational basis. It must be stressed that such a rational dynamic cannot be discernable in the market system exclusively. State subsidy via the military is by no means inevitable and the Soviet Union, a command economy, displayed similar behaviour within its military-industrial complex. The Political Science of Science and Global Security There are a number of other factors to consider. Firstly, there exists a sort of scientific and technological security dilemma. The security dilemma is a regular staple of realist theoretical international relations and though it is real its significance should not be overestimated. That is to say, it is real but it accounts for a very small part of actual strategic developments. The most important form of the security dilemma is not the crude numerical models often spoken of in the literature. Paarberg is correct to note that US global strategic hegemony is due to the scientific and technological edge of its armed forces (which is brought about by underlying economic power). In a condition of anarchy and the concomitant existence of scientific technique it is possible to imagine the possibility of a sort of scientific race. Though real we should be careful not to overstate it. In fact, the arms race during the cold war was a series of moves and counter-moves in the technical sphere. One reason why Gorbachev called off the race was because the USSR was starting to lag technologically and the Soviet system could not convert scientific advance into meaningful industrial production. Given this dynamic we may speak of an epistemic argument against state sovereignty. It is interesting to observe that all proposals for dealing with the genie unleashed by the development of nuclear physics and technology involve the constraint of state sovereignty. Nuclear non proliferation and disarmament measures are successful to the extent that they corrode state sovereignty. Man’s innate epistemic capacity to form sciences and unfettered state power do not mix and the existence of this cognitive capacity compels the formation of post-Westphalian political forms. It is interesting that the state system and the scientific revolution have closely tracked each other. This common origin needs to be further explored. One very important link here is democracy. It has been noted that the strategic nuclear weapons policy in the US, but also elsewhere, has been the domain of a small policy and technocratic elite. A lot of the underlying theories of dangerous nuclear postures have been developed via fanciful game theoretic and systems analysis that served to provide ideological cover for strategic build-ups. This has led to what the noted American political scientist Robert Dahl has referred to as “guardianship”. In other words throughout the nuclear age the big decisions governing nuclear policy have been in the hands of a small community of elite policy makers rather than the public. Dahl notes that most critiques of democracy argue that, The average person is not sufficiently competent to govern, while, on the other hand, a minority of persons, consisting of the best qualified, are distinctly more competent to rule, and so ought to rule over the rest. This is, in essence, Plato’s argument in The Republic for a system of guardianship. Leaders who proclaim this view usually contend that they, naturally, are among the minority of exceptionally able people who ought to exercise guardianship over the rest… …Consider a few contemporary issues in this country: What are we to do about nuclear waste disposal? Should recombinant DNA research be regulated by the government? If so, how? The problem of nuclear reactor safety and the trade offs between the risks and gains of nuclear power are much more complex than the simple solutions offered on all sides would suggest. Or consider the technical and economic issues involved in clean air. At what point do the costs of auto emissions control exceed the gains? How and to what point should industrial pollution be regulated? For example, should electric utilities be required to convert to clean burning fuels, or to install stack scrubbers? How serious a problem is ozone depletion, and what should be done about it? The same applies to such matters as nuclear weapons, nuclear proliferation, BMD, space weapons and so on. So long as policy is effectively out of the hands of the public it is not possible to envisage a link being drawn between science and moral agency. The democratisation of science and technology is a necessary task to ensure further survival. It is a point made forcefully by the eminent theoretical physicist and cosmologist Sir Martin Rees. The democratisation of science would also remove the public subsidy that undergirds the Pentagon system.

### 1NC 5

#### Natural gas prices are rising now – causes utilities to shift to coal

Litvak 2012 (November 9, Anya, “Pennsylvania coal industry faces changing future” <http://www.bizjournals.com/pittsburgh/print-edition/2012/11/09/coal-industry-faces-changing-future.html?page=all>)

When having a discussion on the future of coal, it would be unlikely to hear natural gas go unmentioned. Natural gas is a cleaner burning fuel whose recently made available reserves have brought down prices to historic lows. “It is economics driving this move from coal to gas, at least right now,” said Paul Sotkiewicz, chief economist for PJM, the nation’s largest grid operator that controls the flow of electricity in 13 states, including Pennsylvania. In the first six months of this year, under 42 percent of electricity in PJM came from coal, while nearly 20 percent came from gas — a record high and a record low, respectively. Five years ago, coal was at 57 percent and gas below 6 percent. Over the past two years, new gas units coming into the grid have doubled, while nearly 18 gigawatts of coal generation will be deactivated. “Gas prices will be between $4-$5 per British thermal unit in the near term range and coal prices are only going to continue marching forward,” Sotkiewicz said. “We’re looking at a huge reconfiguration of the fleet.” In spite of all that, he warned, in paraphrasing Mark Twain, “the death of coal has been greatly exaggerated.” This year, Ohio-based FirstEnergy Corp. (NYSE: FE), the largest utility in Pennsylvania and owner of West Penn Power, said it was considering co-burning natural gas with coal at five of its power plants, including three in the state. More than 60 percent of FirstEnergy’s fuel comes from coal plants. Its first gas co-firing test target would be Hatfield’s Ferry, a three-boiler coal plant in Masontown with a capacity of 1,710 megawatts. Spokesman Mark Durbin said it’s unlikely FirstEnergy would go through with co-firing if natural gas prices go beyond $3 per MBtu (million British thermal units). That would make gas uncompetitive with the price of coal, he said. For the first part of 2012, the average price of a million Btus of coal at electric utilities was $2.44, according to the Energy Information Administration. The average price of natural gas was $2.50 per MBtu. Usually, the gap is much greater. In 2009, Consol Energy Inc. (NYSE: CNX), a 148-year-old coal company, entered the shale business, partly as a hedge against its traditional fuel. “We made a $3.5 billion bet that gas was going to be the fuel of the future,” said Randy Albert, COO of Consol’s gas division. Alpha Natural Resources (NYSE: ANR) did the same a year later, partnering with Rice Energy to explore the Marcellus Shale in Washington and Greene counties. Right now, low natural gas prices are actually hurting both sides of their business. They handicap the profits the companies can make on the gas side and make coal less competitive for utilities, thereby decreasing demand. However, when the price of one fuel goes up, the other follows. “People in the gas market are sitting there rooting for exports to Asia so they can get the price of coal up, so that can drive the prices of gas up,” said John Hynes, a partner with West Virginia-based Excidian LLC. In late September, natural gas finally broke the $3 mark for the first time this year and has since been on the rise. Already, Consol is seeing the upside of that trend, said Robert Pusateri, executive vice president of energy sales and transportation services. “Favorable natural gas price trends have enabled us to conclude several large thermal coal agreements for 2013,” Pusateri told investors during an earnings call last month. “In a recent conversation that I had with a fuel buyer, he commented that with the recent uptick of natural gas pricing, that this was making him rethink his coal purchase strategy for 2013 so that he didn’t get himself caught short as gas prices continually trend up.” With natural gas prices on the rebound, coal may regain its traditional rank as a stable, low-cost fuel. “Cheap energy’s not a right, it’s a privilege,” Albert said. “And at the end of the day, American people won’t stand for that privilege to be taken away.”

#### Expanding nuclear power drives down natural gas prices

Adams, Chief Contributor for Atomic Energy Insights and small nuclear plant operator/designer, 09

(Nuclear Energy Growth Might Turn Promises of Low Natural Gas Prices Into a Reality, atomicinsights.com/2009/11/nuclear-energy-growth-might-turn-promises-of-low-natural-gas-prices-into-a-reality.html)

However, I am not the only energy industry observer who understands the interrelationships between various fuel choices. If, in fact, people in positions to make major decisions about energy policy follow my advice and reduce the barriers that currently slow down nuclear power plant construction, one of the effects of that might be to make it seem like the natural gas salesmen were correct in their promises of abundant supplies. As more nuclear power plants come on line, their output would displace power that is currently being produced by burning natural gas. Their output might even be enough to drive down electrical power prices to a level that would make all-electric home and commercial heating and cooling systems an economical choice. That would also free up more gas and lower the prices of that newly abundant fuel – an abundance produced by falling demand instead of by a growing supply. That effect would be very similar to the way the market behaved for well over a decade after the last rapid build out of nuclear power plants. From 1985-2000, natural gas prices all over the world were quite low – Russia was selling gas to favored customers for about $50 per 1000 cubic meters (roughly $1.40 per thousand cubic feet) while US prices hovered around $2 per million BTU (which is also very close to $2 per thousand cubic feet). Though some might disagree, it is hard to overlook the fact that those low prices followed an era where nuclear energy production increased rapidly. That era of low gas prices made investors in nuclear generation facilities look a little silly while the people who built simple gas turbines and burned cheap gas looked like sage energy price prediction geniuses.

#### EPA regulations mean low natural gas prices stop the shift to CCS

McCarthy and Copeland 2011 - Specialist in Environmental Policy AND Specialist in Resources and Environmental Policy (August 8, James E. and Claudia, “EPA’s Regulation of Coal-Fired Power: Is a “Train Wreck” Coming? ” <http://www.lawandenvironment.com/uploads/file/CRS-EPA.pdf>)

What these scenarios tell us is that utilities will look at the impending regulations and decide what to do largely based on their assumptions regarding the cost of the alternatives—natural gas (where it’s available) being the most often discussed, but others include conservation, wind, and other renewable resources. If they expect the price of gas to remain low or the cost of other alternatives to be competitive, their primary method of compliance likely will be to retire old coal plants and switch to gas or the alternatives. If they expect the price of gas or other alternatives to be high, they’ll invest the money in retrofitting the coal plants to reduce their emissions. As the NERC report stated: Unit retirement is assumed when the generic required cost of compliance with the proposed environmental regulation exceeds the cost of replacement power.... For the purpose of this assessment, replacement power costs were based on new natural gas generation capacity. If the unit’s retrofit costs are less than the cost of replacement power, then the unit is marked to be upgraded and retrofitted to meet the requirements of the potential environmental regulation., i.e., it is not considered “economically vulnerable” for retirement. 99 As utilities attempt to forecast the price of natural gas, their conclusions will be based in large part on assumptions as to whether gas will be available in sufficient quantities to meet the increased demands of electric power generation. Natural gas faces its own controversies, as domestic production increasingly relies on “unconventional” sources such as shale, from which gas is obtained by hydraulic fracturing. (For additional information on this practice, see CRS Report R41760, Hydraulic Fracturing and Safe Drinking Water Act Issues, by Mary Tiemann and Adam Vann.) Nevertheless, a 2009 NERC report stated: Concerns regarding the availability and deliverability of natural gas have diminished during 2009 as North American production has begun to trend upward due to a shift toward unconventional gas production from shale, tight sands, and coal-bed methane reservoirs. In its latest biennial assessment, the Potential Gas Committee increased U.S. natural gas resources by nearly 45 percent to 1,836 TCF [trillion cubic feet], largely because of increases in unconventional gas across many geographic areas. Pipeline capacity has similarly increased, by 15 BCFD [billion cubic feet per day] in 2007 and 44 BCFD in 2008, with an increase of 35 BCFD expected in 2009. Storage capacity has also increased substantially. 100 In short, the “train wreck” facing the coal-fired electric generating industry, to the extent that it exists, is being caused by cheap, abundant natural gas as much as by EPA regulations. As John Rowe, Chairman and CEO of Exelon Corporation, recently stated: “These regulations will not kill coal.... In fact, modeling done on the impacts of these rules shows that up to 50% of retirements are due to the current economics of the plant due to natural gas and coal prices.

#### Cheap natural gas obliterates the railroad industry – Coal shipping and competition with trucking

Ferry, Contributor to the Motley Fool Blog Network, 12

(6/17, Railroads Prepare for the Threat of Natural Gas, beta.fool.com/catominor/2012/06/17/railroads-prepare-threat-natural-gas/5836/

North American's freight railroads have delivered impressive performances since deregulation in the 1980s, growing into one of the largest and most efficient freight transportation systems in the world. Significant revenue drivers for railroads over the past few years have been large coal shipments to power plants, as well as a competitive advantage over trucking due to better fuel efficiency. Over the next decade, a secular trend in favor of cheap, clean natural gas will undermine these strengths. Railroads are anticipating the challenge and are taking steps to protect their businesses, but some lines will be far more exposed than others. American power plants have been hungry for coal, and the railroads have delivered it, transporting over 70% of the nation's coal. Coal typically accounts for around a quarter of rail volumes and just under a third of revenue for North America's Class I railroads. Like most commodities, coal volumes took a hit in 2009, which in turn dragged heavily on railroad's bottom lines. More distressingly, coal has been slow to recover with the rest of the economy, as a natural gas boom made possible by hydrofracking makes coal a less attractive fossil fuel. Worse for coal, the EPA has come out with new emissions guidelines that are likely to prevent another new coal plant from ever opening in the country. Last quarter, the volume of coal shipped by railroads slipped by 15–20%. But the railroads aren't sitting still. For one, while natural gas may be on the rise in the US, China is still hungry for coal and American exporters haven't even begun to meet this need. As domestic demand cools, coal miners and railroads alike are hoping that China can pick up the slack. Vast reserves in Wyoming's Powder River Basin are conveniently located for Pacific export, but current infrastructure on the West Coast is insufficient to handle large volumes. Plans are in the works to construct six new coal terminals in Washington and Oregon, and that would tremendously benefit rail lines with access to both the Powder River Basin and the planned terminals, including Union Pacific (NYSE: UNP) and BNSF, owned by Berkshire Hathaway (NYSE: BRK-B). Rail lines exposed primarily to Appalachian coal, without access to Pacific terminals, like CSX (NYSE: CSX) and Norfolk Southern (NYSE: NSC), will find it much more difficult to compensate for lagging domestic demand through export growth, as the European export market is already quite developed. These companies will simply have to diversify their shipment mix away from coal. Canadian National (NYSE: CNI) is the leader here, with coal accounting for only 7% of revenue, less than a quarter of its peers. Recently railroads have profited from an increase in the volume of automobiles and intermodal traffic, typically containerized cargo. Ironically the natural gas boom could help railroads, because cheap natural gas is used by American chemical companies as a feedstock for other products. Increased chemical production should translate to increased volumes of chemical shipments on the rails. Ultimately, the bigger threat from natural gas could be the advantage it gives to rail's chief competitor, freight trucking. The trucking industry is in the early stages of converting to natural gas engines, which will drastically reduce truckers' fuel costs. The better fuel efficiency of rail is what makes it competitive, because trucking benefits from public infrastructure support that rail doesn't have. Trucks do pay the Federal Highway Use Tax, but this doesn't cover the full cost of highway construction and maintenance, and truckers only have to pay the tax to the extent that they actually use roads, allowing them to better control expenses when volumes are low. Rail companies typically own their own tracks, and are fully responsible for maintenance and expansion. When volumes suffer, and fewer trains use the tracks, the railroads must still maintain them at full cost, putting them at a disadvantage. Most Class I railroads pay around 20% of total revenue on capital expenditure. If they lose their advantage in fuel efficiency to natural gas engine trucks, they could be forced to accept lower pricing to remain competitive. In an industry that has typically struggled to earn returns above and beyond their cost of capital, this prospect could negatively impact shareholders for many years to come.

#### Strong commercial freight railroads are key to readiness

Robert S. Korpanty is a licensed professional engineer employed by the Military Traffic Management Command Transportation Engineering Agency in Newport News, Virginia, December 1999, "Preserving Strategic Rail Mobility," [www.almc.army.mil/alog/issues/NovDec99/MS455.htm](http://www.almc.army.mil/alog/issues/NovDec99/MS455.htm)

Tell any mechanized maneuver commander he has to fight a battle without his Abrams tanks or Bradley fighting vehicles, and you probably will see a puzzled look on his face that could be interpreted as, "What planet are you from?" or, "What language are you speaking?" Since it is doubtful that a major conflict will occur just outside the gates of Fort Stewart, Georgia, or Fort Hood, Texas, a key element of a successful engagement will be getting combat power wherever it is needed on time. Without a reliable commercial rail infrastructure, it is doubtful the tanks and Bradleys will make it to their place of business. To make sure they do, the Military Traffic Management Command developed the Railroads for National Defense (RND) Program in 1976. In 1991, the RND Program was assigned to the Military Traffic Management Command Transportation Engineering Agency (MTMCTEA), which now executes the program on behalf of the U.S. Transportation Command. This program ensures that the commercial rail infrastructure in the United States meets Department of Defense (DOD) requirements for deploying a force. The RND Program works to preserve our strategic rail mobility. RND's Functions The poor condition of the rail industry in the mid- 1970's led to development of the RND Program. At that time, the rail industry was characterized by poor track maintenance that caused several derailments and the bankruptcy of six major eastern carriers and foretold a questionable future. DOD experienced on-post derailments that delayed deployment exercises. At this point, DOD realized how important the rail infrastructure was and became concerned about the state of the commercial rail industry. DOD also realized that it did not know which installations required rail service or which commercial rail lines between installations and ports were important to national defense.

#### Decline of readiness causes global lashout and war

Spencer, Senior Research Fellow at Heritage, 2000

(The Facts About Military Readiness, www.heritage.org/research/reports/2000/09/bg1394-the-facts-about-military-readiness

Military readiness is vital because declines in America's military readiness signal to the rest of the world that the United States is not prepared to defend its interests. Therefore, potentially hostile nations will be more likely to lash out against American allies and interests, inevitably leading to U.S. involvement in combat. A high state of military readiness is more likely to deter potentially hostile nations from acting aggressively in regions of vital national interest, thereby preserving peace. Readiness Defined. Readiness measures the ability of a military unit, such as an Army division or a carrier battle group, to accomplish its assigned mission. Logistics, available spare parts, training, equipment, and morale all contribute to readiness. The military recognizes four grades of readiness.7 At the highest level, a unit is prepared to move into position and accomplish its mission. At the lowest level, a unit requires further manpower, training, equipment, and/or logistics to accomplish its mission. There is evidence of a widespread lack of readiness within the U.S. armed forces. Recently leaked Army documents report that 12 of the 20 schools training soldiers in skills such as field artillery, infantry, and aviation have received the lowest readiness rating. They also disclose that over half of the Army's combat and support training centers are rated at the lowest readiness grade.8 As recently as last November, two of the Army's 10 active divisions were rated at the lowest readiness level, and none were rated at the highest.9 Every division required additional manpower, equipment, or training before it would be prepared for combat, due largely to the units' commitments to operations in the Balkans.10 And 23 percent of the Army's Chinook cargo helicopters, 19 percent of its Blackhawk helicopters, and 16 percent of its Apaches are not "mission-capable."11 In other words, they are not ready. The Facts about Military Readiness The reduction in forces of the U.S. armed forces began in the early 1990s. After the end of the Cold War, the Bush Administration began to reduce the size of the military so that it would be consistent with post-Cold War threats.12 Under the Clinton Administration, however, that reduction in forces escalated too rapidly at the same time that U.S. forces were deployed too often with too little funding. The result was decreased readiness as personnel, equipment, training, and location suffered. Since the Persian Gulf War in 1991, the U.S. military has been deployed on over 50 peacekeeping and peace-enforcement operations.13 Yet the resources available to fund these missions have steadily decreased: The number of total active personnel has decreased nearly 30 percent, and funding for the armed services has decreased 16 percent. The strain on the armed forces shows clearly now as the reduced forces deploy for too long with insufficient and antiquated equipment. The result is indisputable: Readiness is in decline. Because the security of the United States is at stake, it is imperative to present the facts about military readiness: FACT #1. The size of the U.S. military has been cut drastically in the past decade. Between 1992 and 2000, the Clinton Administration cut national defense by more than half a million personnel and $50 billion in inflation-adjusted dollars.14 (See Table 1.) The Army alone has lost four active divisions and two Reserve divisions. Because of such cuts, the Army has lost more than 205,000 soldiers, or 30 percent of its staff, although its missions have increased significantly throughout the 1990s. In 1992, the U.S. Air Force consisted of 57 tactical squadrons and 270 bombers. Today the Air Force has 52 squadrons and 178 bombers. The total number of active personnel has decreased by nearly 30 percent. In the Navy, the total number of ships has decreased significantly as well. In 1992, there were around 393 ships in the fleet, while today there are only 316, a decrease of 20 percent. The number of Navy personnel has fallen by over 30 percent. In 1992, the Marine Corps consisted of three divisions. The Corps still has three divisions, but since 1992, it has lost 22,000 active duty personnel, or 11 percent of its total. The Clinton Administration also cut the Marine Corps to 39,000 reserve personnel from 42,300 in 1992. Effect on Readiness. In spite of these drastic force reductions, missions and operations tempo have increased, resulting in decreased military readiness. Because every mission affects far greater numbers of servicemen than those directly involved, most operations other than warfare, such as peacekeeping, have a significant negative impact on readiness. For each serviceman who participates in a military operation, two others are involved in the mission: one who is preparing to take the participant's place, and another who is recovering from having participated and retraining. Therefore, if 10,000 troops are on peace operations in the Balkans, 30,000 troops are actually being taken away from preparing for combat. Ten thousand are actively participating, while 10,000 are recovering, and 10,000 are preparing to go. Coupled with declining personnel, increased tempo has a devastating effect on readiness. Morale problems stemming from prolonged deployments, equipment that wears out too quickly, and decreased combat training levels heighten when troops are committed to non-combat operations. Further exacerbating the military's declining readiness is the tendency to take troops with special skills from non-deployed units. Thus, a mission may affect non-deployed units as well because they will not be able to train properly. The soldiers integral to the non-deployed mission are not present, and there is no one to take their place. A mission's spillover effects are clearly illustrated by a July 2000 report by the U.S. General Accounting Office (GAO) on the U.S. commitments in the Balkans: In January 2000 ... four active divisions and one Guard division were affected by these operations [in the Balkans]. Among the active divisions, the 1st Cavalry Division was recovering from a 1-year deployment in Bosnia, the 10th Mountain Division was deployed there, and elements of the Guard's 49th Armored Division were preparing to deploy there. At the same time, the European-based 1st Infantry Division was deployed to Kosovo, and the 1st Armored Division was preparing to deploy there. Although none of these divisions deployed in its entirety, deployment of key components--especially headquarters--makes these divisions unavailable for deployment elsewhere in case of a major war.15 Simultaneously, the military's budget has continuously decreased over the past eight years; and, thus, the services are being forced to choose between funding quality of life improvements, procurement, training, and other essential spending. Consequently, none is adequately funded. For example, the Army is short by thousands of night vision goggles, binoculars, global positioning systems and hundreds of generator sets, battery chargers, and chemical agent monitors. (See Table 2.) According to the Office of the Army Deputy Chief of Staff for Logistics, these shortages are due to "recent increases in requirements," "slowed procurement funding," and "use of operations and maintenance funds for higher priorities."16 Furthermore, when smaller forces deploy for more missions, the result is increased wear-and-tear on equipment and longer deployments for servicemen. Coupled with too little money, the result is a military weakened by aging equipment, low morale, and poor training. FACT #2. Military deployments have increased dramatically throughout the 1990s. The pace of deployments has increased 16-fold since the end of the Cold War.17 According to Representative Curt Weldon (R-PA), the Clinton Administration has deployed U.S. forces 34 times in less than eight years. During the entire 40-year period of the Cold War, the military was committed to comparable deployments just 10 times.18 Between 1960 and 1991, the Army conducted 10 operations outside of normal training and alliance commitments, but between 1992 and 1998, the Army conducted 26 such operations. Similarly, the Marines conducted 15 contingency operations between 1982 and 1989, and 62 since 1989.19 During the 1990s, U.S. forces of 20,000 or more troops were engaged in non-warfighting missions in Somalia (1993), Haiti (1994), Bosnia (1996), and Iraq and Kuwait (1998).20 In 1998, before U.S. interventions in Kosovo and East Timor, General Henry Shelton, the Chairman of the Joint Chiefs of Staff, warned, "In the past four years we've conducted some four dozen major operations. And today, in support of our national strategy, we have more than 50,000 troops deployed in 12 major operations--and, I might add, many smaller ones--in dozens of countries around the world." Today the Army has 144,716 soldiers in 126 countries.21 Throughout the 1990s, U.S. taxpayers spent an average of $3 billion per year on peace operations.22 In 1990, the U.S. Department of Defense (DOD) spent around $200 million on peace operations. Today that amount has ballooned to $3.6 billion.23 The 78-day Kosovo campaign in 1999 cost around $5 billion, not including the ongoing peace mission.24 Operations Southern and North Watch in Iraq cost $1.1 billion per year; the Haiti operation cost a total of $2.4 billion; and to date, the Balkans have cost over $15 billion.25 (See Table 3.) Effect on Readiness. This dramatic increase in the use of America's armed forces has had a detrimental effect on overall combat readiness. According to General Shelton, "our experience in the Balkans underscores the reality that multiple, persistent commitments place a significant strain on our people and can erode warfighting readiness."26 Both people and equipment wear out faster under frequent use. For example, units deployed in Somalia took 10 months to restore their equipment to predeployment readiness levels.27 According to a Congressional Budget Office (CBO) survey of Army leaders who participated in peace missions, almost two-thirds said that their units' training readiness had declined.28 Training is a key component of readiness, and frequent missions cause the armed forces to reduce training schedules. For example, Operation Allied Force caused 22 joint exercises to be cancelled in 1999. Joint training exercises were reduced from 277 in fiscal year (FY) 1996 to 189 in FY 2000.

### AT: Solvency

#### Natural gas is reversing nuclear power by closing plants

Reuters - Scott DiSavino and Eileen O'Grady – 2/6/13, Retired Duke reactor may signal more U.S. nuclear shutdowns, http://www.reuters.com/article/2013/02/06/us-utilities-duke-nuclear-idUSBRE91519A20130206

A decision by Duke Energy Corp to retire rather than repair its damaged Crystal River reactor in Florida may signal the shutdown of other older U.S. nuclear plants as weak natural gas prices make significant investment in them uneconomical. While energy analysts said the circumstances surrounding Duke's decision were unique to that plant, decade-low electric prices, especially in deregulated states where the market sets power rates, make it difficult to support costly upgrades on reactors when building gas-fired units is much cheaper. "It is a tough economic environment in the electricity market due to the glut of natural gas, particularly for those that operate in a deregulated environment," said Tony Pietrangelo, chief nuclear officer of industry trade group Nuclear Energy Institute (NEI). Profit margins for nuclear operators in deregulated markets have decreased over the last few years due to lower power prices and weaker growth in demand since the recession, he told Reuters. Duke, the largest U.S. power company, said on Tuesday that it would retire the Crystal River reactor, which has been shut since 2009, due to rising repair costs and uncertainty about how long it would take to fix a series of cracks in the walls of the reactor containment building. One Duke report found the repair bill for the 860-megawatt (MW) reactor might exceed $3 billion and take up to eight years. By comparison, it would cost about $1 billion to build a similar-sized gas-fired plant in about three years. Duke said it is considering the construction of a new combined cycle gas plant, among other alternatives, to replace the power produced by Crystal River for its more than 1.6 million customers in Florida. "You can buy replacement power much more cheaply today than in the past, and you can install replacement capacity very cheaply, in the form of a combined-cycle plant," said Sanford C. Bernstein senior analyst Hugh Wynne. Nuclear plants were extremely profitable when gas prices soared in the mid-2000s. The situation reversed course, though, as gas prices began to slump due to a boom in shale production that drove supplies to record highs. The average gas price sank to a 13-year low in 2012. "Gas prices have gotten so low they are challenging the nuclear portfolio," said UBS energy analyst Julien Dumoulin-Smith. "It's getting tougher for nuclear to compete." GAS IS CHEAP Those weak gas prices helped pull power prices to near-decade lows, making it uneconomical for many generators to invest in their older plants - especially coal-fired units - to keep them compliant with stricter federal environmental regulations. Since 2009, power companies have announced plans to shut more than 40,000 MW of coal-fired capacity in the coming years, and nuclear plants are next. The Kewaunee reactor in Wisconsin is the first nuclear unit to succumb, as owner Dominion Resources Inc plans to shut it this year, partly because of pressure from shale gas. UBS's Dumoulin-Smith has identified other reactors in danger of shutting, including Entergy Corp's Vermont Yankee in Vermont and FitzPatrick in New York, Exelon Corp's Clinton in Illinois and Constellation Energy Nuclear Group LLC's Ginna in New York.

#### \*\*The world can only churn out so many parts in a year – bottlenecks delay the aff for years

Micah Springut, Stephen Schlaikjer, and David Chen – CENTRA (contracting for the U.S.-China Economic and Security Review Commission) - January 2011, China’s Program for Science and Technology Modernization: Implications for American Competitiveness, <http://www.uscc.gov/researchpapers/2011/USCC_REPORT_China's_Program_forScience_and_Technology_Modernization.pdf>

Some observers also note the potential for China’s nuclear expansion plans to set back US energy interests. On the one hand, successful construction and start-up of AP-1000 reactors would give US utilities the confidence to place orders for some of Westinghouse’s reactors. On the other hand, nuclear-component forges in Japan, Korea and France have limited global capacity to produce nuclear reactor vessels and steam generators. If there is to be a nuclear energy renaissance in the United States, as some hope, and if the Chinese reactor programs were keep up their momentum, Chinese demand could absorb the global capacity to supply critical reactor components for years to come.295

#### Tax credits fail – they can’t cover capital costs, which are the biggest barrier

Gale et al - Finance Department Chair of Latham & Watkins’ San Diego office and global Co-Chair for the Climate Change and Cleantech Practice Groups – 2009

Sony Ben-Moshe, Jason J. Crowell, Kelley M. Gale,\* Breton A. Peace, Brett P. Rosenblatt, and Kelly D. Thomason\*\* (The co-authors are attorneys in the Project Finance Practice Group in the San Diego office of Latham & Watkins LLP), FINANCING THE NUCLEAR RENAISSANCE: THE BENEFITS AND POTENTIAL PITFALLS OF FEDERAL & STATE GOVERNMENT SUBSIDIES AND THE FUTURE OF NUCLEAR POWER IN CALIFORNIA, ENERGY LAW JOURNAL, Vol. 30:497, http://www.felj.org/docs/elj302/19gale-crowell-and-peace.pdf

Tax credits have been used in combination with accelerated depreciation under the Modified Accelerated Cost Recovery System for quite some time to spur the development of renewable energy projects. It appears as though Congress intended to draw on the positive experience it has had with subsidizing renewable energy projects through tax credits in order to promote new nuclear development under the EPAct 2005. But the nuclear PTCs do not reflect certain fundamental distinctions that make the comparisons of nuclear power and renewable energy not analogous in respect of effective tax subsidization; this has led to a number of issues that impair the value of the PTCs for use as part of an overall financial structure for nuclear projects. As a basic premise, tax credits operate to "level the playing field," so to speak, for alternative forms of energy generation that may carry with them larger production costs than traditional forms of energy. In other words, taking PTCs as an example, by providing tax credits for units of energy generated from alternative sources of energy, the federal government can subsidize the value of any such unit of energy by reducing the tax liability associated with the revenue derived from that unit of output. However, when it comes to structuring a financing for an alternative energy project, the tax credit itself is just the starting point. Tax credits have historically worked to spur development of renewable energy because there have been eighteen or so large financial institutions that, in the mid-2000‘s, monetized those tax credits to help indirectly offset the upfront capital requirements ifor renewable projects.50 This historically worked because the tax investors had substantial annual tax liabilities and could barter cash in exchange for tax credits to achieve favorable tax offsets at a good price. Those same tax investors have historically provided commitments to fund cash in exchange for tax credits. Those commitments are generally made prior to the closing of a construction financing for a new power project. Consequently, although the cash provided in exchange for tax credits is typically funded only after a new project is complete, the commitment of a credit-worthy tax investor provides a separate source of anticipated cash that can be leveraged in an interim debt transaction in order provide an additional source of funds to pay for development and construction costs. Similarly, although PTCs have value for nuclear power plants from the simple standpoint of lowering the costs of producing a unit of output and thereby creating a competitive advantage, the value of PTCs should also be evaluated from the perspective of whether or not they can be monetized prior to commencement of construction in order to provide an additional source of financing that creates flexibility for financial institutions in structuring the various financing tranches necessary to raise the substantial volumes of capital needed to build a new nuclear power plant. From this perspective, setting aside the fact that the tax equity market has all but completely dried up in 2008 and early 2009, it is unlikely that any single tax investor would ever have a desire to purchase the quantity of tax offsets that would be produced by a nuclear power plant from a single source. The reason is simple portfolio risk theory: it is better to be diversified across many investments in case one or a small number of them fail to meet performance expectations. If for some reason a nuclear power plant ceases to produce electricity in optimal quantities, then a portion of the PTCs associated with that output are also eliminated. This problem is exacerbated in the context of nuclear power because, unlike any other source of clean energy, nuclear power plants produce baseload output measured in gigawatts. Assuming the PTCs work properly to subsidize the intended levels of output at each individual facility, and setting aside caps or issues associated with PTCs being spread too thin among too many projects (as we discuss below), the result would be, by definition, huge pools of tax offsets aggregated at individual nuclear projects, which carries with it risk of large PTC losses if a single project encounters problems. Additionally, to effectively monetize such a large pool of credits may require multiple tax investors in any single financing transaction. That may sound fine in theory, but combining debt and tax equity investment from a single tax investor is hard enough to structure. Creating a structure that would likely require multiple self-interested tax investors introduces substantial complexity into transaction structures, making the financing of nuclear power more expensive and difficult by layering in additional forbearance and inter-investor issues at the tax equity level. Figure 1, above, illustrates the complexity generated by the addition of multiple tax equity investors. In reality, a dollar of foregone tax revenue is no different from a dollar of expenditure. In the case of nuclear projects, it may make sense to consider implementing cash grants in lieu of at least a portion of the PTCs, as was done in the American Recovery and Reinvestment Act of 2009 to stimulate investment in other renewable resources.51 Cash grants would theoretically allow for interim debt financing secured by revenues under the grant program, which could be financed separately from the project as depicted in Figure 1. As it currently stands, unless the tax credits can be monetized, the PTCs cannot be used to indirectly offset upfront capital requirements and can only be used to offset taxable income of the project‘s sponsor. While these tax benefits are useful to a project sponsor, unless properly monetized they do not directly aid in achieving a workable financing structure.52 In our view, the PTC program can be structured more efficiently by introducing well-thought-out direct-pay subsidies to avoid certain issues associated with monetization of tax credits on nuclear power generating assets. Presenting problems on the opposite side of the spectrum, the 6,000 megawatts worth of new nuclear PTCs will be allocated proportionally among qualifying reactors and if too many developers apply, the PTCs will be spread too thin to be effective because the value allocated to any single project will pale in comparison to the project‘s capital requirements. 53 This erosion in efficacy will likely result if a simple majority of the current NRC license applicants for new nuclear reactors become eligible for the PTCs.54 Additionally, the nuclear PTCs, unlike the renewable PTCs,55 are not adjusted for inflation and thus do not retain their original value. As a focal point, because applications for an NRC license must have been submitted by December 31, 2007 in order to be eligible to apply for the PTCs, future applicants cannot participate in this subsidy unless the program is expanded and extended.56 Information on the companies that have submitted or announced the intent to submit applications to the NRC for new nuclear plant licenses is included in Appendix I. As shown in Appendix I, NRC applications submitted before the December 31, 2007 cut-off date referenced at least three different reactor designs.57 As a result, it is likely that only one or two reactors of each design can be built with the benefits of the PTCs. Some experts do not believe that one or two repetitions of a design will be enough to reduce the first in-kind costs associated with new technology and construction cost overruns to a point at which future nuclear construction can be economically viable without the PTCs.58 Consequently, although well-intentioned, the PTC program for nuclear reactors may not be sized appropriately to achieve its stated goals. Guidelines have been issued for the PTCs, but as of yet, there have been no applications for allocation of the 6,000 national megawatt capacity. The Internal Revenue Service is considering issuing revised guidance for the PTC program, which was expected as early as the early part of 2009, but, as of the date of this article, there are no indications of when such guidance might be available.59 However, irrespective of what it contains, that guidance cannot solve the issues associated with the potentially inadequate sizing of the PTCs (i.e., PTCs being spread too thin among too many projects) discussed above, and, even if the sizing issue were addressed by Congressional action, clear guidance alone is similarly unable to effectively mitigate the complexities of monetizing large pools of PTCs associated with a single project (and the associated inter-investor complexities described above). The simplest solution to these issues is to recast the program through new legislation that would provide either upfront cash payments or even refundable tax credits or other payments that can be made over time but which are, from the project sponsor‘s perspective, direct revenues that can be monetized through an interim financing that would be secured separately from the project assets.60 More fundamentally, PTCs are paid based upon output, which of course requires that the project receiving PTCs must have been successfully commissioned. Consequently, PTCs by their very nature are not designed or equipped to address the construction and regulatory risks facing new nuclear development. As a result, PTCs can best be viewed as a pure subsidy intended to enhance the value of power generated by a nuclear reactor so as to ―level the playing field‖ with other conventional forms of electricity generation, as has been done with PTCs for renewable power projects. However, given the limitations described above on the efficiency of the program, it remains to be seen whether PTCs for nuclear power will prove a necessary or effective subsidy to spur new development. From our perspective, the guarantee and other programs described below that address the construction and regulatory risks facing new development will likely prove far more instrumental in financing the ―nuclear renaissance.‖

#### \*\*No one wants to reprocess

Thomas Clements – 9/27/12, Plutonium Fuel (MOX) Program at Savannah River Site Hit with Major Setback, http://aikenleader.villagesoup.com/p/plutonium-fuel-mox-program-at-savannah-river-site-hit-with-major-setback/897688

In yet another series of significant set-backs for the Department of Energy’s (DOE) troubled plutonium fuel (MOX) program at the Savannah River Site (SRS), a key Tennessee Valley Authority (TVA) official has backed away from considering MOX use in TVA’s aging reactors at this time. The Decatur Daily, a newspaper located in Decatur, Alabama and just a few miles from TVA’s Browns Ferry reactors, quotes Preston Swofford, chief nuclear officer at TVA, as saying that he’s not at this point interested in MOX use and the agency is instead focused on a host of problems facing operation and management of TVA’s nuclear plants. The official was quoted as a DOE hearing on plutonium disposition, including necessity of testing of MOX in the problem-plagued Browns Ferry reactors, was conducted near Decatur on September 13. The paper quotes Swofford’s negative comments about consideration of MOX: "It's just so low on my radar screen that I refuse to jump in the fray. I don't think I do service to the ratepayers of the Valley bringing on one more issue. Now three or four years from now, when the fleet's back to steady, we'll take a look at the product." “Given TVA’s reluctance in pursuing MOX and the fact that DOE has no customers to use experimental MOX fuel is reason to put the brakes on the entire MOX program and halt construction of the $6-billion MOX plant to nowhere,” said Tom Clements, Nonproliferation Policy Director with the Alliance for Nuclear Accountability. “It appears that the MOX program continues to degrade into a big-government program with a singular mission: transfer of tax payer money into the pockets of the plutonium industry.” MOX Garners no Support at Plutonium Hearing near Browns Ferry Nuclear Reactors At the DOE hearing on the draft Supplemental Environmental Impact Statement on plutonium testing and use in Browns Ferry, pro-MOX advocates were shocked that sixteen members of the public spoke against use of the experimental plutonium fuel in Browns Ferry while not a single person spoke in favor. Three people spoke in favor of pursuit of thorium reactors, not considered by DOE as an option for plutonium disposition. Given the troubles with the Browns Ferry reactors, including have the worst rating by the Nuclear Regulatory Commission (NRC) of any reactors in the US, public sensitivity about the operation of the reactors is high. Comments from many members of the public who live nearby focused on increased risks to reactor operation if MOX is used in the GE Mark I reactors (Fukushima design). According to the Nuclear Regulatory Commission in a September 18 blog on "Mid-Term Grades Go Out For Nuclear Power Plants," the Browns Ferry reactors are in a unique, dangerous class when it comes to poor operation. The NRC states that "Browns Ferry 1 in Alabama, is in the fourth performance category and requires increased oversight due to a safety finding of high significance, which will include additional inspections to confirm the plant’s performance issues are being addressed." TVA is struggling to deal with the host of issue at the Browns Ferry Fukushima-design reactors and do not need to add to problems by taking on the dodgy MOX mission, according to ANA. "If the DOE tries to force TVA to commit now to MOX use in the Browns Ferry degraded reactors, which may never be able to perform at a higher safety level, I predict this arm-twisting approach will be seen for what it is and backfire into DOE's face," according to Clements. "If they were acting in a responsible manner, both DOE and AREVA would announce that the aging Browns Ferry reactors are off the table for testing and use of experimental weapons-grade MOX." Also, at the hearing in Alabama, it was pointed out to NNSA by ANA, via a written comment, that a video being shown about MOX included an erroneous statement that there was a "treaty" with Russia for plutonium disposition. There is a only an "agreement" with Russia, which has much less status than a treaty which must be passed by the Senate. To its credit, NNSA has agreed to edit the video and fix the error. DOE Won’t Able to Legally Issue a Final Supplemental EIS on MOX Use in TVA Reactors? Swofford’s position and TVA’s reluctance to look seriously into MOX use will likely have a decisive impact on DOE’s legal ability to issue a final Supplemental Environmental Impact Statement (Final SEIS) on plutonium disposition. While DOE’s “preferred alternative” is for MOX use in TVA reactors, the draft SEIS states (page S-iv) that “The TVA does not have a preferred alternative at this time regarding whether to pursue irradiation of MOX fuel in TVA reactors and which reactors might be used for this purpose.” As TVA owns the reactors which might test and use MOX and is charged with complying with regulations of the NRC in operation of the reactors, DOE’s National Nuclear Security Administration (NNSA) has no legal jurisdictional authority to direct TVA to accept MOX for testing and use.

### AT: Peak Uranium

#### Uranium price is a small fraction of nuclear electricity costs – we’ll just mine the more expensive ore

Richard A. Muller – Cal Physics Prof – ’12, Energy for Future Presidents, kindlebook

Reports persist that there is not enough uranium for a significant nuclear future, but such claims are based on a misunderstanding. This issue was addressed in detail in a long and comprehensive analysis by Kenneth S. Deffeyes and Ian D. MacGregor back in 1978, and what they concluded then continues to be true. They show that although we are indeed running out of the best uranium ore, we are not running out of economically recoverable deposits. Here’s why people are worried. The highest-grade uranium ore contains 1o,ooo parts per million (ppm) of uranium or more. Only about 100,000 tons of such ore is located in recoverable deposits around the world. Atypical nuclear reactor burns a ton of uranium to produce million kilowatt-hours of electric energy. World electric use today is about 130 billion kilowatt-hours per year. Using nuclear power to supply all the electricity we currently use would require 130 billion/ 44 million ≈ 3,000 tons of uranium every year, and the 1oo,ooo tons of reserves would last only 33 years. If we expand nuclear power, we will run out sooner. Of course, a lot more uranium would be available if we could use a cheaper grade. If we include ore containing only one-tenth as much uranium, 1,ooo ppm, then according to the Deffeyes-MacGregor survey the world reserves are 300 times greater. Instead of lasting only 30 years, the uranium would, in principle, last 9,000 years at the current rate of use—or 900 years if the use went up tenfold. Would it cost too much to use such low-grade ore? Let’s look at the numbers. A kilogram of uranium oxide, extracted from high-grade ore, currently costs about $60. That kilogram, enriched and put in a reactor, can produce about 30,000 kilowatt-hours of electricity. That means that the uranium cost for 1 kilowatt-hour is $60/30,000 = $0.002 = 0.2 ¢. That’s just 2% of the value of the electricity (1o4 per kilowatt-hour). Even if the cost went up tenfold, to 24 per kilowatt-hour, it would not require a significant increase in the cost of the electricity—but it would increase our uranium supply by a factor of 300. Bottom line: We are not going to run out of affordable uranium in the foreseeable future.

#### Uranium would have to be $340 for commercialization of reprocessing

Todd P. Lagus – WISE - August 4, 2005, Reprocessing of Spent Nuclear Fuel: A Policy Analysis, Journal of Engineering and Public Policy, vol. 9, http://www.wise-intern.org/journal/2005/lagus.pdf

There have been several studies conducted on reprocessing of spent fuel. During the June 16, 2005 House Science Energy Subcommittee hearing on reprocessing, Matthew Bunn, Senior Research Associate with Harvard University’s Project on Managing the Atom, has testified that reprocessing does not have an economic advantage over the once through fuel cycle. In a report from the project entitled The Economics of Reprocessing vs. Direct Disposal of Spent Nuclear Fuel, Bunn et al. asserts that reprocessing in light water reactors (LWR) would have a “breakeven price” of natural uranium ore of $340/kgHM. The breakeven price is the price at which reprocessing becomes economically equal to the once through cycle. In other words, the price of uranium would need to rise from the current $40/kgHM to $340/kgHM to be economically equivalent.34

#### BEST CASE predictions for next year are about one-fourth that price

Debra Fiakas - Crystal Equity Research – 12/31/12, Profits In Uranium Energy's Future?, Seeking Alpha, <http://seekingalpha.com/article/1087881-profits-in-uranium-energy-s-future>

What is more, industry analysts are forecasting higher selling prices. A Credit Suisse report suggest prices in a range of $80 to $90 per pound in 2013 and J.P. Morgan projects a price range of $78 to $85 per pound. This would represent a significant increase from recent spot prices that fell to a low of $45 per pound. Big firm predictions are often times just wishful thinking. However, investors should note that one of Australia's more important uranium mining companies, Paladin Energy Ltd. (PALAF), recently received a $200 million pre-payment from a utility for up to 14 million pounds of uranium to be delivered beginning in 2019. It is an unprecedented supply agreement that signals supply concerns among uranium users - and quite a bit of support for aggressive price forecasts by industry analysts.

#### Status quo solves – seawater extraction

Prigg, Science and Technology Editor, 8/21/12

[Mark, Science and Technology Editor for Daily Mail Online, “Are oceans the future of nuclear power? Scientists move closer to extracting uranium from seawater,” Daily Mail Online, <http://www.dailymail.co.uk/sciencetech/article-2191571/Do-oceans-hold-future-nuclear-power-Scientists-closer-extracting-uranium-seawater.html>]

Extracting uranium from seawater is closer to becoming an economic reality which could guarantee the future of nuclear power, scientists said today. The world's oceans hold at least four billion tons of the precious metal. But for the past four decades, the goal of mining seawater for uranium has remained a dream because of the technical difficulties and high cost. Today, a report presented to a scientific meeting showed that fast progress is being made towards turning the oceans into a uranium reservoir. Improvements to the extraction technology have almost halved production costs from around 560 dollars (£355) per pound of uranium to 300 dollars (£190). Dr. Robin Rogers, from the University of Alabama, told the annual meeting of the American Chemical Society in Philadelphia: 'Estimates indicate that the oceans are a mother lode of uranium, with far more uranium dissolved in seawater than in all the known terrestrial deposits that can be mined. 'The difficulty has always been that the concentration is just very, very low, making the cost of extraction high. 'But we are gaining on that challenge.' The standard extraction technique, developed in Japan, uses mats of braided plastic fibres embedded with compounds that capture uranium atoms. Each mat is 50 to 100 yards long and suspended 100 to 200 yards under the water. After being brought back to the surface, the mats are rinsed with a mild acid solution to recover the uranium. They are then dunked in the water again in a process that can be repeated several times. The new work involves making cheaper and more efficient versions of the mats and the compounds that latch onto uranium. A team led by Dr. Rogers is exploring the use of waste shrimp shells from the seafood industry to produce a biodegradable mat material. Dr. Erich Schneider, from the University of Texas, another speaker at the American Chemical Society symposium, said the aim was to establish seawater uranium as an 'economic backstop' that will sustain the nuclear power industry. Nuclear power plants are built to operate for 60 years or longer and involve a huge investment, he told the meeting. Before committing themselves to building nuclear plants, energy companies had to be sure they can source reasonably priced uranium for many decades to come. 'This uncertainty around whether there's enough terrestrial uranium is impacting the decision-making in the industry, because it's hard to make long-term research and development or deployment decisions in the face of big uncertainties about the resource,' said Dr. Schneider. 'So if we can tap into uranium from seawater, we can remove that uncertainty.' Seawater extraction of uranium may also have environmental advantages, the meeting heard. Traditional uranium mining produced contaminated wastewater and posed health risks for miners.

#### Effective NNSA workforce is critical to maintaining the reliability of the nuclear deterrent – it’s on the brink and not easily replaced

GAO – April 12, MODERNIZING THE NUCLEAR SECURITY ENTERPRISE, http://www.gao.gov/assets/600/590488.pdf

The National Nuclear Security Administration (NNSA)—a separately organized agency within the Department of Energy (DOE)—has primary responsibility for ensuring the safety, security, and reliability of the nation’s nuclear weapons stockpile.1 NNSA carries out these activities at eight government-owned, contractor-operated sites, which include three national laboratories, four production plants, and one test site. Collectively, these sites are referred to as the nuclear security enterprise. The enterprise, formerly known as the nuclear weapons complex, has been a significant component of U.S. national security since the 1940s. Contractors operate sites within the enterprise under management and operations (M&O) contracts.2 These contracts provide the contractor with broad discretion in carrying out the mission of the particular contract but grant the government the option to become much more directly involved in day-to-day management and operations. Historically, confidence in the safety and reliability of the nuclear stockpile was derived through a continuous process of designing, testing, and deploying new weapons to replace older weapons. In 1992, at the end of the Cold War, and in response to a congressionally imposed U.S. nuclear test moratorium,3 the United States ceased underground testing of nuclear weapons, and adopted the Stockpile Stewardship Program as an alternative to testing and producing new weapons. The Stockpile Stewardship Program primarily relies on analytical simulations and computer modeling to make expert judgments about the safety, security, and reliability of the nation’s nuclear weapons. In addition, NNSA refurbishes weapons in the stockpile to extend their operational lives. Under current national policy, NNSA may also be called upon to resume underground nuclear testing at the Nevada National Security Site within a 3-year time frame under certain circumstances, including the accumulation of uncertainties about the reliability of the nuclear stockpile. Currently, NNSA’s workforce is made up of about 34,000 M&O contractor employees that span the enterprise, and about 2,400 federal employees directly employed by NNSA in its Washington headquarters, at site offices located at each of the eight enterprise sites, and at its Albuquerque, New Mexico, complex. NNSA’s staff provide leadership and program management for the nuclear security enterprise and support and oversee its M&O contractors by providing business, technical, financial, legal, and management advice, including support for contractor workforce planning and restructuring, compensation, benefits, oversight of labor-management relations, and the quality of contractor deliverables such as nuclear weapons components. Many workers in the enterprise––both NNSA’s staff and its M&O contractors––possess certain critical skills not readily available in the job market. These workers often have advanced degrees in scientific or engineering fields or experience in high-skill, advanced manufacturing techniques. In addition, certain critical skills are unique to the enterprise and, according to NNSA officials, can only be developed within its secure, classified environment. According to these officials, it generally takes a minimum of 3 years of on-the-job training to achieve the skills necessary to succeed in most critical skills positions. Some nuclear weapons expertise can take even longer to develop and must be gained through several years of mentoring, training, and on-the-job experience. For example, according to officials at Los Alamos National Laboratory, it takes 5 to10 years to train a scientist or engineer with an advanced degree to be a fully qualified nuclear weaponeer. Over the last 20 years, in an effort to operate more efficiently and at reduced cost, DOE has sharply reduced its enterprise contractor workforce––from approximately 52,000 in 1992 to its current level of about 34,000. This decrease raised concerns about preserving critical skills in the enterprise. In 1999, a report from a congressionally mandated commission warned that unless DOE acted quickly to recruit and retain its critically skilled staff and M&O contractor employees—and sharpen the expertise already available—the department could have difficulty ensuring the safety, security, and reliability of the nation’s nuclear weapons.4 DOE, and later NNSA, took steps to correct these problems, and in February 2005, we reported that these efforts had been generally effective.5 However, in February 2011, in a report assessing the extent to which NNSA has the data necessary to make informed, enterprisewide decisions,6 we found that NNSA did not have comprehensive information on the status of its M&O contractor workforce. In particular, we reported that NNSA did not have data on the critical skills needed to maintain the Stockpile Stewardship Program’s capabilities. As a result, we recommended that NNSA establish a plan with time frames and milestones for the development of a comprehensive contractor workforce baseline that includes the identification of critical human capital skills, competencies, and levels needed to maintain the nation’s nuclear weapons strategy. NNSA stated that it understood all of our recommendations in that report and believed that it could implement them. As of March 2012, NNSA had completed a draft plan and was incorporating stakeholders’ comments. NNSA officials said that they expect to complete the final contractor workforce baseline plan by May 2012. NNSA expressed concerns in its FY 2012 Stockpile Stewardship Management Plan about the state of both its federal and contractor workforces, stating that there was an urgent need to “refresh” both. In particular, NNSA noted that many employees have retired or are expected to retire soon. At the same time, NNSA’s mission has become even more dependent on high-level science, computer science, technology, and engineering skills as it has moved from underground testing as a means for assessing the safety and reliability of nuclear weapons to one dependent on advanced computer simulations, analyses, and nonnuclear tests. These changes make it even more important that NNSA and its M&O contractors preserve critical skills in their workforces. Additional concerns about human capital in the enterprise have been raised by the debate over––and eventual ratification of––the New Start Treaty,7 which commits the United States to reduce the size of its strategic nuclear weapon stockpile from a maximum of 2,200 to 1,550 nuclear weapons. Reductions in the number of nuclear weapons make it all the more important that NNSA and contractor staff have the requisite critical skills to maintain the safety, security, and reliability of the remaining weapons. However, as the enterprise has contracted, NNSA officials note that training opportunities have been limited, leaving little or no redundancy in certain critical skills within the contractor workforce.

#### Aff causes brain drain – there’s a limited pool of scientists who can do nuclear simulations and monitoring

Andrew C. Klein - Professor of Nuclear Engineering and Radiation Health Physics at Oregon

State University, fmr. Director of Educational Partnerships at the Idaho National Laboratory - February 2012, Required Infrastructure for the Future of Nuclear Energy, http://www.fas.org/pubs/\_docs/Nuclear\_Energy\_Report-lowres.pdf

One potential limiting capability will be the development of the people who are educated and trained to operate these new small reactor systems. The leading concepts being considered are evolutionary developments from current light water based nuclear reactors and the skills needed to operate these systems may not be far from those needed to operate current technologies. However, testing facilities will be needed for these new concepts, in both integral and separate-effects forms, to provide validation and verification of the computer codes used to predict their performance during both normal and accident conditions. A few special technologies and materials are important to the new nuclear energy industry and may need special attention to ensure their availability when they are needed. Specialty materials, such as zirconium, hafnium, gadolinium, beryllium, and others, will need suppliers to provide processing, manufacturing, and recycling technologies that are cost-effective to the manufacturers and utilities building new nuclear power plants. Some, but not all, of these specialty materials have other uses in the economy but their availability to the nuclear industry needs to be ensured. Today’s nuclear R&D infrastructure in the nation’s national laboratories is rather aged. Many of the nuclear R&D facilities across the complex of national laboratories were originally developed in the 1960s and 1970s. However, while they may be old, many critical facilities have seen reasonable maintenance and upgrades over the years so that a basic capability remains available. DOE continues to review its infrastructure needs on a regular basis, including updates to the ten-year site plans at each national laboratory and facility reviews conducted by the National Academies of Science and Engineering, the DOE Nuclear Energy Advisory Committee and others. These reports periodically give the government and the public insight into the capabilities and needs of the nuclear energy R&D community and are used by DOE to guide their annual budget requests to Congress. All of the facilities that researchers might want may not readily be available, but a basic infrastructure has been maintained for R&D activities and a process for their maintenance and expansion is available annually to DOE. A few skilled technical areas related to construction of new nuclear power plants have not been used over the past 20 years in the United States. Since very few new plants have come on-line, there has been little need for people trained in nuclear plant construction and plant startup/test engineering. These highly specialized skills previously were available while new plant projects were being brought on-line during the 1970s and 1980s; however, new education and training programs will be needed to make sure that people are ready when the new plants begin to load fuel and contemplate full operation. Also, should the recycling and reuse of nuclear fuel reach a mature stage of development over the next 30 years, there will be a significant need for radiochemists and radiochemistry technicians, and the development of education and training programs for recycling facility engineers, technicians and operators. Competing interests for a top quality workforce will come from various sectors, both inside and outside of the nuclear industry. The electric utility industry, including all means of production and distribution of electricity will look for similarly educated and trained personnel. The defense, telecommunications, oil and natural gas industries will also be searching for highly educated and trained workers. However, utility careers are sometimes viewed by students to be low-technology career paths of lesser excitement when compared to other high-technology options, and thus the electric utilities must offer competitive compensation packages in order to recruit the best personnel into the nuclear industry. One important aspect of the nuclear energy pipeline for both personnel and equipment is the long design lifetimes for nuclear power plants relative to the length of time that is typical for any one individual. Current nuclear power plants have initial design and license lifetimes of 40 years. Most, if not nearly all, currently operating nuclear power plants in the United States will receive a 20-year license extension from the NRC. Some of these plants may be able to gain an additional 20-year license extension, if current research and development activities show that they can clearly be operated in a safe manner. The new power plant designs all have initial design lifetimes of 60 years, and conceivably their licensed lifetimes could extend to 80 or 100 years. If five to 10 years are required to construct a plant and then another five to 10 years to decommission it, the plant’s total product lifetime approaches 110 to 120 years from conception to dismantlement. This is considerably longer than the product lifetime for any other industrial product. Compare this to the roughly 40-year productive career that is typical for most workers. This difference emphasizes the need for continuous education and training of the nuclear workforce.

#### NNSA workforce is essential for deterrence – also turns prolif

D’Anne E. Spence, Major, USAF - Fall 2011, Zero Nuclear Weapons and Nuclear Security Enterprise Modernization, Strategic Studies Quarterly, http://www.au.af.mil/au/ssq/2011/fall/spence.pdf

Every president since Franklin D. Roosevelt has authorized the production of nuclear weapons, requiring that the US government both understand the nuclear weapons program and establish policy for nuclear weapons employment.1 Each of these presidents also has reiterated a desire to eliminate or reduce the role of nuclear weapons, only to confront the reality that as long as other countries possess them the United States must maintain a credible nuclear capability to deter adversaries and protect itself and its allies. Maintaining a credible nuclear deterrent is essential to US national security. Any degradation of its nuclear enterprise will impact negatively on its nuclear deterrent capability; an even greater impact could result if deterrence fails. Therefore, the United States must maintain its focus on nuclear weapons and the supporting infrastructure through modernization of the entire nuclear security enterprise (the enterprise), even while it pursues a world without nuclear weapons. To understand the current and future status of the nuclear enterprise, one must first consider its role in history and that of the National Nuclear Security Administration (NNSA). Historic Roles Nuclear deterrence has been a critical component of national security since World War II. During the Cold War, the nuclear weapons complex was a massive operation focused on an arms race with the Soviet Union and mass production of nuclear weapons.2 As the Cold War endured, the average age of stockpiled weapons increased, reaching a plateau at approximately 12 years (see fig. 1). Weapons designers were focused on maximizing yield-to-weight ratios rather than increasing the longevity of the weapons. At the end of the weapons’ life expectancy, they were dismantled and replaced with new ones designed to address the current perceived threat and to incorporate technological improvements. This high turnover created a solid base of expertise in weapons design. Between 1945 and 1992, these designers created innovative new designs and ultimately produced more than 65 different types of weapons, including air-dropped bombs, intercontinental ballistic missiles (ICBM), submarine launched ballistic missiles (SLBM), and artillery devices.3 Due to the evolutionary nature of the weapons, designers did not anticipate stockpiling them more than 12 years and therefore paid limited attention to designing components that would not corrode or fail over an extended life cycle.4 The end of the Cold War in 1990, the ratification of the first Strategic Arms Reduction Treaty (START) in 1991, and the subsequent US moratorium on underground nuclear testing dramatically changed the landscape of nuclear weapons in US national security strategy. For the first time since the Manhattan Project, the United States was no longer building nuclear weapons and was in fact downsizing its nuclear arsenal. In 2000, the NNSA was established by congressional mandate as a semiautonomous agency under the Department of Energy with the mission to provide management and “security to the nation’s nuclear weapons, nuclear non proliferation, and naval reactors programs.”5 The NNSA maintains the US nuclear weapons stockpile and is tasked, in tandem with the Department of Defense, to ensure the US nuclear deterrent is safe, secure, and effective to meet national security requirements. This joint task has become increasingly difficult over the past two decades, in part because various treaties and agreements have significantly restricted the development and testing of nuclear weapons. Nuclear weapons that were originally designed for a 10-year lifespan have been in the stockpile for 30-plus years. Each new treaty works to reduce the role of nuclear weapons in the US national security strategy and further restrict what the United States can possess in its active nuclear stockpile. Self-imposed limitations on modernization also thwart efforts to extend the life of the aging nuclear weapons. Over time, the huge nuclear security enterprise managed by the NNSA has shrunk from 15 to eight sites. Using a government-owned, contractor-operated model, the NNSA provides high-level oversight and requirements coordination. Its sites design, produce, and apply science and engineering to maintain and safeguard the nation’s nuclear weapons. The enterprise, depicted in table 1, consists of three national laboratories, four engineering and production plants, and the Nevada National Security Site (until recently called the Nevada Test Site). While the size and structure of the enterprise may have changed since the Cold War, lingering elements of that era still affect the present-day mission of the NNSA, not the least of which is the drastic change in political perspective on acceptable weapons longevity. Current Status The average age of a weapon in the US nuclear stockpile today is over 25 years, well past its intended life. Meanwhile, funding from recent presidents and Congress for the stockpile and supporting infrastructure has reached historic lows due to the perceived reduced role of nuclear weapons in the US national security strategy. In fact, in the last five years the NNSA has lost 20 percent of its buying power although the vital mission to maintain a safe, secure, and effective stockpile has not changed.6 Collectively, these events have reduced the nation’s focus on nuclear weapons as a supporting pillar of US national security policy. This lack of focus has put the NNSA on a path to failure, because insufficient funding makes it more difficult to assess weapon reliability.7 This means the NNSA must maintain an increasingly dilapidated weapons complex and stockpile with maintenance funds that decrease significantly each year. The aging weapons problem is further complicated by an unprecedented presidential commitment to achieve a world without nuclear weapons. In an April 2009 speech in Prague, Pres. Barack Obama created a paradox when, first, he said that the United States, as a world leader, would actively pursue a world without nuclear weapons and, second, promised that as long as other countries had nuclear weapons, the United States would maintain an effective nuclear deterrent.8 Since Prague, the United States has negotiated the “New START” treaty with Russia to reduce the number of nuclear weapons in both countries. Keeping with the Prague promises, the lower weapon levels negotiated in the New START translate into a critical need that the remaining weapons be highly credible and effective. To maintain US nuclear weapons as a credible deterrent, significant funding must go into the entire enterprise to reverse years of atrophy and neglect. In 2008, the bipartisan Perry-Schlesinger Commission studied the role of nuclear weapons in US security policy and concluded that more money must be spent on the enterprise to maintain a credible US nuclear deterrent.9 This commission was established by Congress and co-chaired by William Perry, former secretary of defense, and James Schlesinger, former secretary of defense and energy. The commission confirmed in its report that the primary role of nuclear weapons in the US national security strategy is deterrence. They also provide extended deterrence to US allies and support nonproliferation among those allies who otherwise might develop their own arsenal without the US nuclear umbrella.10 The commission made several key recommendations on the future US strategic posture which have served as a guide for the Obama administration. Notably, the commission recognized the substantial work that has already been invested in reducing the nuclear threat worldwide. The United States has reduced its arsenal from a peak of 31,255 warheads in 1969 to 5,113 warheads (total active and reserve) today; the lowest numbers since the Truman administration (see fig. 2).11 Likewise, the Russians have significantly reduced their stockpile from over 45,000 at the peak of the Cold War.12 Ratification of the New START will reduce these numbers further, sizably shrinking both countries’ nuclear arsenals. More significant, however, is the inverse correlation between reduced nuclear stockpile numbers and increased importance that the remaining weapons remain safe, secure, and effective. Aging of the nuclear weapons, coupled with the decreased number of weapons available, creates increased operational risk to the nuclear deterrent for the United States and its allies. This risk requires the United States to maintain a significant number of “hedge” weapons that protect it against technical uncertainty. Reducing the technical uncertainty in these aging weapons would allow the United States to reduce the overall number while maintaining the credibility of the weapons. However, current agreements and restrictions do not allow the United States to test weapons or to build newly designed weapons. These restrictions and the weapon-aging problem create a quandary for the directors of Los Alamos, Lawrence Livermore, and Sandia when they provide an independent assessment of the stockpile each year to the president, certifying the weapons are safe, secure, and effective. To alleviate these credibility concerns, the NNSA must continue to develop and fund two critical programs, the Stockpile Stewardship Program (SSP) and the Life Extension Program (LEP). Weapon surveillance is the foundation of both programs. Surveillance involves the evaluation of both nuclear and nonnuclear components of a weapon through destructive and nondestructive testing. The process is responsible for identifying original manufacturing flaws, design limitations, and effects of aging.13 The results from these tests drive the NNSA’s understanding of weapon-aging issues and establish a baseline for life extension work. The surveillance results also feed into the modeling and simulation work done in the stewardship program to better understand the internal dynamics during a nuclear detonation. The stewardship program was established in 1992 when the underground nuclear weapons testing moratorium was instituted “to ensure the preservation of the core intellectual and technical competencies of the United States in nuclear weapons.”14 Its goal was to keep the nuclear stockpile reliable without nuclear testing. The SSP is a comprehensive, experiment-based modeling and simulation effort that applies data from multiple subcritical tests, simulating phases of a nuclear detonation, into high-speed computer models. The compilation of this data provides the NNSA a better understanding of nuclear weapons behavior.15 In the absence of nuclear weapons testing, the stewardship program becomes the primary tool used to certify weapon reliability each year. The complexity of thoroughly analyzing a nuclear detonation requires multiple nonnuclear experiments and the world’s fastest supercomputers, driving up the cost of the program. Without full funding, the safety, security, and effectiveness of the weapons become questionable. The surveillance program supports the Life Extension Program. The LEP is the solution to maintaining the nuclear weapons stockpile without designing and building a new nuclear weapon.16 To comply with US policy on nonproliferation and worldwide dismantlement, the 2010 Nuclear Posture Review (NPR) highlights the preference for refurbishment of existing warheads or reuse of components from old weapons. To this end, the NNSA has a full spectrum of life extension options, all of which refurbish, reuse, or replace individual components within a weapon without giving it any newly designed components or new military capabilities. Replacement of nuclear components is only done as a last resort to maintain a weapon and requires an extremely high level of political scrutiny for approval.17 The NNSA develops life extension programs based on DoD requirements for the enduring stockpile, which include an approximate 30-year life expectancy as well as added safety and security features to protect the weapons. The enduring stockpile, as established by the NPR, maintains the nuclear triad of SLBM and ICBM warheads and air-dropped bombs. To maintain all three legs of the triad, warheads from each leg must be life extended. Currently, the NNSA is in the production phase for the W76 SLBM life extension program. Already in the initial developmental phases, the B61, W78, and W88 warhead LEPs will follow. The LEP couples databases from the legacy systems and nuclear tests with the SSP data to sustain nuclear weapons for the enduring stockpile without having to test weapons explosively. Just as aging weapons systems create a perception by some of diminished deterrence capabilities for the United States and its allies, the atrophied physical infrastructure of the enterprise further affects the credibility of US nuclear deterrence. Vital facilities within the enterprise date back 50 to 60 years to the Manhattan Project and are on the verge of catastrophic failure. Caustic chemicals and processes have sped up the corrosion and breakdown of the facilities. Then congressman Lincoln Davis (D-TN) stated on a tour of the nuclear facilities that he felt like he was in a Russian facility, given the utter state of disrepair.18 This deterioration occurred because the original facilities were built for maximizing production rather than for long-term structural integrity. The mission today is much different. Funding cuts and reduced stockpile numbers have forced the NNSA to consolidate facilities, reducing the overall square footage by 50 percent and the number of sites from 15 to eight.19 This transition eliminated redundancy, creating single points of failure for the majority of systems needed to maintain the nuclear weapons stockpile. In other words, the NNSA is now a capability-based organization; that is, regardless of the size of the stockpile, it must ensure core competencies in several key areas to maintain the weapons stockpile rather than the capacity-based organization of the Cold War. Without significant investment in modernizing the existing infrastructure, the nuclear weapons program becomes vulnerable. There is no guarantee the sites are capable of maintaining their own operational status, let alone the operational status of nuclear weapons. The Future of the Nuclear Enterprise What is the future for the NNSA and the nuclear weapons complex? Most broadly, the NNSA must secure increased funding from Congress to modernize the enterprise. Recapitalization efforts must offset continued reduction in the nuclear stockpile and enable life extension programs, timely dismantlement, and proper management of fissile materials.20 The smaller, streamlined enterprise must maintain all of the critical capabilities necessary to sustain the nuclear stockpile. The new facilities, although smaller, must be built to twenty-first-century safety and security standards. These standards are significantly different from original construction and will drive the cost of new facilities into the billions of dollars. The major facilities the NNSA anticipates building over the next 10 years to ensure uninterrupted capability and reduced risk include a chemical metallurgy research replacement facility at Los Alamos, a high-explosive pressing facility in Amarillo, and a uranium processing facility at Oak Ridge. While the costs and challenges will be high, there are also benefits in these modernization efforts. First, the new facilities will be more reliable, safe, and secure. Also, the external security benefits of the infrastructure improvements cannot be ignored. For example, at Oak Ridge the security cordon around special nuclear material will be reduced from 150 acres to 15 acres once the uranium processing facility is operational. This reduction will lower security costs and the possibility of loss of special nuclear material due to the smaller footprint and state-of-the-art facilities. The infrastructure available to support the reduced number of nuclear weapons must be modernized to avoid operational risk that increases as the United States reduces the number of weapons in its arsenal. The modernization of the nuclear infrastructure will require significant, sustained investment and commitment over the next several decades. Without this investment, the risk associated with assessing the safety, security, and effectiveness of the weapons will increase to an unacceptable level. The Perry-Schlesinger report acknowledges this reality explicitly. It states that to invest effectively in nuclear weapons systems through stewardship and life extension, there must also be investment in the enterprise infrastructure. Without such dual investment, the United States will be unable to maintain a credible nuclear deterrent. As it continues to reduce its stockpile toward zero without fully addressing the aging issues in both the stockpile and the infrastructure, its nuclear umbrella will lack the credibility needed to deter potential adversaries and protect allies. These factors could lead other countries to question the viability of the US nuclear program and the credibility of the weapons currently in the stockpile. Without the resources and facilities needed to maintain the weapons, the deterrent effect is dramatically reduced. Even with increased funding for weapons and infrastructure modernization, the complex cannot be properly maintained without the sustained efforts and engagement of the best and brightest scientists and engineers. The world’s top scientists initially produced the atomic bomb, and the same critical skills will be needed to maintain the weapons complex for the foreseeable future. The end of underground nuclear testing launched the stewardship program to ensure nuclear weapons reliability through subcritical tests and other experimentation via simulation, modeling, and high-power computing. The critical skills required to maximize the science, technology, and engineering capacity and properly execute the SSP underpin the strength of the US nuclear deterrent and establish a fundamental understanding of nuclear weapon behavior. Consequently, to assess the stockpile, appropriately trained scientists are needed to resolve technical issues, extend the lifespan of weapons, and aid in dismantlement activities.21 Maintaining the critical skills of the workforce is at the core of meeting mission requirements. The reduction in mission legitimacy, the increasing age of employees, and other pressures have created the perception that employment on nuclear weapons is no longer important to the national security of the United States. This perception has caused many potential workers to seek other opportunities with higher career potential. The majority of nuclear weapons program personnel have spent their entire careers working on nuclear weapons. As Dr. Chris Deeney says, “The only certainty is the increasing age of the workforce.”22 Only a handful of individuals who still work for the NNSA have experience designing weapons and performing underground tests. Some of those have stayed on well past retirement because of a desire to continue to contribute to US national security.23 The fact of the matter is, as these individuals retire and eventually die, their knowledge dies with them. Therefore, it is vital to get a young, motivated workforce in place that can learn from the legacy of the past while building the future surety. The surveillance program’s success relies on an engaged, highly trained, and motivated workforce. The pool of recruits is inherently small due to the highly focused training and US citizenship requirement. For example, stewardship program experts need specialized degrees and experience in such areas as high-density physics to understand nuclear weapons behavior. To attract this kind of talent, the NNSA must have important national security work, including development and experimentation that is unavailable anywhere else in the world and aids in the understanding of nuclear behavior. It must also invest in the world’s highest-power computers to solve the challenging modeling and simulation problems. These efforts will entice the nation’s best scientists into a career of service to the US nuclear program. As the stockpile decreases, investment in human capital is essential to ensure the next generation of scientists and engineers has the right set of skills, expertise, and experience. The credibility of the reduced stockpile hinges on the workforce’s manipulation of the science, technology, and engineering base to fully understand the weapon-aging issues and develop LEPs to address these concerns.

### AT: Warming

#### Nuclear power can’t solve warming – time needed and electricity’s share of emissions

Green 2006 - honors degree in public health and was awarded a PhD in science and technology studies for his analysis of the Lucas Heights research reactor debates (November, Jim, “Nuclear power and climate change” <http://www.energyscience.org.au/FS03%20Nucl%20Power%20Clmt%20Chng.pdf>)

It is widely accepted that anthropogenic greenhouse gas emissions must be sharply reduced to avert climate change. However, nuclear power is at best a very partial, problematic and unnecessary response to climate change: • A doubling of nuclear power would reduce global greenhouse emissions by about 5%. A much larger nuclear expansion program would pose enormous proliferation and security risks, and it would run up against the problem of limited known conventional uranium reserves. • The serious hazards of civil nuclear programs - the repeatedly demonstrated contribution of civil nuclear programs to weapons proliferation, intractable waste management problems, and the risk of serious accidents. • The availability of a plethora of clean energy options - renewable energy sources plus energy efficiency - which, combined, can meet energy demand and sharply reduce greenhouse emissions. (See for example the reports produced by the Clean Energy Future Group). This information paper addresses the first of those arguments - the limitations of nuclear power as a climate change abatement strategy. A limited response Nuclear power is used almost exclusively for electricity generation. (A very small number of reactors are used for heat co-generation and desalination.) Electricity is responsible for less than one third of global greenhouse gas emissions. According to the Uranium Institute, the figure is “about 30%”. 2 That fact alone puts pay to the simplistic view that nuclear power alone can ‘solve’ climate change. According to a senior energy analyst with the International Atomic Energy Agency, Alan McDonald: “Saying that nuclear power can solve global warming by itself is way over the top”. 3 Ian Hore-Lacy from the Uranium Information Centre (UIC) claims that a doubling of nuclear power would reduce greenhouse emissions in the power sector by 25%. 4 That figure is reduced to a 7.5% reduction if considering the impact on overall emissions rather than just the power sector. The figure needs to be further reduced because the UIC makes no allowance for the considerable time that would be required to double nuclear output. Electricity generation is projected to increase over the coming decades so the contribution of a fixed additional input of nuclear power has a relatively smaller impact. Overall, it is highly unlikely that a doubling of global nuclear power would reduce emissions by more than 5%.

#### We won’t translate domestic reprocessing into international leadership – 123 agreements prevent sharing reprocessing tech

HENRY D. SOKOLSKI - Executive Director of the Nonproliferation Policy Education Center - June 28, 2012, Fukushima and Iran: The Case for Tightening the Nuclear Rules, <http://www.fas.org/blog/pir/2012/06/28/duly-noted-nuclear-energy-program/>

It’s also why Presidents Bush and Obama, worked so hard to establish a new, tougher set of nuclear nonproliferation conditions with the United Arab Emirates (UAE) in the nuclear cooperative agreement the United States reached with the UAE in 2009. Under this deal, the UAE could not receive any controlled nuclear goods until it forswore making nuclear fuel and ratified the Additional Protocol — a set of tough, international nuclear inspection rules. President Obama sold this agreement arguing that it established a new nonproliferation “Gold Standard” for civilian nuclear cooperation agreements. Now, that standard is up for grabs as the U.S. State Department is negotiating nuclear cooperative deals with Jordan, Saudi Arabia, and Vietnam. Congress would like these agreements to meet the Gold Standard. If they fail to do so, the House Committee on Foreign Affairs (HCFA) has proposed legislation that would require such agreements be approved by a majority vote in both houses. This means that after these nuclear agreements are negotiated, it cannot be assumed, as is currently the case, that they would be approved automatically. Proponents of this legislation vote that Saudi Arabia has warned that it must get nuclear weapons if Iran does so and that Jordan and Vietnam refuse to forswear making nuclear fuel and are far from being stable democracies. They insist that if these agreements fail to meet the Gold Standard, it makes sense to scrutinize them closely and put them to a vote. The HCFA has also called for Congressional approval of new overseas efforts to separate or reprocess nuclear weapons useable plutonium from spent fuel generated from U.S.-origin fuel or U.S.-exported reactors. This would mean that reprocessing such fuel in India or China – two states that might later seize the material to ramp up the size of the nuclear weapons arsenals significantly — would have to be put to a vote in both the House and Senate.

#### Fukushima decked US nuclear leadership

HENRY D. SOKOLSKI - Executive Director of the Nonproliferation Policy Education Center - June 28, 2012, Fukushima and Iran: The Case for Tightening the Nuclear Rules, http://www.fas.org/blog/pir/2012/06/28/duly-noted-nuclear-energy-program/

Also, if the United States insists on new nonproliferation conditions before other nuclear suppliers do, the State Department insists it will disadvantage U.S. nuclear exporters and eliminate the “control” U.S. exports would otherwise exercise. This argument, though, seems strained. After Fukushima, it’s unlikely that the United States will be making many nuclear reactor sales – let alone enough to control the trade unilaterally. The U.S.-designed reactors that melted down at Fukushima, in fact, were sold on the condition that U.S. nuclear reactor vendors be exempted of any responsibility for damages in the case of an accident. Now, few, if any, new foreign nuclear customers would be foolish enough to agree to such an exemption.

#### Warming inevitable and there’s nothing you can do about it

Solomon et al, IPCC Climate Science Co-Chair, ‘09 (Susan- member of the US National Academy of Sciences, the European Academy of Sciences, and the Academy of Sciences of France, Nobel Peace Prize Winner, Chairwoman of the IPCC, February 10, “Irreversible climate change due to carbon dioxide emissions” PNAS, Vol 106, http://www.pnas.org/content/early/2009/01/28/0812721106.full.pdf)

Over the 20th century, the atmospheric concentrations of key greenhouse gases increased due to human activities. The stated objective (Article 2) of the United Nations Framework Convention on Climate Change (UNFCCC) is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent ‘‘dangerous anthropogenic interference with the climate system.’’ Many studies have focused on projections of possible 21st century dangers (1–3). However, the principles (Article 3) of the UNFCCC specifically emphasize ‘‘threats of serious or irreversible damage,’’ underscoring the importance of the longer term. While some irreversible climate changes such as ice sheet collapse are possible but highly uncertain (1, 4), others can now be identified with greater confidence, and examples among the latter are presented in this paper. It is not generally appreciated that the atmospheric temperature increases caused by rising carbon dioxide concentrations are not expected to decrease significantly even if carbon emissions were to completely cease (5–7) (see Fig. 1). Future carbon dioxide emissions in the 21st century will hence lead to adverse climate changes on both short and long time scales that would be essentially irreversible (where irreversible is defined here as a time scale exceeding the end of the millennium in year 3000; note that we do not consider geo-engineering measures that might be able to remove gases already in the atmosphere or to introduce active cooling to counteract warming). For the same reason, the physical climate changes that are due to anthropogenic carbon dioxide already in the atmosphere today are expected to be largely irreversible. Such climate changes will lead to a range of damaging impacts in different regions and sectors, some of which occur promptly in association with warming, while others build up under sustained warming because of the time lags of the processes involved. Here we illustrate 2 such aspects of the irreversibly altered world that should be expected. These aspects are among reasons for concern but are not comprehensive; other possible climate impacts include Arctic sea ice retreat, increases in heavy rainfall and flooding, permafrost melt, loss of glaciers and snowpack with attendant changes in water supply, increased intensity of hurricanes, etc. A complete climate impacts review is presented elsewhere (8) and is beyond the scope of this paper. We focus on illustrative adverse and irreversible climate impacts for which 3 criteria are met: (i) observed changes are already occurring and there is evidence for anthropogenic contributions to these changes, (ii) the phenomenon is based upon physical principles thought to be well understood, and (iii) projections are available and are broadly robust across models. Advances in modeling have led not only to improvements in complex Atmosphere–Ocean General Circulation Models (AOGCMs) for projecting 21st century climate, but also to the implementation of Earth System Models of Intermediate Complexity (EMICs) for millennial time scales. These 2 types of models are used in this paper to show how different peak carbon dioxide concentrations that could be attained in the 21st century are expected to lead to substantial and irreversible decreases in dry-season rainfall in a number of already-dry subtropical areas and lower limits to eventual sea level rise of the order of meters, implying unavoidable inundation of many small islands and low-lying coastal areas. Results Longevity of an Atmospheric CO2 Perturbation. As has long been known, the removal of carbon dioxide from the atmosphere involves multiple processes including rapid exchange with the land biosphere and the surface layer of the ocean through air–sea exchange and much slower penetration to the ocean interior that is dependent upon the buffering effect of ocean chemistry along with vertical transport (9–12). On the time scale of a millennium addressed here, the CO2 equilibrates largely between the atmosphere and the ocean and, depending on associated increases in acidity and in ocean warming (i.e., an increase in the Revelle or ‘‘buffer’’ factor, see below), typically 20% of the added tonnes of CO2 remain in the atmosphere while 80% are mixed into the ocean. Carbon isotope studies provide important observational constraints on these processes and time constants. On multimil- lenium and longer time scales, geochemical and geological processes could restore atmospheric carbon dioxide to its pre- industrial values (10, 11), but are not included here. Fig. 1 illustrates how the concentrations of carbon dioxide would be expected to fall off through the coming millennium if manmade emissions were to cease immediately following an illustrative future rate of emission increase of 2% per year [comparable to observations over the past decade (ref. 13)] up to peak concentrations of 450, 550, 650, 750, 850, or 1,200 ppmv; similar results were obtained across a range of EMICs that were assessed in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (5, 7). This is not intended to be a realistic scenario but rather to represent a test case whose purpose is to probe physical climate system changes. A more gradual reduction of carbon dioxide emission (as is more likely), or a faster or slower adopted rate of emissions in the growth period, would lead to long-term behavior qualitatively similar to that illustrated in Fig. 1 (see also Fig. S1). The example of a sudden cessation of emissions provides an upper bound to how much reversibility is possible, if, for example, unexpectedly damaging climate changes were to be observed. Carbon dioxide is the only greenhouse gas whose falloff displays multiple rather than single time constants (see Fig. S2). Current emissions of major non-CO2 greenhouse gases such as methane or nitrous oxide are significant for climate change in the next few decades or century, but these gases do not persist over time in the same way as carbon dioxide (14). Fig. 1 shows that a quasi-equilibrium amount of CO2 is expected to be retained in the atmosphere by the end of the millennium that is surprisingly large: typically 40% of the peak concentration enhancement over preindustrial values ( 280 ppmv). This can be easily understood on the basis of the observed instantaneous airborne fraction (AFpeak) of 50% of anthropogenic carbon emissions retained during their buildup in the atmosphere, together with well-established ocean chemistry and physics that require 20% of the emitted carbon to remain in the atmosphere on thousand-year timescales [quasi- equilibrium airborne fraction (AFequi), determined largely by the Revelle factor governing the long-term partitioning of carbon between the ocean and atmosphere/biosphere system] (9–11). Assuming given cumulative emissions, EMI, the peak concen- tration, CO2peak (increase over the preindustrial value CO20), and the resulting 1,000-year quasi-equilibrium concentration, CO2equi can be expressed as COpeak 2 = CO02 + AFpeak EMI [1] COequi 2 = CO02 + AFequi EMI [2] so that COequi2 – CO0 2 = AFequi/AFpeak (COpeak 2 – CO02) [3] Given an instantaneous airborne fraction (AFpeak) of 50% during the period of rising CO2, and a quasi-equilbrium airborne factor (AFequi) of 20%, it follows that the quasi-equilibrium enhancement of CO2 concentration above its preindustrial value is 40% of the peak enhancement. For example, if the CO2 concentration were to peak at 800 ppmv followed by zero emissions, the quasi-equilibrium CO2 concentration would still be far above the preindustrial value at 500 ppmv. Additional carbon cycle feedbacks could reduce the efficiency of the ocean and biosphere to remove the anthropogenic CO2 and thereby increase these CO2 values (15, 16). Further, a longer decay time and increased CO2 concentrations at year 1000 are expected for large total carbon emissions (17). Irreversible Climate Change: Atmospheric Warming. Global average temperatures increase while CO2 is increasing and then remain approximately constant (within 0.5 °C) until the end of the millennium despite zero further emissions in all of the test cases shown in Fig. 1. This important result is due to a near balance between the long-term decrease of radiative forcing due to CO2 concentration decay and reduced cooling through heat loss to the oceans. It arises because long-term carbon dioxide removal and ocean heat uptake are both dependent on the same physics of deep-ocean mixing. Sea level rise due to thermal expansion accompanies mixing of heat into the ocean long after carbon dioxide emissions have stopped. For larger carbon dioxide concentrations, warming and thermal sea level rise show greater increases and display transient changes that can be very rapid (i.e., the rapid changes in Fig. 1 Middle), mainly because of changes in ocean circulation (18). Paleoclimatic evidence suggests that additional contributions from melting of glaciers and ice sheets may be comparable to or greater than thermal expansion (discussed further below), but these are not included in Fig. 1. Fig. 2 explores how close the modeled temperature changes are to thermal equilibrium with respect to the changing carbon dioxide concentration over time, sometimes called the realized warming fraction (19) (shown for the different peak CO2 cases). Fig. 2 Left shows how the calculated warmings compare to those expected if temperatures were in equilibrium with the carbon dioxide concentrations vs. time, while Fig. 2 Right shows the ratio of these calculated time-dependent and equilibrium tempera- tures. During the period when carbon dioxide is increasing, the realized global warming fraction is 50–60% of the equilibrium warming, close to values obtained in other models (5, 19). After emissions cease, the temperature change approaches equilib- rium with respect to the slowly decreasing carbon dioxide concentrations (cyan lines in Fig. 2 Right). The continuing warming through year 3000 is maintained at 40–60% of the equilibrium warming corresponding to the peak CO2 concentration (magenta lines in Fig. 2 Right). Related changes in fast-responding atmospheric climate variables such as precipitation, water vapor, heat waves, cloudiness, etc., are expected to occur largely simultaneously with the temperature changes. Irreversible Climate Change: Precipitation Changes. Warming is expected to be linked to changes in rainfall (20), which can adversely affect the supply of water for humans, agriculture, and ecosystems. Precipitation is highly variable but long-term rainfall decreases have been observed in some large regions including, e.g., the Mediterranean, southern Africa, and parts of south- western North America (21–25). Confident projection of future changes remains elusive over many parts of the globe and at small scales. However, well-known physics (the Clausius–Clapeyron law) implies that increased temperature causes increased atmospheric water vapor concentrations, and changes in water vapor transport and the hydrologic cycle can hence be expected (26–28). Further, advances in modeling show that a robust characteristic of anthropogenic climate change is poleward expansion of the Hadley cell and shifting of the pattern of precipitation minus evaporation (P–E) and the storm tracks (22, 26), and hence a pattern of drying over much of the already-dry subtropics in a warmer world ( 15°-40° latitude in each hemi- sphere) (5, 26). Attribution studies suggest that such a drying pattern is already occurring in a manner consistent with models including anthropogenic forcing (23), particularly in the south- western United States (22) and Mediterranean basin (24, 25). We use a suite of 22 available AOGCM projections based upon the evaluation in the IPCC 2007 report (5, 29) to characterize precipitation changes. Changes in precipitation are expected (5, 20, 30) to scale approximately linearly with increasing warming (see Fig. S3). The equilibrium relationship between precipitation and temperature may be slightly smaller (by 15%) than the transient values, due to changes in the land/ ocean thermal contrast (31). On the other hand, the observed 20th century changes follow a similar latitudinal pattern but presently exceed those calculated by AOGCMs (23). Models that include more complex representations of the land surface, soil, and vegetation interactively are likely to display additional feedbacks so that larger precipitation responses are possible. Here we evaluate the relationship between temperature and precipitation averaged for each month and over a decade at each grid point. One ensemble member is used for each model so that all AOGCMs are equally weighted in the multimodel ensemble; results are nearly identical if all available model ensemble members are used. Fig. 3 presents a map of the expected dry-season (3 driest consecutive months at each grid point) precipitation trends per degree of global warming. Fig. 3 shows that large uncertainties remain in the projections for many regions (white areas). How- ever, it also shows that there are some subtropical locations on every inhabited continent where dry seasons are expected to become drier in the decadal average by up to 10% per degree of warming. Some of these grid points occur in desert regions that are already very dry, but many occur in currently more temperate and semiarid locations. We find that model results are more robust over land across the available models over wider areas for drying of the dry season than for the annual mean or wet season (see Fig. S4). The Insets in Fig. 3 show the monthly mean projected precipitation changes averaged over several large regions as delineated on the map. Increased drying of respective dry seasons is projected by 90% of the models averaged over the indicated regions of southern Europe, northern Africa, southern Africa, and southwestern North America and by 80% of the models for eastern South America and western Australia (see Fig. S3). Although given particular years would show exceptions, the long-term irreversible warming and mean rainfall changes as suggested by Figs. 1 and 3 would have important consequences in many regions. While some relief can be expected in the wet season for some regions (Fig. S4), changes in dry-season precipitation in northern Africa, southern Europe, and western Australia are expected to be near 20% for 2 °C warming, and those of southwestern North America, eastern South America, and southern Africa would be 10% for 2 °C of global mean warming. For comparison, the American ‘‘dust bowl’’ was associated with averaged rainfall decreases of 10% over 10–20 years, similar to major droughts in Europe and western Australia in the 1940s and 1950s (22, 32). The spatial changes in precipitation as shown in Fig. 3 imply greater challenges in the distribution of food and water supplies than those with which the world has had difficulty coping in the past. Such changes occurring not just for a few decades but over centuries are expected to have a range of impacts that differ by region. These include, e.g., human water supplies (25), effects on dry-season wheat and maize agriculture in certain regions of rain-fed farming such as Africa (33, 34), increased fire frequency, ecosystem change, and desertification (24, 35–38). Fig. 4 Upper relates the expected irreversible changes in regional dry-season precipitation shown in Fig. 3 to best estimates of the corresponding peak and long-term CO2 concentrations. We use 3 °C as the best estimate of climate sensitivity across the suite of AOGCMs for a doubling of carbon dioxide from preindustrial values (5) along with the regional drying values depicted in Fig. 3 and assuming that 40% of the carbon dioxide peak concentration is retained after 1000 years. Fig. 4 shows that if carbon dioxide were to peak at levels of 450 ppmv, irreversible decreases of 8–10% in dry-season precipitation would be expected on average over each of the indicated large regions of southern Europe, western Australia, and northern Africa, while a carbon dioxide peak value near 600 ppmv would be expected to lead to sustained rainfall decreases of 13–16% in the dry seasons in these areas; smaller but statistically significant irreversible changes would also be expected for southwestern North America, eastern South America, and Southern Africa. Irreversible Climate Change: Sea Level Rise. Anthropogenic carbon dioxide will cause irrevocable sea level rise. There are 2 relatively well-understood processes that contribute to this and a third that may be much more important but is also very uncertain. Warm- ing causes the ocean to expand and sea levels to rise as shown in Fig. 1; this has been the dominant source of sea level rise in the past decade at least (39). Loss of land ice also makes important contributions to sea level rise as the world warms. Mountain glaciers in many locations are observed to be retreating due to warming, and this contribution to sea level rise is also relatively well understood. Warming may also lead to large losses of the Greenland and/or Antarctic ice sheets. Additional rapid ice losses from particular parts of the ice sheets of Greenland and Antarctica have recently been observed (40–42). One recent study uses current ice discharge data to suggest ice sheet contributions of up to 1–2 m to sea level rise by 2100 (42), but other studies suggest that changes in winds rather than warming may account for currently observed rapid ice sheet flow (43), rendering quantitative extrapolation into the future uncertain. In addition to rapid ice flow, slow ice sheet mass balance processes are another mechanism for potential large sea level rise. Paleoclimatic data demonstrate large contributions of ice sheet loss to sea level rise (1, 4) but provide limited constraints on the rate of such processes. Some recent studies suggest that ice sheet surface mass balance loss for peak CO2 concentrations of 400–800 ppmv may be even slower than the removal of manmade carbon dioxide following cessation of emis- sions, so that this loss could contribute less than a meter to irreversible sea level rise even after many thousands of years (44, 45). It is evident that the contribution from the ice sheets could be large in the future, but the dependence upon carbon dioxide levels is extremely uncertain not only over the coming century but also in the millennial time scale. An assessed range of models suggests that the eventual contribution to sea level rise from thermal expansion of the ocean is expected to be 0.2–0.6 m per degree of global warming (5). Fig. 4 uses this range together with a best estimate for climate sensitivity of 3 °C (5) to estimate lower limits to eventual sea level rise due to thermal expansion alone. Fig. 4 shows that even with zero emissions after reaching a peak concentration, irreversible global average sea level rise of at least 0.4–1.0 m is expected if 21st century CO2 concentrations exceed 600 ppmv and as much as 1.9 m for a peak CO2 concentration exceeding 1,000 ppmv. Loss of glaciers and small ice caps is relatively well understood and is expected to be largely complete under sustained warming of, for example, 4 °C within 500 years (46). For lower values of warming, partial remnants of glaciers might be retained, but this has not been examined in detail for realistic representations of glacier shrinkage and is not quantified here. Complete losses of glaciers and small ice caps have the potential to raise future sea level by 0.2–0.7 m (46, 47) in addition to thermal expansion. Further contributions due to partial loss of the great ice sheets of Antarctica and/or Greenland could add several meters or more to these values but for what warming levels and on what time scales are still poorly characterized. Sea level rise can be expected to affect many coastal regions (48). While sea walls and other adaptation measures might combat some of this sea level rise, Fig. 4 shows that carbon dioxide peak concentrations that could be reached in the future for the conservative lower limit defined by thermal expansion alone can be expected to be associated with substantial irreversible commitments to future changes in the geography of the Earth because many coastal and island features would ultimately become submerged. Discussion: Some Policy Implications It is sometimes imagined that slow processes such as climate changes pose small risks, on the basis of the assumption that a choice can always be made to quickly reduce emissions and thereby reverse any harm within a few years or decades. We have shown that this assumption is incorrect for carbon dioxide emissions, because of the longevity of the atmospheric CO2 perturbation and ocean warming. Irreversible climate changes due to carbon dioxide emissions have already taken place, and future carbon dioxide emissions would imply further irreversible effects on the planet, with attendant long legacies for choices made by contemporary society. Discount rates used in some estimates of economic trade-offs assume that more efficient climate mitigation can occur in a future richer world, but neglect the irreversibility shown here. Similarly, understanding of irreversibility reveals limitations in trading of greenhouse gases on the basis of 100-year estimated climate changes (global warming potentials, GWPs), because this metric neglects carbon dioxide’s unique long-term effects. In this paper we have quantified how societal decisions regarding carbon dioxide concentrations that have already occurred or could occur in the coming century imply irreversible dangers relating to climate change for some illustrative populations and regions. These and other dangers pose substantial challenges to humanity and nature, with a magnitude that is directly linked to the peak level of carbon dioxide reached.

#### No impact – empirics

Willis et. al, ’10 [Kathy J. Willis, Keith D. Bennett, Shonil A. Bhagwat & H. John B. Birks (2010): 4 °C and beyond: what did this mean for biodiversity in the past?, Systematics and Biodiversity, 8:1, 3-9, <http://www.tandfonline.com/doi/pdf/10.1080/14772000903495833>, ]

The most recent climate models and fossil evidence for the early Eocene Climatic Optimum (53–51 million years ago) indicate that during this time interval atmospheric CO2 would have exceeded 1200 ppmv and tropical temperatures were between 5–10 ◦ C warmer than modern values (Zachos et al., 2008). There is also evidence for relatively rapid intervals of extreme global warmth and massive carbon addition when global temperatures increased by 5 ◦ C in less than 10 000 years (Zachos et al., 2001). So what was the response of biota to these ‘climate extremes’ and do we see the large-scale extinctions (especially in the Neotropics) predicted by some of the most recent models associated with future climate changes (Huntingford et al., 2008)? In fact the fossil record for the early Eocene Climatic Optimum demonstrates the very opposite. All the evidence from low-latitude records indicates that, at least in the plant fossil record, this was one of the most biodiverse intervals of time in the Neotropics (Jaramillo et al., 2006). It was also a time when the tropical forest biome was the most extensive in Earth’s history,

extending to mid-latitudes in both the northern and southern hemispheres – and there was also no ice at the Poles and Antarctica was covered by needle-leaved forest (Morley, 2007). There were certainly novel ecosystems, and an increase in community turnover with a mixture of tropical and temperate species in mid latitudes and plants persisting in areas that are currently polar deserts. [It should be noted; however, that at the earlier Palaeocene–Eocene Thermal Maximum (PETM) at 55.8 million years ago in the US Gulf Coast, there was a rapid vegetation response to climate change. There was major compositional turnover, palynological richness decreased, and regional extinctions occurred (Harrington & Jaramillo, 2007). Reasons for these changes are unclear, but they may have resulted from continental drying, negative feedbacks on vegetation to changing CO2 (assuming that CO2 changed during the PETM), rapid cooling immediately after the PETM, or subtle changes in plant–animal interactions (Harrington & Jaramillo, 2007).]

#### Growing emissions in developing countries make CO2 reduction impossible – modeling is irrelevant

Koetzle, 08 – Ph.D. and Senior Vice President of Public Policy at the Institute for Energy Research (William, “IER Rebuttal to Boucher White Paper”, 4/13/2008, http://www.instituteforenergyresearch.org/2008/04/13/ier-rebuttal-to-boucher-white-paper/)

For example, if the United States were to unilaterally reduced emissions by 30% or 40% below 2004 levels[8] by 2030; net global CO2 emissions would still increase by more than 40%. The reason is straightforward: either of these reduction levels is offset by the increases in CO2 emissions in developing countries. For example, a 30% cut below 2004 levels by 2030 by the United States offsets less than 60% of China’s increase in emissions during the same period. In fact, even if the United States were to eliminate all CO2 emissions by 2030, without any corresponding actions by other countries, world-wide emissions would still increase by 30%. If the United States were joined by the other OECD countries in a CO2 reduction effort, net emissions would still significantly increase. In the event of an OCED-wide reduction of 30%, global emissions increase by 33%; a reduction of 40% still leads to a net increase of just under 30%. Simply put, in order to hold CO2 emissions at 2004 levels, absent any reductions by developing nations like China and India, all OECD emissions would have to cease.[9] The lack of participation by all significant sources of GHGs not only means it is unlikely that net reductions will occur; it also means that the cost of meaningful reductions is increased dramatically. Nordhous (2007) for example, argues that for the “importance of near-universal participation to reduce greenhouse gases.”[10] His analysis shows that GHG emission reduction plans that include, for example, 50% of world-wide emissions impose additional costs of 250 percent. Thus, he find’s GHG abatement plans like Kyoto (which does not include significant emitters like the United States, China, and India) to be “seriously flawed” and “likely to be ineffective.” [11] Even if the United States had participated, he argues that Kyoto would make “but a small contribution to slowing global warming, and it would continue to be highly inefficient.”[12]The data on emissions and economic analysis of reduction programs make it clear that GHG emissions are a global issue. Actions by localities, sectors, states, regions or even nations are unlikely to effectively reduce net global emissions unless these reductions are to a large extent mirrored by all significant emitting nations.

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## SMR CP

### AT: Russia Addon

#### Russia will cheat anyways

Ed Lyman – Union of Concerned Scientists – 2/16/11, It’s Time to Pull the Plug on the MOX “Factory to Nowhere”, <http://allthingsnuclear.org/its-time-to-pull-the-plug-on-the-mox-factory-to/>

The chief rationale for the U.S. Plutonium Disposition Program was to engage Russia in a bilateral exercise in order to encourage it to do the same, thus addressing the security problem of poorly secured plutonium stocks in Russia that the National Academy of Sciences (NAS) called a “clear and present danger” in 1993. (In addition to MOX, the NAS also identified an alternative means of plutonium disposition known as “immobilization,” which entails mixing the plutonium with radioactive waste and imbedding it in large heavy rods of glass or ceramic, and then burying it along with highly radioactive wastes. Although NNSA determined that the immobilization would be cheaper than MOX, the United States believed that Russia did not want to treat its plutonium as waste and would only be interested in the MOX option. In 2002, NNSA cancelled all work on immobilization.) The United States and Russia signed an agreement in 2000 to each dispose of 34 metric tons of surplus plutonium. However, Russia never seriously adhered to the terms of the original agreement, and the bilateral initiative has effectively come undone. In 2010, the two nations signed an amended protocol which for all intents and purposes decoupled the two disposition programs by allowing Russia to use plutonium in fast neutron reactors. This amendment essentially sanctioned what Russia had been planning to do on its own all along. Moreover, the amended protocol allows Russia to reprocess 30% of the spent fuel from those reactors to produce additional separated plutonium, thereby undermining a chief benefit of the original agreement: to reduce the amount of separated plutonium stored in Russia. Even so, there are troubling indications that Russia is still not holding up its end of the deal. In the FY 2012 NNSA budget request, the Obama administration is proposing to withhold additional U.S. funding for the Russian plutonium disposition program pending a new agreement between the U.S. and Russia on “detailed implementation milestones.” This is particularly puzzling in view of the fact that the 2010 amended protocol already contained an “Annex on Key Program Elements” with detailed implementation milestones. It appears that Russia is still not moving forward expeditiously with the program even after signing the amended protocol.

#### CTR is dead

GSN (Global Security Newswire) – 10/10/12, Russia to Drop Cooperative Threat Reduction Deal With U.S.: Report, http://www.nti.org/gsn/article/russia-drop-cooperative-threat-reduction-deal-us-report/

Russia has opted against renewing a key agreement allowing the United States to assist in securing and eliminating Soviet-built weapons of mass destruction, U.S. State Department insiders said in comments quoted by RIA Novosti on Wednesday. Russian international relations officials told their U.S. equivalents that Moscow has prioritized the protection of national security information over the acquisition of foreign monetary aid it now deems unnecessary, the State Department insiders told the Kommersant newspaper. The present enabling deal for Cooperative Threat Reduction operations in Russia is due to lapse in 2013; prior renewals of the 21-year-old accord took place in 1999 and 2006. "Russia announced that it had no more need for American finances ... that it could implement the tasks in question entirely on its own," one State Department staffer told Kommersant. A Russian Foreign Ministry insider stated: "The agreement is thoroughly discriminating. It fails to take into account the changes that took place in the world after its signing in the 1990s."

#### No chance of recovery – proves overall relations are tanked

DAVID M. HERSZENHORN – NYT – 10/10/12, Russia Won’t Renew Pact on Weapons With U.S., http://www.nytimes.com/2012/10/11/world/europe/russia-wont-renew-pact-with-us-on-weapons.html

American officials, including one of the original architects of the program, Senator Richard G. Lugar, Republican of Indiana, have said they still have hope of reaching some form of new agreement with Russia. But the prospects seem bleak. President Vladimir V. Putin, while expressing a willingness to cooperate on nonproliferation issues, has said that a more pressing priority is to address Russia’s opposition to United States plans for a missile defense system based in Europe. President Obama has shown little willingness to make any concessions, other than to offer repeated reassurance that the system is not intended for use against Russia. And the Republican presidential nominee, Mitt Romney, seems even less likely to compromise on the missile defense issue. The plan to end the Nunn-Lugar program appears to be the latest step by the Russian government in an expanding effort to curtail American-led initiatives, and especially the influence of American money, in various spheres of Russian public policy. Last month, the Kremlin directed the United States Agency for International Development to halt all of its operations in Russia, which similarly entailed two decades of work, but in support of nonprofit groups like human rights advocates and civil society and public health programs. The Russian government had made no secret of its unhappiness with some programs financed by the Agency for International Development, like Golos, the country’s only independent election-monitoring group, which helped expose fraud in disputed parliamentary voting last December.

## Solvency

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#### \*\*No one wants to reprocess

Thomas Clements – 9/27/12, Plutonium Fuel (MOX) Program at Savannah River Site Hit with Major Setback, http://aikenleader.villagesoup.com/p/plutonium-fuel-mox-program-at-savannah-river-site-hit-with-major-setback/897688

In yet another series of significant set-backs for the Department of Energy’s (DOE) troubled plutonium fuel (MOX) program at the Savannah River Site (SRS), a key Tennessee Valley Authority (TVA) official has backed away from considering MOX use in TVA’s aging reactors at this time. The Decatur Daily, a newspaper located in Decatur, Alabama and just a few miles from TVA’s Browns Ferry reactors, quotes Preston Swofford, chief nuclear officer at TVA, as saying that he’s not at this point interested in MOX use and the agency is instead focused on a host of problems facing operation and management of TVA’s nuclear plants. The official was quoted as a DOE hearing on plutonium disposition, including necessity of testing of MOX in the problem-plagued Browns Ferry reactors, was conducted near Decatur on September 13. The paper quotes Swofford’s negative comments about consideration of MOX: "It's just so low on my radar screen that I refuse to jump in the fray. I don't think I do service to the ratepayers of the Valley bringing on one more issue. Now three or four years from now, when the fleet's back to steady, we'll take a look at the product." “Given TVA’s reluctance in pursuing MOX and the fact that DOE has no customers to use experimental MOX fuel is reason to put the brakes on the entire MOX program and halt construction of the $6-billion MOX plant to nowhere,” said Tom Clements, Nonproliferation Policy Director with the Alliance for Nuclear Accountability. “It appears that the MOX program continues to degrade into a big-government program with a singular mission: transfer of tax payer money into the pockets of the plutonium industry.” MOX Garners no Support at Plutonium Hearing near Browns Ferry Nuclear Reactors At the DOE hearing on the draft Supplemental Environmental Impact Statement on plutonium testing and use in Browns Ferry, pro-MOX advocates were shocked that sixteen members of the public spoke against use of the experimental plutonium fuel in Browns Ferry while not a single person spoke in favor. Three people spoke in favor of pursuit of thorium reactors, not considered by DOE as an option for plutonium disposition. Given the troubles with the Browns Ferry reactors, including have the worst rating by the Nuclear Regulatory Commission (NRC) of any reactors in the US, public sensitivity about the operation of the reactors is high. Comments from many members of the public who live nearby focused on increased risks to reactor operation if MOX is used in the GE Mark I reactors (Fukushima design). According to the Nuclear Regulatory Commission in a September 18 blog on "Mid-Term Grades Go Out For Nuclear Power Plants," the Browns Ferry reactors are in a unique, dangerous class when it comes to poor operation. The NRC states that "Browns Ferry 1 in Alabama, is in the fourth performance category and requires increased oversight due to a safety finding of high significance, which will include additional inspections to confirm the plant’s performance issues are being addressed." TVA is struggling to deal with the host of issue at the Browns Ferry Fukushima-design reactors and do not need to add to problems by taking on the dodgy MOX mission, according to ANA. "If the DOE tries to force TVA to commit now to MOX use in the Browns Ferry degraded reactors, which may never be able to perform at a higher safety level, I predict this arm-twisting approach will be seen for what it is and backfire into DOE's face," according to Clements. "If they were acting in a responsible manner, both DOE and AREVA would announce that the aging Browns Ferry reactors are off the table for testing and use of experimental weapons-grade MOX." Also, at the hearing in Alabama, it was pointed out to NNSA by ANA, via a written comment, that a video being shown about MOX included an erroneous statement that there was a "treaty" with Russia for plutonium disposition. There is a only an "agreement" with Russia, which has much less status than a treaty which must be passed by the Senate. To its credit, NNSA has agreed to edit the video and fix the error. DOE Won’t Able to Legally Issue a Final Supplemental EIS on MOX Use in TVA Reactors? Swofford’s position and TVA’s reluctance to look seriously into MOX use will likely have a decisive impact on DOE’s legal ability to issue a final Supplemental Environmental Impact Statement (Final SEIS) on plutonium disposition. While DOE’s “preferred alternative” is for MOX use in TVA reactors, the draft SEIS states (page S-iv) that “The TVA does not have a preferred alternative at this time regarding whether to pursue irradiation of MOX fuel in TVA reactors and which reactors might be used for this purpose.” As TVA owns the reactors which might test and use MOX and is charged with complying with regulations of the NRC in operation of the reactors, DOE’s National Nuclear Security Administration (NNSA) has no legal jurisdictional authority to direct TVA to accept MOX for testing and use.

#### \*\*The world can only churn out so many parts in a year – bottlenecks delay the aff for years

Micah Springut, Stephen Schlaikjer, and David Chen – CENTRA (contracting for the U.S.-China Economic and Security Review Commission) - January 2011, China’s Program for Science and Technology Modernization: Implications for American Competitiveness, <http://www.uscc.gov/researchpapers/2011/USCC_REPORT_China's_Program_forScience_and_Technology_Modernization.pdf>

Some observers also note the potential for China’s nuclear expansion plans to set back US energy interests. On the one hand, successful construction and start-up of AP-1000 reactors would give US utilities the confidence to place orders for some of Westinghouse’s reactors. On the other hand, nuclear-component forges in Japan, Korea and France have limited global capacity to produce nuclear reactor vessels and steam generators. If there is to be a nuclear energy renaissance in the United States, as some hope, and if the Chinese reactor programs were keep up their momentum, Chinese demand could absorb the global capacity to supply critical reactor components for years to come.295

### 2NC No Renaissance

#### No nuke renaissance

Peter Kelly-Detwiler – Forbes – 1/15/13, New Centralized Nuclear Plants: Still an Investment Worth Making?, <http://www.forbes.com/sites/peterdetwiler/2013/01/15/new-centralized-nuclear-plants-still-an-investment-worth-making/>

Just a few years ago, the US nuclear renaissance seemed at hand. It probably shouldn’t have been. Cost overruns from Finland to France to the US were already becoming manifest, government guarantees were in doubt, and shale gas drillers were beginning to punch holes into the ground with abandon. Then came Fukushima. The latter proved a somewhat astonishing reminder of forgotten lessons about nuclear power risks, unique to that technology: A failure of one power plant in an isolated location can create a contagion in countries far away, and even where somewhat different variants of that technology are in use. Just as Three Mile Island put the kaibosh on nuclear power in the US for decades, Fukushima appears to have done the same for Japan and Germany, at a minimum. It certainly did not help public opinion, and at a minimum, the effect of Fukushima will likely be to increase permitting and associated regulatory costs. By contrast, when a gas-fired plant in Connecticut exploded during construction a few years ago, it didn’t affect the public perception of other gas plants. But Fukushima and nuclear power is another story. The stakes are so much bigge Even without Fukushima, the verdict on large centralized US nukes is probably in, for the following reasons: 1) They take too long: In the ten years it can take to build a nuclear plant, the world can change considerably (look at what has happened with natural gas prices and the costs of solar since some of these investments were first proposed). The energy world is changing very quickly, which poses a significant risk for thirty to forty year investments. 2) They are among the most expensive and capital-intensive investments in the world; they cost many billions of dollars, and they are too frequently prone to crippling multi-billion dollar cost overruns and delays. In May 2008, the US Congressional Budget Office found that the actual cost of building 75 of America’s earlier nuclear plants involved an average 207% overrun, soaring from $938 to $2,959 per kilowatt. 3) And once the investments commence, they are all-or-nothing. You can’t pull out without losing your entire investment. For those with longer memories, WPPS and Shoreham represent $2.25 bn (1983) and $6 bn (1989) wasted investments in which nothing was gained and ratepayers and bondholders lost a good deal. Some recent investments in centralized nuclear plants in other countries highlight and echo these lessons. Electricite de France’s Flamanville plant has seen its budget explode from 3.3 to 6 bn (July 2011) to 8 bn Euros ($10.5 bn) as of last December, with a delay of four years over original targets. EDF in part blames stricter post-Fukushima regulations for part of the overrun). To the north, Finland’s Olkiluoto – being constructed by Areva – has seen delays of nearly five years, and enormous cost overruns. The original turnkey cost of 3.0 bn Euros has skyrocketed beyond all fears, increasing at least 250%. Just last month, Areva’s CEO conceded “We estimate that the costs of Olkiluoto are near those of Flamanville.” In the US, recent experience doesn’t look much better: Progress Energy (now Duke) first announced the 2,200 MW Levy nuclear project in 2006, with an estimated price tag of $4 to $6 bn and an online date of 2016. The cost estimated increased to $17 bn in 2008. This year, Progress announced the project would cost $24 billion and come online in 2024. The Levy plant currently has a debt in excess of $1.1 bn for which customers had already paid $545 million through 2011. As of now, the utility plans to proceed, with the Executive VP for Power Generation stating ”We’ve made a decision to build Levy…I’m confident in the schedule and numbers.” In Georgia, Vogtle Units 3 and 4 (owned jointly by a number of utilities, including Georgia Power) appear in somewhat better shape, but issues have cropped up there as well. Customers currently pay $10 per month in advance to cover financing associated with the two 1,117 MW units. Georgia Power is allowed by legislation to recover $1.7 bn in financing costs of its estimated $6.1 bn portion of the $14 bn plant during the construction period. However, there have already been some cost problems, and Georgia Power is disputing its responsibility to pay $425 million of overruns resulting from delays in licensing approvals. Total cost excesses to all partners total $875 mn. The two units were expected to come online in 2016 and 2017, but in a Georgia PSC meeting in December, an independent monitor noted that expected delays of fifteen months are largely as a result of poor paperwork related to stringent design rules and quality assurance. Those delays will likely continue to cost more money. Unfortunately, these experiences are not outliers. From 2007 to 2010, the NRC received 18 nuclear applications ( of which only twelve are still active). Of these, the consulting outfit Analysis Group reported that for eight plants where they were able to obtain two or more comparable cost estimate, 7 are over budget (including Levy and Vogtle), with updated numbers “often double or triple initial estimates.” This is consistent with an MIT study estimating ‘overnight’ costs nearly doubling from 2002 to 2007. As utilities management consultant Stephen Maloney was quoted in the Analysis Group study “No one has ever built a contemporary reactor to contemporary standards, so no one has the experience to state with confidence what it will cost. We see cost escalations as companies coming up the learning curve.” Last August, Exelon abandoned plans to construct two facilities in Texas, blaming low natural gas prices. Two months later, Dominion Resources announced that it would shut down its existing Kewaunee station in Wisconsin as a consequence of low gas prices and a lack of buyers. The latter move was particularly eye-opening: building a nuclear plant is supposed to be the expensive part, while operation is expected to be relatively cheap. So it appears that the nuclear renaissance may be largely over before it started. And yet, many projects have not yet been canceled, with utilities and ratepayers accepting ever more risk in order to rescue sunk costs. In many cases, these costs have soared or will soar into the billions. As risk management expert Russell Walker of the Kellogg School of Management is quoted as saying in the Tampa Bay Times “When the stakes get higher, it gets harder for organizations to walk away…this happens a lot. It’s the same problem a gambler has: If I play a little longer, it’ll come around.” With low natural gas prices, efficient combined cycled turbines, more efficient renewables and a host of more efficient end-use technologies, that’s a bet fewer and fewer seem wiling to take. Unfortunately for ratepayers at some utilities, they are at the table whether they like it or not…

## Warming

### 2NC

#### Too late for nuclear to solve warming

Wauchope 2012 - taught science before switching to nursing. She has several post-graduate qualifications, in health informatics, medical terminology and clinical coding (June 12, Noel, “Answering Barry Brook on Australia's nuclear power future” http://www.onlineopinion.com.au/view.asp?article=13726&page=0)

Climate Change I should start from Barry Brook's own starting point. He is the director of climate science at the University of Adelaide's Environment Institute, - so his main argument is that nuclear power is needed to counteract climate change - to replace greenhouse gas- emitting fossil fuels, coal and gas. This position is in itself debatable. Given that climate scientists are warning that climate change is near to becoming irreversible, one might well ask - will all the nuclear reactors be built in time to prevent this, even if they are not greenhouse gas producers? (And in the total cycle from uranium mining to waste disposal, nuclear power IS a greenhouse gas producer).

#### Already passed the tipping point

Michael McCarthy, Environment Editor of The Independent, Global warming: passing the 'tipping point', 2006 http://www.independent.co.uk/environment/global-warming-passing-the-tipping-point-466187.html

A crucial global warming "tipping point" for the Earth, highlighted only last week by the British Government, has already been passed, with devastating consequences. Research commissioned by The Independent reveals that the accumulation of greenhouse gases in the atmosphere has now crossed a threshold, set down by scientists from around the world at a conference in Britain last year, beyond which really dangerous climate change is likely to be unstoppable. The implication is that some of global warming's worst predicted effects, from destruction of ecosystems to increased hunger and water shortages for billions of people, cannot now be avoided, whatever we do. It gives considerable force to the contention by the green guru Professor James Lovelock, put forward last month in The Independent, that climate change is now past the point of no return. The danger point we are now firmly on course for is a rise in global mean temperatures to 2 degrees above the level before the Industrial Revolution in the late 18th century. At the moment, global mean temperatures have risen to about 0.6 degrees above the pre-industrial era - and worrying signs of climate change, such as the rapid melting of the Arctic ice in summer, are already increasingly evident. But a rise to 2 degrees would be far more serious. By that point it is likely that the Greenland ice sheet will already have begun irreversible melting, threatening the world with a sea-level rise of several metres. Agricultural yields will have started to fall, not only in Africa but also in Europe, the US and Russia, putting up to 200 million more people at risk from hunger, and up to 2.8 billion additional people at risk of water shortages for both drinking and irrigation. The Government's conference on Avoiding Dangerous Climate Change, held at the UK Met Office in Exeter a year ago, highlighted a clear threshold in the accumulation of greenhouse gases such as carbon dioxide (CO2) in the atmosphere, which should not be surpassed if the 2 degree point was to be avoided with "relatively high certainty". This was for the concentration of CO2 and other gases such as methane and nitrous oxide, taken together in their global warming effect, to stay below 400ppm (parts per million) in CO2 terms - or in the jargon, the "equivalent concentration" of CO2 should remain below that level. The warning was highlighted in the official report of the Exeter conference, published last week. However, an investigation by The Independent has established that the CO2 equivalent concentration, largely unnoticed by the scientific and political communities, has now risen beyond this threshold. This number is not a familiar one even among climate researchers, and is not readily available. For example, when we put the question to a very senior climate scientist, he said: "I would think it's definitely over 400 - probably about 420." So we asked one of the world's leading experts on the effects of greenhouse gases on climate, Professor Keith Shine, head of the meteorology department at the University of Reading, to calculate it precisely. Using the latest available figures (for 2004), his calculations show the equivalent concentration of C02, taking in the effects of methane and nitrous oxide at 2004 levels, is now 425ppm. This is made up of CO2 itself, at 379ppm; the global warming effect of the methane in the atmosphere, equivalent to another 40ppm of CO2; and the effect of nitrous oxide, equivalent to another 6ppm of CO2. The tipping point warned about last week by the Government is already behind us.

### AT: Food

#### And, honeybees

AP, 08 (“Honey Bee Crisis could lead to higher food prices”, http://www.chicagotribune.com/news/politics/sns-ap-sick-bees,0,622176.story)

WASHINGTON — Food prices could rise even more unless the mysterious decline in honey bees is solved, farmers and businessmen told lawmakers Thursday. "No bees, no crops," North Carolina grower Robert D. Edwards told a House Agriculture subcommittee. Edwards said he had to cut his cucumber acreage in half because of the lack of bees available to rent. About three-quarters of flowering plants rely on birds, bees and other pollinators to help them reproduce. Bee pollination is responsible for $15 billion annually in crop value. In 2006, beekeepers began reporting losing 30 percent to 90 percent of their hives. This phenomenon has become known as Colony Collapse Disorder. Scientists do not know how many bees have died; beekeepers have lost 36 percent of their managed colonies this year. It was 31 percent for 2007, said Edward B. Knipling, administrator of the Agriculture Department's Agricultural Research Service. "If there are no bees, there is no way for our nation's farmers to continue to grow the high quality, nutritious foods our country relies on," said Democratic Rep. Dennis Cardoza of California, chairman of the horticulture and organic agriculture panel. "This is a crisis we cannot afford to ignore."

#### And, Population growth

Von Braun, 08 – Director General of the International Food Policy Research Institute (Joachim, April 2008

“High Food Prices: What should be done?”, http://www.ifpri.org/pubs/bp/bp001.asp)

At the same time, the growing world population is demanding more and different kinds of food. Rapid economic growth in many developing countries has pushed up consumers' purchasing power, generated rising demand for food, and shifted food demand away from traditional staples and toward higher-value foods like meat and milk. This dietary shift is leading to increased demand for grains used to feed livestock.

### AT Biodiversity

#### Warming increases genetic diversity as species adapt to climate change

Singer & Avery, ’07 (S. Fred, distinguished research professor at George Mason Dennis T, director of the Center for Global Food Issues at the Hudson Institute, “Unstoppable Global Warming: Every 1,500 Years” Page 12)

We know that species can adapt to abrupt global warming because the climate shifts in the 1,500-year cycle have often been abrupt. Moreover, the world's species have already survived at least six hundred such warmings and coolings in the past million years. The major effect of global warming will be more biodiversity in our forests, as most trees, plants, birds, and animals extend their ranges. This is already happening. Some biologists claim that a further warming of 0.8 degrees Celsius will destroy thousands of species. However, the Earth warmed much more than that during the Holocene Climate Optimum, which occurred 8,000 to 5,000 years ago, and no known species were driven extinct by the temperature increase.

## Peak Uranium

### 2NC

#### Uranium would have to be $340 for commercialization of reprocessing

Todd P. Lagus – WISE - August 4, 2005, Reprocessing of Spent Nuclear Fuel: A Policy Analysis, Journal of Engineering and Public Policy, vol. 9, http://www.wise-intern.org/journal/2005/lagus.pdf

There have been several studies conducted on reprocessing of spent fuel. During the June 16, 2005 House Science Energy Subcommittee hearing on reprocessing, Matthew Bunn, Senior Research Associate with Harvard University’s Project on Managing the Atom, has testified that reprocessing does not have an economic advantage over the once through fuel cycle. In a report from the project entitled The Economics of Reprocessing vs. Direct Disposal of Spent Nuclear Fuel, Bunn et al. asserts that reprocessing in light water reactors (LWR) would have a “breakeven price” of natural uranium ore of $340/kgHM. The breakeven price is the price at which reprocessing becomes economically equal to the once through cycle. In other words, the price of uranium would need to rise from the current $40/kgHM to $340/kgHM to be economically equivalent.34

#### BEST CASE predictions for next year are about one-fourth that price

Debra Fiakas - Crystal Equity Research – 12/31/12, Profits In Uranium Energy's Future?, Seeking Alpha, <http://seekingalpha.com/article/1087881-profits-in-uranium-energy-s-future>

What is more, industry analysts are forecasting higher selling prices. A Credit Suisse report suggest prices in a range of $80 to $90 per pound in 2013 and J.P. Morgan projects a price range of $78 to $85 per pound. This would represent a significant increase from recent spot prices that fell to a low of $45 per pound. Big firm predictions are often times just wishful thinking. However, investors should note that one of Australia's more important uranium mining companies, Paladin Energy Ltd. (PALAF), recently received a $200 million pre-payment from a utility for up to 14 million pounds of uranium to be delivered beginning in 2019. It is an unprecedented supply agreement that signals supply concerns among uranium users - and quite a bit of support for aggressive price forecasts by industry analysts.

#### Status quo solves – seawater extraction

Prigg, Science and Technology Editor, 8/21/12

[Mark, Science and Technology Editor for Daily Mail Online, “Are oceans the future of nuclear power? Scientists move closer to extracting uranium from seawater,” Daily Mail Online, <http://www.dailymail.co.uk/sciencetech/article-2191571/Do-oceans-hold-future-nuclear-power-Scientists-closer-extracting-uranium-seawater.html>]

Extracting uranium from seawater is closer to becoming an economic reality which could guarantee the future of nuclear power, scientists said today. The world's oceans hold at least four billion tons of the precious metal. But for the past four decades, the goal of mining seawater for uranium has remained a dream because of the technical difficulties and high cost. Today, a report presented to a scientific meeting showed that fast progress is being made towards turning the oceans into a uranium reservoir. Improvements to the extraction technology have almost halved production costs from around 560 dollars (£355) per pound of uranium to 300 dollars (£190). Dr. Robin Rogers, from the University of Alabama, told the annual meeting of the American Chemical Society in Philadelphia: 'Estimates indicate that the oceans are a mother lode of uranium, with far more uranium dissolved in seawater than in all the known terrestrial deposits that can be mined. 'The difficulty has always been that the concentration is just very, very low, making the cost of extraction high. 'But we are gaining on that challenge.' The standard extraction technique, developed in Japan, uses mats of braided plastic fibres embedded with compounds that capture uranium atoms. Each mat is 50 to 100 yards long and suspended 100 to 200 yards under the water. After being brought back to the surface, the mats are rinsed with a mild acid solution to recover the uranium. They are then dunked in the water again in a process that can be repeated several times. The new work involves making cheaper and more efficient versions of the mats and the compounds that latch onto uranium. A team led by Dr. Rogers is exploring the use of waste shrimp shells from the seafood industry to produce a biodegradable mat material. Dr. Erich Schneider, from the University of Texas, another speaker at the American Chemical Society symposium, said the aim was to establish seawater uranium as an 'economic backstop' that will sustain the nuclear power industry. Nuclear power plants are built to operate for 60 years or longer and involve a huge investment, he told the meeting. Before committing themselves to building nuclear plants, energy companies had to be sure they can source reasonably priced uranium for many decades to come. 'This uncertainty around whether there's enough terrestrial uranium is impacting the decision-making in the industry, because it's hard to make long-term research and development or deployment decisions in the face of big uncertainties about the resource,' said Dr. Schneider. 'So if we can tap into uranium from seawater, we can remove that uncertainty.' Seawater extraction of uranium may also have environmental advantages, the meeting heard. Traditional uranium mining produced contaminated wastewater and posed health risks for miners.

#### We’re fine for 100 years

IAEA, 2010

[International Atomic Energy Agency, “International Status and Prospects of Nuclear Power 2010 Edition,” <http://www.iaea.org/Publications/Booklets/NuclearPower/np10.pdf>]

The latest estimate of global uranium resources published by the OECD/NEA and the IAEA in 2010 shows identified conventional uranium resources of 6.3 million tonnes (Mt U). This corresponds to almost 100 years of consumption at the present level. Although this figure is high compared with other mineral resources, the important challenge is to improve the utilization of the uranium resource, i.e. to increase energy output per tonne of uranium mined. In parallel, it can be expected that increased exploration and utilization of unconventional resources (such as uranium from phosphates and sea water) will increase uranium resources.

#### No uranium shortages

Cochran et al. 2010 – PhD. and consultant to the Natural Resources Defense Council where he began working in 1973. Prior to retiring in 2011, he was a senior scientist and held the Wade Greene Chair for Nuclear Policy at NRDC, and was director of its Nuclear Program until 2007. He has served as a consultant to numerous government and non-government agencies on energy, nuclear nonproliferation, nuclear reactor and nuclear waste matters (February, Thomas B., Harold A. Feiveson, Walt Patterson, Gennadi Pshakin, M.V. Ramana, Mycle Schneider, Tatsujiro Suzuki, Frank von Hippel, “Fast Breeder Reactor Programs: History and Status” <http://fissilematerials.org/library/rr08.pdf>)

Why commercialization of breeder reactors failed The rationale for pursuing breeder reactors — sometimes explicit and sometimes implicit — was based on the following key assumptions: 1. Uranium is scarce and high-grade deposits would quickly become depleted if fission power were deployed on a large scale; 2. Breeder reactors would quickly become economically competitive with the light-water reactors that dominate nuclear power today; 3. Breeder reactors could be as safe and reliable as light-water reactors; and, 4. The proliferation risks posed by breeders and their “closed” fuel cycle, in which plutonium would be recycled, could be managed. Each of these assumptions has proven to be wrong. Uranium is cheap and abundant. Breeder reactors were seen as a solution for the uranium scarcity problem because, by converting uranium-238 into chainreacting plutonium, they can potentially increase one-hundred-fold the amount of fission energy that can be extracted from a kilogram (kg) of uranium and make it economically feasible to mine much lower grades of uranium ore. 4 In 2007, uranium requirements for the global fleet of nuclear power reactors were 67,000 metric tons — approximately 180 tons per gigawatt of generating capacity per year. The International Atomic Energy Agency (IAEA) projects that global nuclear capacity will increase and that uranium requirements will increase correspondingly to between 94,000 and 122,000 tons a year in 2030. 5 In 2008, the biennial report put out by the OECD Nuclear Energy Agency, Uranium 2007: Resources, Production and Demand — also known as “the Red Book” — found that, despite inflation, global known conventional resources of uranium recoverable for less than $130/kg had increased from about 4.7 to about 5.5 million tons. The Red Book also reported estimates from 27 countries that, with further exploration, an additional 7.6 million tons of uranium would be discovered in the same cost range. 6 At $130/kg, the cost of uranium would contribute 0.3 U.S. cents to the cost of a kilowatt-hour of nuclear electricity. In the long run, worldwide, the amount of uranium recoverable at low cost is virtually certain to be far greater than the numbers reported in the Red Book. If plausible estimates of geological abundance are used, the amount of uranium still to be discovered at recovery costs up to $130/kg would be 50–126 million tons. 7 This corresponds to 500 to 1000 times the projected demand in 2030. It will be seen from figure 1.2 that the price of uranium on the spot market went significantly above $130/kg during the late 1970s and then again after 2005. Except for these two periods when there was disequilibrium between supply and demand, prices have been less than $50 per kg. The 1970s price peak was due 6 to the expectation of an enormous expansion in nuclear power capacity. This expectation was not realized but large stockpiles of uranium were built up and then sold off during the subsequent decades resulting in the closure of many uranium mines. The sale by Russia to the U.S. of low-enriched uranium blended down from 500 tons of weapon-grade uranium from excess Cold War weapons at a rate sufficient to fuel half of the U.S. nuclear capacity extended the period of low demand for freshly mined uranium. 8 The stockpiles of natural uranium have been largely used up, however, and the blend-down of the Russian weapon-grade uranium will be completed in 2013. The most recent uranium price peak therefore reflected, at least in part, the expectation, compounded by speculation, that there might be uranium shortages before uranium-mining capacity increases again to the level required to support growing demand. In any case, unlike the situation with oil or gas-fueled power plants, the cost of uranium fuel can double without having a significant impact on the cost of nuclear power. As noted above, at $130/kg, the cost of uranium contributes only 0.3 cents to the cost of a kilowatt-hour (kWh), which is about 5 percent of the cost of electricity produced by a new light-water reactor. 9

## NNSA

### UQ – A2: NNSA Sucks

#### NNSA is dealing with its issues – and they don’t affect the deterrent

GAO - July 27, 2012, MODERNIZING THE NUCLEAR SECURITY ENTERPRISE, http://gao.gov/assets/600/591975.pdf

NNSA has made considerable progress resolving some of its long-standing management deficiencies, but significant improvement is still needed especially in NNSA’s management of its major projects and contracts. GAO reported in June 2004 that NNSA has better delineated lines of authority and has improved communication between its headquarters and site offices. In addition, NNSA’s establishment of an effective headquarters security organization has made significant progress resolving many of the security weaknesses GAO has identified. Nevertheless, NNSA continues to experience major cost and schedule overruns on its projects, such as research and production facilities and nuclear weapons refurbishments, principally because of ineffective oversight and poor contractor management. In some areas, NNSA can be viewed as a success. Importantly, NNSA has continued to ensure that the nuclear weapons stockpile remains safe and reliable in the absence of underground nuclear testing. At the same time, NNSA’s struggles in defining itself as a separately organized agency within DOE, and the considerable management problems that remain have led to calls in Congress and other organizations to increase NNSA’s independence from DOE. However, senior DOE and NNSA officials have committed to continuing reform, and DOE’s and NNSA’s efforts have led to some management improvements. As a result, GAO continues to believe, as it concluded in its January 2007 report, that drastic organizational change to increase independence is unnecessary and questions whether such change would solve the agency’s remaining management problems.

### Link 2NC

#### Extend Klein

#### The nuclear industry workforce is zero-sum

Jo Lorentzen and Il-haam Petersen – March 2008, HUMAN CAPITAL DYNAMICS IN THREE TECHNOLOGY PLATFORMS: NUCLEAR, SPACE AND BIOTECHNOLOGY, (Chief Research Specialist in the Education Science and Skills Development programme at the Human Sciences Research Council (HSRC) in South Africa), <https://www.labour.gov.za/downloads/documents/research-documents/Technology%20Platforms.pdf>

For the new build programme, the time lines are such that construction could

feasibly start in 2010 and would last six years, irrespective of location. New build implies a massive human capital effort at the level of artisans, technicians, and engineers. Insofar as the new plants are turn-key projects, it would be the contractor’s responsibility to field the required number and quality of welders, electricians, and so forth. But it is also true that in view of the scarcity of these kinds of skills in the country, any upscale of the nuclear workforce would come at the expense of other infrastructure projects, thus resulting in a zero-sum game. In light of this massive market failure, it is unlikely that the solution to the skills constraints could be entirely privatised, i.e. rest with Westinghouse and whoever else makes up its consortium.

#### Trades off with NNSA

GAO-12-468, Apr 26, 2012, Strategies and Challenges in Sustaining Critical Skills in Federal and Contractor Workforces, <http://www.gao.gov/products/GAO-12-468>

Shortages of qualified candidates. NNSA officials told us that qualified candidates are in short supply and that competition from science and technology-related companies in the private sector poses additional challenges. Candidates for most critical skills positions at national laboratories must meet certain criteria, including (1) an advanced degree (master`s or doctorate) in a scientific, technical, or engineering field; (2) the ability to obtain a high-level security clearance, which requires U.S. citizenship; and (3) an interest in and willingness to learn weapons design work. The requirement for U.S. citizenship in particular is becoming an increasingly difficult criterion to satisfy in the recruitment process. National laboratory officials told us that a large percentage of students graduating from top science, technology, and engineering programs are foreign nationals. M&O contractors can hire foreign nationals to work outside of weapons-related areas, but the citizenship requirement for working on programs supporting U.S. nuclear weapons is not negotiable. [Footnote 19]

#### Private industry will win the fight for talent

Omkar Phatak – Buzzle Software Solutions senior writer – 6/1/10, "Nuclear Engineer Salary," Buzzle, www.buzzle.com/articles/nuclear-engineer-salary.html

Starting Salary Through my research on the Internet, I found that the entry-level salary is in the range of $55,000 to $62,000. The average starting level salary is around $60,000. Due to the considerable technical expertise required in this field, only the best are chosen in this industry and paid handsomely right from entry-level. Mid-Level Salary The growth in salary is considerable in this field as one gains experience with time. People with 15 to 20 years of experience may earn a salary of $94,000 to $96,000. High Level Salary People with more than 20 years of experience in this field may earn as much as a $100,000 per year. Private sector jobs offer a higher pay scale to experienced professionals which may touch $110,000 in USA. The demand for skilled professionals in the field of nuclear engineering is only going to increase with time as nuclear power graduates to be the mainstay of power production in the world.

### Link – A2: They Choose the NNSA

#### Private industry will have major advantages over NNSA

GAO-12-468, Apr 26, 2012, Strategies and Challenges in Sustaining Critical Skills in Federal and Contractor Workforces, <http://www.gao.gov/products/GAO-12-468>

Officials from NNSA site offices and M&O contractor work sites reported that their secure work environment and location make recruitment of advanced science and technology candidates more challenging. Due to the sensitive nature of nuclear weapons work, NNSA and M&O contractor sites must be more secure than most private sector laboratories or commercial plants. To meet this security requirement, laboratories and plants in the enterprise tend to be restrictive environments, isolated from security threats by geography and classification protocols. In addition to these potentially undesirable traits, in the view of some candidates, some sites are further constrained by a high cost of living. Restrictive environment. Officials from most M&O contractors reported that the restrictive environment required for nuclear weapons research and maintenance is a disadvantage in recruiting new staff with the potential to become weapons experts. Staff typically need to acquire and maintain high-level clearances and must often work in secure areas that prohibit the use of personal cell phones, personal e-mail, and social media. In particular, they told us younger candidates typically expect to stay continuously connected to their peers via cell phone and social media. Furthermore, any research completed in classified work can only be seen within the classified community; for researchers who desire broader recognition of their work and opportunities for wider collaboration, academia or private industry may be more attractive. Because of these restrictions, most M&O contractor human resources staff told us that it was more difficult to recruit younger scientists and engineers. Isolation. An isolated location may be desirable for building or maintaining nuclear weapons, but it may not appeal to some desirable candidates with advanced degrees in science, technology, and engineering. For example, Los Alamos National Laboratory officials told us that the laboratory’s relative isolation––nearly 100 miles from Albuquerque, New Mexico–– may make it less appealing to some candidates. In addition, the relative lack of other types of employment opportunities nearby may pose challenges for candidates with spouses in careers outside of science, technology and engineering. Officials at two of the three weapons laboratories told us they focus on recruiting top candidates nationwide to gain a wide breadth of thought and opinion among their staff. The laboratories track the proportion of job offers accepted but cannot always ascertain or be sure of the reason a candidate rejects an offer because, according to officials at Lawrence Livermore, candidates may simply state they declined an offer for “personal reasons.” In addition, some of the production plants and the test site are also in isolated locations and face some of the same challenges as the laboratories. However, these sites require fewer candidates with advanced degrees and can generally rely on the local workforce to fill other types of critical skills positions. For example, Savannah River Site and Pantex are also both located far from other large cities. However, because of their relative isolation, they are among the biggest employers in these areas, and many local candidates are qualified and eager to accept positions in weapons manufacturing and maintenance. Pantex officials reported that they do not have difficulty finding most workers to perform weapons maintenance, which requires a shorter amount of on-the-job training than weapons design but nonetheless requires a set of critical skills. However, site staff have had to develop strategies to attract candidates to fill those positions that require advanced degrees. Unlike the laboratories, officials at all of the production plants told us that they focus their recruiting efforts for these positions at local and regional colleges and universities. Officials at Y-12, for example, have identified competitive science and engineering programs at universities within 300 miles of their plant in Oak Ridge, Tennessee. Y-12 officials reported that they have better results in both recruiting and retaining critically skilled workers when those workers have personal ties to the area. In contrast, M&O contractor officials from the laboratories told us that they needed to recruit from the top academic programs across the country. High cost and competition. Two enterprise sites are located in areas with high costs of living, which can deter qualified candidates—Los Alamos and Lawrence Livermore. NNSA and its M&O contractors have flexibility to offer higher compensation for some critical skills, but some candidates are unwilling to live in high cost areas. For example, housing in Los Alamos is expensive and scarce. According to Los Alamos National Laboratory staff, some employees commute nearly 100 miles each way from Albuquerque every day partly due to cost of living constraints. Los Alamos Human Resources managers reported that high housing costs are a concern among current and prospective employees. Lawrence Livermore National Laboratory, located in the San Francisco Bay Area, is also a high cost area. NNSA has authorized higher salaries for some critically skilled M&O contractor employees but delays during the hiring process can give private sector recruiters an advantage with critically skilled candidates. Lawrence Livermore uses the flexibilities it has to negotiate competitive compensation, but a candidate interested in weapons work may be drawn to another site with a lower cost of living, such as Sandia National Laboratories in Albuquerque or one of the production plants.

### Impact – Testing 2NC

#### Loss of confidence in NNSA nuclear stewardship causes resumption of testing

DARYL G. KIMBALL – EXECUTIVE DIRECTOR, THE ARMS CONTROL ASSOCIATION - APRIL 19, 2007, The Future of U.S. Nuclear Weapons: The Weapons Complex and the Reliable Replacement Warhead (RRW), http://www.armscontrol.org/print/3224

KIMBALL: There are other activities, particularly the very fundamental stockpile surveillance and maintenance efforts that NNSA is behind schedule on. That’s what’s necessary to provide the early warning of any potential problem in the stockpile. As I think you mentioned, Sid, one of the concerns that we have about a rush to pursue RRW is that it could come at the cost of some other essential efforts to maintain the existing stockpile, which could raise questions about the need to resume testing.

DRELL: I think we all agree that the part that’s not urgent is getting on and building a new warhead design. But for the infrastructure, there are parts which I think we’re way behind on and we should get on with. QUESTION: There’s something that he mentioned that you all didn’t mention. You didn’t seem to answer the question on the need for experience on how to design a weapon. Say in 50 years, there is a new peer competitor that could threaten us and we have not had the people come into the pipelines; students coming in to nuclear engineering who can have the design skills. In 50 years, all the people who were able to design warheads have passed away. Wouldn’t that cost a lot more money to say, “oh shoot, we need to make up for 20 years of not maintaining design skill sets and personal expertise—not infrastructure, not buildings, not pit facilities—but the people to maintain it?” KIMBALL: Could you just identify yourself please? QUESTION: I’m Jennifer with SAIC, sorry. DRELL: I will answer that one. We have put approximately $7 billion a year into the Stockpile Stewardship Program to maintain a healthy NNSA and well-run laboratories. Those laboratories have had work on very exciting new scientific devices. They’ve been building and have brought into fruition during the past decade very fast super computers and accompanying codes that allow them to do high fidelity, three-dimensional explosion codes. There is the Dual Axis Radiographic Hydrodynamic Test Facility, DARHT, down at Los Alamos that’s going to give us two angles and multiple pulses to steady the implosion. The National Ignition Facility (NIF) is coming on. These are very exciting science tools and you can do a lot to try and understand weapons. We still don’t understand a lot of the fundamentals of what’s going on in the science of nuclear explosions. There are materials under extraordinarily extreme conditions. We didn’t have to worry about that for 50 years while we were designing new warheads. We have made great progress. That’s why I have greater confidence in the stockpile now than 10 years ago, even though we haven’t tested now for 15 years, because we understand these weapons better. So there are very exciting scientific challenges. I think it’s very good while we have the mentors around to teach the young people and to have them think about new designs like they did for RRW-1. So, thinking about warheads, trying to understand them, challenging minds, giving them exciting things to do with new simulations and above ground experiments, that’s all part of this program. When the Stockpile Stewardship Program went in 13 or 14 years ago when the moratorium started there was great concern. That’s why the program has had the science-based stewardship, the life extension program, et cetera. There are some very smart people doing very good work. I reject the notion that I have to blow out the side of a mountain to do good science, however. QUESTION: So you believe that those programs are maintaining the skill set, the – DRELL: Yes. QUESTION: – the nuclear deterrent skill sets that we would need in the future; not just to understand explosions, but to understand if we need a new weapon to deal with new targets? We would be able to develop that when we needed it? DRELL: I think that is the obligation of the laboratories and Congress to fund to do that because we had nuclear weapons and we’re going to have them for a while. We have to better understand them and be able to see danger signals coming and how to respond. But that does not mean, in my mind, deploying a new weapon. QUESTION: Jan Lodal, Atlantic Council. Sid, I would like to encourage you to talk a little bit more about the technical side of the uncertainty, if you will. Steve pointed out that there are birth defects, potentially, of the new weapons and whether you really know that they’ll be less uncertain than the old ones? What can go wrong with older warheads other than perhaps a little bit lower yield or maybe a little bit lower reliability? How significant would that be in that kind of a strategic environment where reliability drops 10 percent from where it is or yields drop 20 percent from where they are? Are there situations with the older warheads that are actually understood or known which the new warhead could deal with that are more serious than that? DRELL: You want me to do that? The case is often made that we are near cliffs in the performance. In order to get the present arsenal to deliver the maximum megatonage in a warhead of the minimum weight—so we could put as many MIRVs on one missile as we could; this was our Cold War strategy—we went near performance cliffs. One that one could talk about quite openly is that during the boost phase you boost the primary to get big yield out of a little primary to drive the secondary. We know that you have to have a certain amount of energy in the primary explosion to make the secondary go off, which is where most of the energy comes from. So how close are we because of a shortage of tritium way back to being near the cliff where if you go a little bit below that energy, you don’t drive the secondary? The argument is that a new weapon would move away from those performance cliffs. So one has to look for those performance cliffs and see if there are any that bother you. It’s been talked about openly and it was made a big point of in the study in 1995 that was done actually by JASON. The unclassified portion talks about it in congressional testimony of making the boosting system more robust so you get further away from that performance cliff. They’ve been doing that. That’s an example of things you can do which don’t require testing or any kind of change. There are, in a system like this, aspects where one looks at whether you are near a performance cliff. That’s what the stewardship program is doing; it’s looking. It’s been making improvements in various ways as it goes along. QUESTION: So you’re saying that can happen inside the stewardship program and you don’t need the RRW. DRELL: That’s right. QUESTION: What I’m looking for is something that you need the RRW. Isn’t it also true, though, that even in that extreme case you get a Hiroshima-size bomb? DRELL: Oh, sure. QUESTION: So it’s not that you don’t get any explosion out of this thing, even if all of these things went wrong that we’re proposing might go wrong. So my point being that it’s quite important, it seems to me, to understand the strategic context of what the mission is that you’re looking for with these weapons and not just saying, “well, they might not quite work,” when “work” is not very well defined. DRELL: I’m answering the easier question as a technical man and saying that we have to have our eyes out for performance cliffs and stay away from them. Now, what would matter if we didn’t get the full yield? If we got 70 percent or 80 percent? That’s a deeper part of the question. That is a political decision and a strategic decision the government people are going to make. If you ask me, do I worry that our weapon will give us only 80 percent of the yield, I worry. I worry that it will give us 80 percent of the yield if we use it. So I’d like to stay away from many fundamental issues of what our strategic policy is. Where the juncture here is even consistent with our present strategic policy, what do we have to do? A longer term question is as we bring the arsenal down. If I saw us reducing the number so we were only dealing with military targets in Russia and we didn’t have 5,000 but maybe a couple hundred, how many warheads does it take to destroy a society? Yours is really a very deep question and it should be addressed in our nuclear policy. What is our nuclear policy and how much confidence do we need? But for an outsider to come in and say, “well, if our weapons only have a 60 percent chance of working, that’s good enough.” You were in government; you know that doesn’t win any arguments about what decision to make. But maybe Steve has another aspect on that. FETTER: I just want to add to that a little bit to say it’s very difficult to evaluate the value of RRW over the present approach because in the present approach of life extension programs and stockpile stewardship, if there were a problem in a current warhead, we would detect that and then we would attempt to rebuild the warhead so that those problems were corrected. Now, the assertion is that in that process of rebuilding and extending the life of an existing warhead, that unforeseen problems might arise and uncertainties might be introduced that would make it difficult to certify that rebuild. But it’s just so hypothetical. It’s difficult to say how likely that is and what would be the impact of it. You also would have to weigh that against the equally unknown problems that an RRW might have as a result of its manufacture. So I don’t think that you can really say with confidence that in this hypothetical situation, one approach or the other would definitely be better. KIMBALL: Anyone else? Or have we covered all the territory? Yes, sir, Mr. Rust. QUESTION: Dean Rust, retired State Department. This administration supports this approach and they say that if you adopt it, you won’t have to test and you’re not likely to have to test and you could actually reduce your stockpile and so on. That’s actually good from a nonproliferation standpoint. So if you oppose that approach and you’re stuck then with the notion that the stockpile stewardship and life extension programs don’t give you the same degree of protection against those things that a reliable replacement warhead would, then you’re going to face increased pressure in the future to test from the people who currently support the RRW program. Let’s face it, you’ve got this administration which hates the Comprehensive Test Ban Treaty but has maintained the moratorium on nuclear testing and in part they’re arguing that the RRW will allow us to continue that moratorium. Okay. So I mean if you’ve got that program in place eight or 10 years from now when there’s renewed pressure for testing, you could easily argue that the administration that hated the Comprehensive Test Ban was completely comfortable with this program. From a political standpoint, it seems to me this is actually positive for this administration to propose a program that they suggest will allow the stockpile to go down and reduce the likelihood of new testing. KIMBALL: Let’s take the suggestion that RRW will facilitate deeper reductions and will reduce the likelihood of testing. Can we tell, Sid, whether an RRW warhead will make us less likely to resume testing than we would be under current plans? DRELL: My technical approach is that it’s a wrong assumption this will make us less likely to test. Steve made a very good point which is that you worry about birth defects. When you have a new design, the most important problem is to get those birth defects out of the design. If you look at the significant findings which are published of our arsenal, you’ll find out that in the beginning there are more significant findings of things you didn’t think about, such as different materials being compatible working in the same environment or something like that. These are very complex devices and they grew slowly with the test program. We have more than 1,000 tests that give a pedigree to our present arsenal. We’ve seen birth defects and we haven’t seen the other half, as far as I know, of the bathtub curve where age means that the findings are going up in any significant way, which is why I said there are no significant aging defects that I see. So you have to answer the question first of all with what you know technically because is it true that if you have an RRW, you’re going to have greater confidence in that weapon 10 or 20 years down the line? You’re introducing birth defects that you have to worry about. Meanwhile, the life extension program is giving us the expertise and the knowledge to know whether a problem arises. The Comprehensive Test Ban Treaty allows you if there’s a problem, either technical or political, to abrogate the treaty and go back to testing. It’s in there for a good reason. But, in my mind, the technical risk, unless further studies, which I said we should do, convince me otherwise, would rely in putting a new warhead in there. Now, put yourself in the head not of this administration, but the chairman of the joint chiefs or the president 15 years down the road and somebody comes to you and says, “you know what, things are not looking very good in the world and I’ve got an arsenal out there and I’ve never tested a warhead in it.” Do you think you feel secure? Ask yourself whether you ever could answer that question positively. FETTER: This argument that RRW will make it easier for us to maintain the stockpile without testing would be far more convincing to me if it were accompanied by a commitment to ratify or push for the ratification of the CTBT by the administration and also if proponents of RRW in the Senate said that if they got RRW they would vote for the ratification of the CTBT. Well, then I have to say, I would look a little differently at this program. But I don’t see that that’s the politics of it. I see this as just another argument thrown in there to make the program seem more appealing. KIMBALL: One other thing that I think is important to consider is back in October of 1999—a month I remember very well—when the CTBT was being debated in the Senate, the three nuclear weapons lab directors testified on October 7th that the Stockpile Stewardship Program will not be fully completed until the middle of the next decade and therefore they implied that the success of the program could not be guaranteed. Well, isn’t this exactly the same thing that D’Agostino said yesterday to the Senate Energy Appropriations Committee which is that if doubts about the confidence of a new warhead were to emerge, he could not guarantee that testing would not be needed when the RRW warhead ages. I mean, essentially, there are no guarantees that you will never test. The question is: are we sufficiently confident that we don’t have to resume testing? The lab directors also said in 1999 that they were confident that the Stockpile Stewardship Program could maintain the stockpile indefinitely without nuclear testing so long as the program is fully supported and sustained. Again, we think the assumption that underlies the argument that RRW will reduce the possibility of resuming testing more than the current approach is wrong or is just impossible to justify.

#### Causes rapid escalation to global nuclear war

Johnson 1 (Rebecca, Executive Director – Acronym Institute for Disarmament Diplomacy, The Guardian, 7-17, http://www.acronym.org.uk/dd/dd58/58rej.htm)

Then the international arms control and non-proliferation regimes collapsed. Americans weren't bothered at first, for hadn't the government promised a super-sophisticated force field round the whole nation that no terrorist or missile would ever penetrate? So nuclear testing resumed in Nevada for new warheads to improve the kill prospects of missile interceptors and to penetrate deep into enemies' bunkers. India had been waiting for just such a go-ahead, and Pakistan soon followed; both raced to test warheads to fit onto missiles, upping the tension in Kashmir and with China. Free now to resume its own testing, China boosted its programme to modernise and increase the size of its nuclear arsenal. Somewhat reluctantly, Russia followed. Moscow suspended all further reductions and cooperative security and safety programmes for its still-large nuclear arsenal and facilities. Within a few short years, the Nuclear Non-Proliferation Treaty (NPT) was just another dead treaty. Many of the governments with nuclear power programmes developed nuclear weapons as well, while others fitted anthrax or sarin onto weapons, just in case. Most hadn't wanted to, but fearful that their neighbours would, all felt compelled. Regional rivalries grew quickly into major international problems. Alliances collapsed amidst suspicion and recriminations. The burgeoning arms races spread into outer space, threatening military surveillance, as well as public communication, entertainment and navigation. No one knew who had what. Deterrence was empty. Defence analysts calculated the advantages of a pre-emptive strike. In that terrified atmosphere of insecurity and mistrust, someone launched first. No-one was left to speak out. The Republicans hadn't yet managed to get missile defence to work. This doomsday scenario is not so fanciful. On July 7, the New York Times went public with the news that President Bush wants to ditch the CTBT. A week before, the administration asked the US nuclear laboratories to work out how quickly the United States could resume testing after its nine-year moratorium. If Bush were to back out of the CTBT or break the moratorium on nuclear testing, undertaken with China, Russia, Britain and France, he would also explicitly breach agreements made last May when 187 countries negotiated a set of measures to strengthen and implement the NPT. The test ban is no outdated Cold War instrument, but a fundamental tool to prevent new, destabilising developments in nuclear weapons. Over several decades, from the Arctic to the Pacific, from the capitals of Europe to the deserts of Nevada, people have marched, petitioned, demonstrated, even sailed or hiked into test sites. Many have been imprisoned, and some even lost their lives trying to stop the nuclear weapon governments from polluting our oceans and the earth's crust with radioactivity from nuclear explosions, conducted for one purpose and one purpose only - to make 'better' nuclear bombs.

### Impact – Disease 2NC

#### NNSA human capital key to solve disease (and turns climate change)

D'Agostino, 10 – U.S. Under Secretary for Nuclear Security

(Thomas, former Stockpile Stewardship Program director, "NNSA Administrator Addresses Next Generation of Computational Scientists," 6-22-10, www.nnsa.energy.gov/mediaroom/speeches/csgfremarks062210, accessed 9-4-12, mss)

Since I spoke to this group last summer, a lot has changed. I believe that the long-term opportunities to promote our Nation’s nuclear security are greater today than at any point since the end of the Cold War. And I believe that means even more opportunities for you and your generation of nuclear security professionals to make valuable and rewarding contributions to our nation’s security. Take, for example, the Nuclear Posture Review released publicly this past April. While it obviously defines the role of nuclear weapons for our future national security, it also recognizes and explicitly mentions a key theme I have been promoting for a number of years: the importance of recruiting and retaining the “human capital” needed in the NNSA for the nuclear security mission. In order to succeed in our mission, we must have the best and brightest minds working to tackle the toughest challenges. Without question, our highly specialized work force is our greatest asset. This Nuclear Posture Review has helped generate renewed interest in nuclear security by elevating these issues to the very top of our national security agenda. I want to share with you a statement from the Directors of Los Alamos, Sandia, and Lawrence Livermore that provides their views on the NPR. The Directors universally state that: “We are reassured that a key component of the NPR is the recognition of the importance of supporting ‘a modern physical infrastructure -comprised of the national security laboratories and a complex of supporting facilities--and a highly capable workforce…..’” The President has now clearly outlined the importance of nuclear issues for our national security, and of keeping the U.S. nuclear deterrent safe, secure, and effective for the foreseeable future. The Administration’s commitment to a clear and long-term plan for managing the stockpile and its comprehensive nuclear security agenda, ensures the scientists and engineers of tomorrow like yourselves will have the opportunity to engage in challenging research and development activities. The mission in NNSA encompasses the nuclear deterrent, nonproliferation, nuclear propulsion, nuclear counterterrorism, emergency management, nuclear forensics and nuclear intelligence analysis. And, we anticipate that those R&D activities will expand far beyond the classical nuclear weapons mission. At the Department of Energy, we are expected to deliver for the Nation in science, energy, and security. The Department will soon issue a new Strategic Plan that reflects an integrated approach to national security activities. We anticipate that our nuclear security facilities will provide significant science, technology, and engineering capabilities that can address non-NNSA issues. Conversely, we anticipate that other DOE programs can provide science, technology, and engineering capabilities to NNSA for our issues. We are looking at a number of areas to move forward: Exa-scale Computing, Energy Systems Simulation, the behavior of Materials in Extreme Environments, and Inertial Fusion Energy – these are some of the cross cutting areas we are a looking at as we map out the future strategic vision of the Department. Already, the supercomputing capabilities born of our nation’s investment in nuclear security are providing the tools to tackle global challenges like climate change, the spread of pandemic diseases, and even hurricane modeling. As we move to the next generation of supercomputers, we will see even more opportunities for the kind of cutting edge science and research that can engage people like you and your colleagues. Creating computational simulations to provide solutions – in effect, creating a new discipline of predictive sciences – is a technical base we need and is a direction that many of you in this room will help pioneer. Like generations of scientists and researchers before you, we hope you will find the opportunity we provide to develop novel solutions to critical challenges to be irresistible to your career path decisions. And I am confident of our future when I look out at audiences like this and see people like you. The work you do, your interests and your choices will form our future. Don’t be bashful about striving for what you want. Your investments now in developing your skills make you best able to contribute towards solving our most complex national problems. From Oppenheimer during the Manhattan Project, to the men and women serving in our national laboratories today, the people who come before you have included some of the greatest names in science and discovery. You are the inheritors of a proud tradition of achievement and advancement. I am confident that legacy is in good hands. Secretary Chu recently stated that the Department of Energy “...must discover and deliver the solutions to advance our national priorities.” The NNSA and our Nuclear Security Enterprise are poised to provide those solutions along with the rest of the Department.

#### Disease causes extinction

Joshua Keating – Foreign Policy web editor – 2009, "The End of the World," Foreign Policy, 11-13-9, www.foreignpolicy.com/articles/2009/11/13/the\_end\_of\_the\_world?page=full

How it could happen: Throughout history, plagues have brought civilizations to their knees. The Black Death killed more off more than half of Europe's population in the Middle Ages. In 1918, a flu pandemic killed an estimated 50 million people, nearly 3 percent of the world's population, a far greater impact than the just-concluded World War I. Because of globalization, diseases today spread even faster - witness the rapid worldwide spread of H1N1 currently unfolding. A global outbreak of a disease such as ebola virus -- which has had a 90 percent fatality rate during its flare-ups in rural Africa -- or a mutated drug-resistant form of the flu virus on a global scale could have a devastating, even civilization-ending impact. How likely is it? Treatment of deadly diseases has improved since 1918, but so have the diseases. Modern industrial farming techniques have been blamed for the outbreak of diseases, such as swine flu, and as the world’s population grows and humans move into previously unoccupied areas, the risk of exposure to previously unknown pathogens increases. More than 40 new viruses have emerged since the 1970s, including ebola and HIV. Biological weapons experimentation has added a new and just as troubling complication.