# Nuclear Power AFF – NCPA Workshop

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### Notes

#### This affirmative can access both hegemony and global warming providing flexibility and allows the affirmative team to capture almost every impact presented. Another strength is a UNIQUENESS trick, the evidence that says the Floating SMRs are already being employed by Russia, makes inevitable most negative disads pertaining to proliferation/terrorism/ or environmental threats.

#### There is also a strong US key warrant through the hegemony advantage and the evidence that says US lead is critical to get the world onboard.

#### Key Terms -

#### According to the International Atomic Energy Agency, "small" reactors are defined to have power outputs up to 300 MWe and "medium" reac- tors have outputs between 300 and 700 MWe

#### International Atomic Energy Agency (IAEA) definitions, a large conventional nuclear reactor typically exceeds an output of 700 MW. In contrast, small nuclear reactors are defined as those producing less than 300 MW (IAEA, 2007).

#### Purchase-Power Agreement – government purchases the energy output of the SMR which was created and funded by private markets. Private companies would foot the bill and the government would purchase the energy it created. In essence, it is an agreement to purchase power.

### Contention One is Warming

#### The best science proves it’s anthropogenic

Muller, 2012 [Richard, professor of physics at the University of California, Berkeley, and a former MacArthur Foundation fellow, “The Conversion of a Climate-Change Skeptic”, http://www.nytimes.com/2012/07/30/opinion/the-conversion-of-a-climate-change-skeptic.html?pagewanted=all]

CALL me a converted skeptic. Three years ago I identified problems in previous climate studies that, in my mind, threw doubt on the very existence of global warming. Last year, following an intensive research effort involving a dozen scientists, I concluded that global warming was real and that the prior estimates of the rate of warming were correct. I’m now going a step further: Humans are almost entirely the cause. My total turnaround, in such a short time, is the result of careful and objective analysis by the Berkeley Earth Surface Temperature project, which I founded with my daughter Elizabeth. Our results show that the average temperature of the earth’s land has risen by two and a half degrees Fahrenheit over the past 250 years, including an increase of one and a half degrees over the most recent 50 years. Moreover, it appears likely that essentially all of this increase results from the human emission of greenhouse gases. These findings are stronger than those of the Intergovernmental Panel on Climate Change [IPCC], the United Nations group that defines the scientific and diplomatic consensus on global warming. In its 2007 report, the I.P.C.C. concluded only that most of the warming of the prior 50 years could be attributed to humans. It was possible, according to the I.P.C.C. consensus statement, that the warming before 1956 could be because of changes in solar activity, and that even a substantial part of the more recent warming could be natural. Our Berkeley Earth approach used sophisticated statistical methods developed largely by our lead scientist, Robert Rohde, which allowed us to determine earth land temperature much further back in time. We carefully studied issues raised by skeptics: biases from urban heating (we duplicated our results using rural data alone), from data selection (prior groups selected fewer than 20 percent of the available temperature stations; we used virtually 100 percent), from poor station quality (we separately analyzed good stations and poor ones) and from human intervention and data adjustment (our work is completely automated and hands-off). In our papers we demonstrate that none of these potentially troublesome effects unduly biased our conclusions. The historic temperature pattern we observed has abrupt dips that match the emissions of known explosive volcanic eruptions; the particulates from such events reflect sunlight, make for beautiful sunsets and cool the earth’s surface for a few years. There are small, rapid variations attributable to El Niño and other ocean currents such as the Gulf Stream; because of such oscillations, the “flattening” of the recent temperature rise that some people claim is not, in our view, statistically significant. What has caused the gradual but systematic rise of two and a half degrees? We tried fitting the shape to simple math functions (exponentials, polynomials), to solar activity and even to rising functions like world population. By far the best match was to the record of atmospheric carbon dioxide (CO2), measured from atmospheric samples and air trapped in polar ice.

#### Fossil fuels are key

Vertessy and Clark3-13**-**2012[Rob, Acting Director of Australian Bureau of Meteorology, and Megan, Chief Executive Officer at the Commonwealth Scientific and Industrial Research Organisation, “State of the Climate 2012”, <http://theconversation.edu.au/state-of-the-climate-2012-5831>]

Carbon dioxide (CO2) emissions account for about 60% of the effect from anthropogenic greenhouse gases on the earth’s energy balance over the past 250 years. These global CO2 emissions are mostly from fossil fuels (more than 85%), land use change, mainly associated with tropical deforestation (less than 10%), and cement production and other industrial processes (about 4%). Australia contributes about 1.3% of the global CO2 emissions. Energy generation continues to climb and is dominated by fossil fuels – suggesting emissions will grow for some time yet. CO2 levels are rising in the atmosphere and ocean. About 50% of the amount of CO2 emitted from fossil fuels, industry, and changes in land-use, stays in the atmosphere. The remainder is taken up by the ocean and land vegetation, in roughly equal parts. The extra carbon dioxide absorbed by the oceans is estimated to have caused about a 30% increase in the level of ocean acidity since pre-industrial times. The sources of the CO2 increase in the atmosphere can be identified from studies of the isotopic composition of atmospheric CO2 and from oxygen (O2) concentration trends in the atmosphere. The observed trends in the isotopic (13C, 14C) composition of CO2 in the atmosphere and the decrease in the concentration of atmospheric O2 confirm that the dominant cause of the observed CO2 increase is the combustion of fossil fuels.

#### 4 degree warming is inevitable with current carbon usage trends – emissions must be reduced

Potsdam Institute, 2012 (Potsdam Institute for Climate Impact Research and Climate Analytics, “Turn Down the Heat: Why a 4°C Warmer World Must be Avoided”, A report for the World Bank, November, http://climatechange.worldbank.org/sites/default/files/Turn\_Down\_the\_heat\_Why\_a\_4\_degree\_centrigrade\_warmer\_world\_must\_be\_avoided.pdf)

The emission pledges made at the climate conventions in Copenhagen and Cancun, if fully met, place the world on a trajectory for a global mean warming of well over 3°C. Even if these pledges are fully implemented there is still about a 20 percent chance of exceeding 4°C in 2100.10 If these pledges are not met then there is a much higher likelihood—more than 40 percent—of warming exceeding 4°C by 2100, and a 10 percent possibility of this occurring already by the 2070s, assuming emissions follow the medium business-as-usual reference pathway. On a higher fossil fuel intensive business-as-usual pathway, such as the IPCC SRESA1FI, warming exceeds 4°C earlier in the 21st century. It is important to note, however, that such a level of warming can still be avoided. There are technically and economically feasible emission pathways that could still limit warming to 2°C or below in the 21st century. To illustrate a possible pathway to warming of 4°C or more, Figure 22 uses the highest SRES scenario, SRESA1FI, and compares it to other, lower scenarios. SRESA1FI is a fossil-fuel intensive, high economic growth scenario that would very likely cause mean the global temperature to exceed a 4°C increase above preindustrial temperatures. Most striking in Figure 22 is the large gap between the projections by 2100 of current emissions reduction pledges and the (lower) emissions scenarios needed to limit warming to 1.5–2°C above pre-industrial levels. This large range in the climate change implications of the emission scenarios by 2100 is important in its own right, but it also sets the stage for an even wider divergence in the changes that would follow over the subsequent centuries, given the long response times of the climate system, including the carbon cycle and climate system components that contribute to sea-level rise. The scenarios presented in Figure 22 indicate the likely onset time for warming of 4°C or more. It can be seen that most of the scenarios remain fairly close together for the next few decades of the 21st century. By the 2050s, however, there are substantial differences among the changes in temperature projected for the different scenarios. In the highest scenario shown here (SRES A1FI), the median estimate (50 percent chance) of warming reaches 4°C by the 2080s, with a smaller probability of 10 percent of exceeding this level by the 2060s. Others have reached similar conclusions (Betts et al. 2011). Thus, even if the policy pledges from climate convention in Copenhagen and Cancun are fully implemented, there is still a chance of exceeding 4°C in 2100. If the pledges are not met and present carbon intensity trends continue, then the higher emissions scenarios shown in Figure 22 become more likely, raising the probability of reaching 4°C global mean warming by the last quarter of this century. Figure 23 shows a probabilistic picture of the regional patterns of change in temperature and precipitation for the lowest and highest RCP scenarios for the AR4 generation of AOGCMS. Patterns are broadly consistent between high and low scenarios. The high latitudes tend to warm substantially more than the global mean. RCP8.5, the highest of the new IPCC AR5 RCP scenarios, can be used to explore the regional implications of a 4°C or warmer world. For this report, results for RCP8.5 (Moss et al. 2010) from the new IPCC AR5 CMIP5 (Coupled Model Intercomparison Project; Taylor, Stouffer, & Meehl 2012) climate projections have been analyzed. Figure 24 shows the full range of increase of global mean temperature over the 21st century, relative to the 1980–2000 period from 24 models driven by the RCP8.5 scenario, with those eight models highlighted that produce a mean warming of 4–5°C above preindustrial temperatures averaged over the period 2080–2100. In terms of regional changes, the models agree that the most pronounced warming (between 4°C and 10°C) is likely to occur over land. During the boreal winter, a strong “arctic amplification” effect is projected, resulting in temperature anomalies of over 10°C in the Arctic region. The subtropical region consisting of the Mediterranean, northern Africa and the Middle East and the contiguous United States is likely to see a monthly summer temperature rise of more than 6°C.

#### Not too late – every reduction key

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We're not yet committed to surpassing 2°C global warming, but as Watson noted, we are quickly running out of time to realistically give ourselves a chance to stay below that 'danger limit'. However, 2°C is not a do-or-die threshold. Every bit of CO2 emissions we can reduce means that much avoided future warming, which means that much avoided climate change impacts. As Lonnie Thompson noted, the more global warming we manage to mitigate, the less adaption and suffering we will be forced to cope with in the future. Realistically, based on the current political climate (which we will explore in another post next week), limiting global warming to 2°C is probably the best we can do. However, there is a big difference between 2°C and 3°C, between 3°C and 4°C, and anything greater than 4°C can probably accurately be described as catastrophic, since various tipping points are expected to be triggered at this level. Right now, we are on track for the catastrophic consequences (widespread coral mortality, mass extinctions, hundreds of millions of people adversely impacted by droughts, floods, heat waves, etc.). But we're not stuck on that track just yet, and we need to move ourselves as far off of it as possible by reducing our greenhouse gas emissions as soon and as much as possible. There are of course many people who believe that the planet will not warm as much, or that the impacts of the associated climate change will be as bad as the body of scientific evidence suggests. That is certainly a possiblity, and we very much hope that their optimistic view is correct. However, what we have presented here is the best summary of scientific evidence available, and it paints a very bleak picture if we fail to rapidly reduce our greenhouse gas emissions. If we continue forward on our current path, catastrophe is not just a possible outcome, it is the most probable outcome. And an intelligent risk management approach would involve taking steps to prevent a catastrophic scenario if it were a mere possibility, let alone the most probable outcome. This is especially true since the most important component of the solution - carbon pricing - can be implemented at a relatively low cost, and a far lower cost than trying to adapt to the climate change consequences we have discussed here (Figure 4).

#### Three Impacts---

#### Agriculture – 4 degrees trumps CO2 benefits

Potsdam Institute, 2012 (Potsdam Institute for Climate Impact Research and Climate Analytics, “Turn Down the Heat: Why a 4°C Warmer World Must be Avoided”, A report for the World Bank, November, http://climatechange.worldbank.org/sites/default/files/Turn\_Down\_the\_heat\_Why\_a\_4\_degree\_centrigrade\_warmer\_world\_must\_be\_avoided.pdf)

The overall conclusions of IPCC AR4 concerning food production and agriculture included the following: • Crop productivity is projected to increase slightly at mid- to high latitudes for local mean temperature increases of up to 1 to 3°C depending on the crop, and then decrease beyond that in some regions (medium confidence) {WGII 5.4, SPM}. • At lower latitudes, especially in seasonally dry and tropical regions, crop productivity is projected to decrease for even small local temperature increases (1 to 2°C) which would increase the risk of hunger (medium confidence) {WGII 5.4, SPM}. • Globally, the potential for food production is projected to increase with increases in local average temperature over a range of 1 to 3°C, but above this it is projected to decrease (medium confidence) {WGII 5.4, 5.5, SPM}. These findings clearly indicate a growing risk for low-latitude regions at quite low levels of temperature increase and a growing risk for systemic global problems above a warming of a few degrees Celsius. While a comprehensive review of literature is forthcoming in the IPCC AR5, the snapshot overview of recent scientific literature provided here illustrates that the concerns identified in the AR4 are confirmed by recent literature and in important cases extended. In particular, impacts of extreme heat waves deserve mention here for observed agricultural impacts (see also Chapter 2). This chapter will focus on the latest findings regarding possible limits and risks to large-scale agriculture production because of climate change, summarizing recent studies relevant to this risk assessment, including at high levels of global warming approaching 4°C. In particular, it will deliberately highlight important findings that point to the risks of assuming a forward projection of historical trends. Projections for food and agriculture over the 21st century indicate substantial challenges irrespective of climate change. As early as 2050, the world’s population is expected to reach about 9 billion people (Lutz and Samir 2010) and demand for food is expected to increase accordingly. Based on the observed relationship between per capita GDP and per capita demand for crop calories (human consumption, feed crops, fish production and losses during food production), Tilman et al. (2011) project a global increase in the demand for crops by about 100 percent from 2005 to 2050. Other estimates for the same period project a 70 percent increase of demand (Alexandratos 2009). Several projections suggest that global cereal and livestock production may need to increase by between 60 and 100 percent to 2050, depending on the warming scenario (Thornton et al. 2011). The historical context can on the one hand provide reassurance that despite growing population, food production has been able to increase to keep pace with demand and that despite occasional fluctuations, food prices generally stabilize or decrease in real terms (Godfray, Crute, et al. 2010). Increases in food production have mainly been driven by more efficient use of land, rather than by the extension of arable land, with the former more widespread in rich countries and the latter tending to be practiced in poor countries (Tilman et al. 2011). While grain production has more than doubled, the area of land used for arable agriculture has only increased by approximately 9 percent (Godfray, Beddington, et al. 2010). However, although the expansion of agricultural production has proved possible through technological innovation and improved water-use efficiency, observation and analysis point to a significant level of vulnerability of food production and prices to the consequences of climate change, extreme weather, and underlying social and economic development trends. There are some indications that climate change may reduce arable land in low-latitude regions, with reductions most pronounced in Africa, Latin America, and India (Zhang and Cai 2011). For example, flooding of agricultural land is also expected to severely impact crop yields in the future: 10.7 percent of South Asia´s agricultural land is projected to be exposed to inundation, accompanied by a 10 percent intensification of storm surges, with 1 m sea-level rise (Lange et al. 2010). Given the competition for land that may be used for other human activities (for example, urbanization and biofuel production), which can be expected to increase as climate change places pressure on scarce resources, it is likely that the main increase in production will have to be managed by an intensification of agriculture on the same—or possibly even reduced—amount of land (Godfray, Beddington et al. 2010; Smith et al. 2010). Declines in nutrient availability (for example, phosphorus), as well as the spread in pests and weeds, could further limit the increase of agricultural productivity. Geographical shifts in production patterns resulting from the effects of global warming could further escalate distributional issues in the future. While this will not be taken into consideration here, it illustrates the plethora of factors to take into account when thinking of challenges to promoting food security in a warming world. New results published since 2007 point to a more rapidly escalating risk of crop yield reductions associated with warming than previously predicted (Schlenker and Lobell 2010; Schlenker and Roberts 2009). In the period since 1980, patterns of global crop production have presented significant indications of an adverse effect resulting from climate trends and variability, with maize declining by 3.8 percent and wheat production by 5.5 percent compared to a case without climate trends. A significant portion of increases in crop yields from technology, CO2 fertilization, and other changes may have been offset by climate trends in some countries (Lobell et al. 2011). This indication alone casts some doubt on future projections based on earlier crop models. In relation to the projected effects of climate change three interrelated factors are important: temperature-induced effect, precipitation-induced effect, and the CO2 -fertilization effect. The following discussion will focus only on these biophysical factors. Other factors that can damage crops, for example, the elevated levels of tropospheric ozone (van Groenigen et al. 2012), fall outside the scope of this report and will not be addressed. Largely beyond the scope of this report are the far-reaching and uneven adverse implications for poverty in many regions arising from the macroeconomic consequences of shocks to global agricultural production from climate change. It is necessary to stress here that even where overall food production is not reduced or is even increased with low levels of warming, distributional issues mean that food security will remain a precarious matter or worsen as different regions are impacted differently and food security is further challenged by a multitude of nonclimatic factors.

#### Biodiversity – 4 degrees overwhelms resilience and adaptation – extinction

Potsdam Institute, 2012 (Potsdam Institute for Climate Impact Research and Climate Analytics, “Turn Down the Heat: Why a 4°C Warmer World Must be Avoided”, A report for the World Bank, November, http://climatechange.worldbank.org/sites/default/files/Turn\_Down\_the\_heat\_Why\_a\_4\_degree\_centrigrade\_warmer\_world\_must\_be\_avoided.pdf)

Ecosystems and their species provide a range of important goods and services for human society. These include water, food, cultural and other values. In the AR4 an assessment of climate change effects on ecosystems and their services found the following: • If greenhouse gas emissions and other stresses continue at or above current rates, the resilience of many ecosystems is likely to be exceeded by an unprecedented combination of change in climate, associated disturbances (for example, flooding, drought, wildfire, insects, and ocean acidification) and other stressors (global change drivers) including land use change, pollution and over-exploitation of resources. • Approximately 20 to 30 percent of plant and animal species assessed so far are likely to be at increased risk of extinction, if increases in global average temperature exceed of 2–3° above preindustrial levels. • For increases in global average temperature exceeding 2 to 3° above preindustrial levels and in concomitant atmospheric CO2 concentrations, major changes are projected in ecosystem structure and function, species’ ecological interactions and shifts in species’ geographical ranges, with predominantly negative consequences for biodiversity and ecosystem goods and services, such as water and food supply. It is known that past large-scale losses of global ecosystems and species extinctions have been associated with rapid climate change combined with other ecological stressors. Loss and/or degradation of ecosystems, and rates of extinction because of human pressures over the last century or more, which have intensified in recent decades, have contributed to a very high rate of extinction by geological standards. It is well established that loss or degradation of ecosystem services occurs as a consequence of species extinctions, declining species abundance, or widespread shifts in species and biome distributions (Leadley et al. 2010). Climate change is projected to exacerbate the situation. This section outlines the likely consequences for some key ecosystems and for biodiversity. The literature tends to confirm the conclusions from the AR4 outlined above. Despite the existence of detailed and highly informative case studies, upon which this section will draw, it is also important to recall that there remain many uncertainties (Bellard, Bertelsmeier, Leadley, Thuiller, and Courchamp, 2012). However, threshold behavior is known to occur in biological systems (Barnosky et al. 2012) and most model projections agree on major adverse consequences for biodiversity in a 4°C world (Bellard et al., 2012). With high levels of warming, coalescing human induced stresses on ecosystems have the potential to trigger large-scale ecosystem collapse (Barnosky et al. 2012). Furthermore, while uncertainty remains in the projections, there is a risk not only of major loss of valuable ecosystem services, particularly to the poor and the most vulnerable who depend on them, but also of feedbacks being initiated that would result in ever higher CO2 emissions and thus rates of global warming. Significant effects of climate change are already expected for warming well below 4°C. In a scenario of 2.5°C warming, severe ecosystem change, based on absolute and relative changes in carbon and water fluxes and stores, cannot be ruled out on any continent (Heyder, Schaphoff, Gerten, & Lucht, 2011). If warming is limited to less than 2°C, with constant or slightly declining precipitation, small biome shifts are projected, and then only in temperate and tropical regions. Considerable change is projected for cold and tropical climates already at 3°C of warming. At greater than 4°C of warming, biomes in temperate zones will also be substantially affected. These changes would impact not only the human and animal communities that directly rely on the ecosystems, but would also exact a cost (economic and otherwise) on society as a whole, ranging from extensive loss of biodiversity and diminished land cover, through to loss of ecosystems services such as fisheries and forestry (de Groot et al., 2012; Farley et al., 2012). Ecosystems have been found to be particularly sensitive to geographical patterns of climate change (Gonzalez, Neilson, Lenihan, and Drapek, 2010). Moreover, ecosystems are affected not only by local changes in the mean temperature and precipitation, along with changes in the variability of these quantities and changes by the occurrence of extreme events. These climatic variables are thus decisive factors in determining plant structure and ecosystem composition (Reu et al., 2011). Increasing vulnerability to heat and drought stress will likely lead to increased mortality and species extinction. For example, temperature extremes have already been held responsible for mortality in Australian flying-fox species (Welbergen, Klose, Markus, and Eby 2008), and interactions between phenological changes driven by gradual climate changes and extreme events can lead to reduced fecundity (Campbell et al. 2009; Inouye, 2008). Climate change also has the potential to facilitate the spread and establishment of invasive species (pests and weeds) (Hellmann, Byers, Bierwagen, & Dukes, 2008; Rahel & Olden, 2008) with often detrimental implications for ecosystem services and biodiversity. Human land-use changes are expected to further exacerbate climate change driven ecosystem changes, particularly in the tropics, where rising temperatures and reduced precipitation are expected to have major impacts (Campbell et al., 2009; Lee & Jetz, 2008). Ecosystems will be affected by the increased occurrence of extremes such as forest loss resulting from droughts and wildfire exacerbated by land use and agricultural expansion (Fischlin et al., 2007). Climate change also has the potential to catalyze rapid shifts in ecosystems such as sudden forest loss or regional loss of agricultural productivity resulting from desertification (Barnosky et al., 2012). The predicted increase in extreme climate events would also drive dramatic ecosystem changes (Thibault and Brown 2008; Wernberg, Smale, and Thomsen 2012). One such extreme event that is expected to have immediate impacts on ecosystems is the increased rate of wildfire occurrence. Climate change induced shifts in the fire regime are therefore in turn powerful drivers of biome shifts, potentially resulting in considerable changes in carbon fluxes over large areas (Heyder et al., 2011; Lavorel et al., 2006) It is anticipated that global warming will lead to global biome shifts (Barnosky et al. 2012). Based on 20th century observations and 21st century projections, poleward latitudinal biome shifts of up to 400 km are possible in a 4° C world (Gonzalez et al., 2010). In the case of mountaintop ecosystems, for example, such a shift is not necessarily possible, putting them at particular risk of extinction (La Sorte and Jetz, 2010). Species that dwell at the upper edge of continents or on islands would face a similar impediment to adaptation, since migration into adjacent ecosystems is not possible (Campbell, et al. 2009; Hof, Levinsky, Araújo, and Rahbek 2011). The consequences of such geographical shifts, driven by climatic changes as well as rising CO2 concentrations, would be found in both reduced species richness and species turnover (for example, Phillips et al., 2008; White and Beissinger 2008). A study by (Midgley and Thuiller, 2011) found that, of 5,197 African plant species studied, 25–42 percent could lose all suitable range by 2085. It should be emphasized that competition for space with human agriculture over the coming century is likely to prevent vegetation expansion in most cases (Zelazowski et al., 2011) Species composition changes can lead to structural changes of the entire ecosystem, such as the increase in lianas in tropical and temperate forests (Phillips et al., 2008), and the encroachment of woody plants in temperate grasslands (Bloor et al., 2008, Ratajczak et al., 2012), putting grass-eating herbivores at risk of extinction because of a lack of food available—this is just one example of the sensitive intricacies of ecosystem responses to external perturbations. There is also an increased risk of extinction for herbivores in regions of drought-induced tree dieback, owing to their inability to digest the newly resident C4 grasses (Morgan et al., 2008). The following provides some examples of ecosystems that have been identified as particularly vulnerable to climate change. The discussion is restricted to ecosystems themselves, rather than the important and often extensive impacts on ecosystems services. Boreal-temperate ecosystems are particularly vulnerable to climate change, although there are large differences in projections, depending on the future climate model and emission pathway studied. Nevertheless there is a clear risk of large-scale forest dieback in the boreal-temperate system because of heat and drought (Heyder et al., 2011). Heat and drought related die-back has already been observed in substantial areas of North American boreal forests (Allen et al., 2010), characteristic of vulnerability to heat and drought stress leading to increased mortality at the trailing edge of boreal forests. The vulnerability of transition zones between boreal and temperate forests, as well as between boreal forests and polar/tundra biomes, is corroborated by studies of changes in plant functional richness with climate change (Reu et al., 2011), as well as analyses using multiple dynamic global vegetation models (Gonzalez et al., 2010). Subtle changes within forest types also pose a great risk to biodiversity as different plant types gain dominance (Scholze et al., 2006). Humid tropical forests also show increasing risk of major climate induced losses. At 4°C warming above pre-industrial levels, the land extent of humid tropical forest, characterized by tree species diversity and biomass density, is expected to contract to approximately 25 percent of its original size [see Figure 3 in (Zelazowski et al., 2011)], while at 2°C warming, more than 75 percent of the original land can likely be preserved. For these ecosystems, water availability is the dominant determinant of climate suitability (Zelazowski et al., 2011). In general, Asia is substantially less at risk of forest loss than the tropical Americas. However, even at 2°C, the forest in the Indochina peninsula will be at risk of die-back. At 4°C, the area of concern grows to include central Sumatra, Sulawesi, India and the Philippines, where up to 30 percent of the total humid tropical forest niche could be threatened by forest retreat (Zelazowski et al., 2011). There has been substantial scientific debate over the risk of a rapid and abrupt change to a much drier savanna or grassland ecosystem under global warming. This risk has been identified as a possible planetary tipping point at around a warming of 3.5–4.5°C, which, if crossed, would result in a major loss of biodiversity, ecosystem services and the loss of a major terrestrial carbon sink, increasing atmospheric CO2 concentrations (Lenton et al., 2008)(Cox, et al., 2004) (Kriegler, Hall, Held, Dawson, and Schellnhuber, 2009). Substantial uncertainty remains around the likelihood, timing and onset of such risk due to a range of factors including uncertainty in precipitation changes, effects of CO2 concentration increase on water use efficiency and the CO2 fertilization effect, land-use feedbacks and interactions with fire frequency and intensity, and effects of higher temperature on tropical tree species and on important ecosystem services such as pollinators. While climate model projections for the Amazon, and in particular precipitation, remain quite uncertain recent analyses using IPCC AR4 generation climate indicates a reduced risk of a major basin wide loss of precipitation compared to some earlier work. If drying occurs then the likelihood of an abrupt shift to a drier, less biodiverse ecosystem would increase. Current projections indicate that fire occurrence in the Amazon could double by 2050, based on the A2 SRES scenario that involves warming of approximately 1.5°C above pre-industrial levels (Silvestrini et al., 2011), and can therefore be expected to be even higher in a 4°C world. Interactions of climate change, land use and agricultural expansion increase the incidence of fire (Aragão et al., 2008), which plays a major role in the (re)structuring of vegetation (Gonzalez et al., 2010; Scholze et al., 2006). A decrease in precipitation over the Amazon forests may therefore result in forest retreat or transition into a low biomass forest (Malhi et al., 2009). Moderating this risk is a possible increase in ecosystem water use efficiency with increasing CO2 concentrations is accounted for, more than 90 percent of the original humid tropical forest niche in Amazonia is likely to be preserved in the 2°C case, compared to just under half in the 4°C warming case (see Figure 5 in Zelazowski et al., 2011) (Cook, Zeng, and Yoon, 2012; Salazar & Nobre, 2010). Recent work has analyzed a number of these factors and their uncertainties and finds that the risk of major loss of forest due to climate is more likely to be regional than Amazon basin-wide, with the eastern and southeastern Amazon being most at risk (Zelazowski et al., 2011). Salazar and Nobre (2010) estimates a transition from tropical forests to seasonal forest or savanna in the eastern Amazon could occur at warming at warming of 2.5–3.5°C when CO2 fertilization is not considered and 4.5–5.5°C when it is considered. It is important to note, as Salazar and Nobre (2010) point out, that the effects of deforestation and increased fire risk interact with the climate change and are likely to accelerate a transition from tropical forests to drier ecosystems. Increased CO2 concentration may also lead to increased plant water efficiency (Ainsworth and Long, 2005), lowering the risk of plant die-back, and resulting in vegetation expansion in many regions, such as the Congo basin, West Africa and Madagascar (Zelazowski et al., 2011), in addition to some dry-land ecosystems (Heyder et al., 2011). The impact of CO2 induced ‘greening’ would, however, negatively affect biodiversity in many ecosystems. In particular encroachment of woody plants into grasslands and savannahs in North American grassland and savanna communities could lead to a decline of up to 45 percent in species richness ((Ratajczak and Nippert, 2012) and loss of specialist savanna plant species in southern Africa (Parr, Gray, and Bond, 2012). Mangroves are an important ecosystem and are particularly vulnerable to the multiple impacts of climate change, such as: rise in sea levels, increases in atmospheric CO2 concentration, air and water temperature, and changes in precipitation patterns. Sea-level rise can cause a loss of mangroves by cutting off the flow of fresh water and nutrients and drowning the roots (Dasgupta, Laplante et al. 2010). By the end of the 21st century, global mangrove cover is projected to experience a significant decline because of heat stress and sea-level rise (Alongi, 2008; Beaumont et al., 2011). In fact, it has been estimated that under the A1B emissions scenario (3.5°C relative to pre-industrial levels) mangroves would need to geographically move on average about 1 km/year to remain in suitable climate zones (Loarie et al., 2009). The most vulnerable mangrove forests are those occupying low-relief islands such as small islands in the Pacific where sea-level rise is a dominant factor. Where rivers are lacking and/ or land is subsiding, vulnerability is also high. With mangrove losses resulting from deforestation presently at 1 to 2 percent per annum (Beaumont et al., 2011), climate change may not be the biggest immediate threat to the future of mangroves. However if conservation efforts are successful in the longer term climate change may become a determining issue (Beaumont et al., 2011). Coral reefs are acutely sensitive to changes in water temperatures, ocean pH and intensity and frequency of tropical cyclones. Mass coral bleaching is caused by ocean warming and ocean acidification, which results from absorption of CO2 (for example, Frieler et al., 2012a). Increased sea-surface temperatures and a reduction of available carbonates are also understood to be driving causes of decreased rates of calcification, a critical reef-building process (De’ath, Lough, and Fabricius, 2009). The effects of climate change on coral reefs are already apparent. The Great Barrier Reef, for example, has been estimated to have lost 50 percent of live coral cover since 1985, which is attributed in part to coral bleaching because of increasing water temperatures (De’ath et al., 2012). Under atmospheric CO2 concentrations that correspond to a warming of 4°C by 2100, reef erosion will likely exceed rates of calcification, leaving coral reefs as “crumbling frameworks with few calcareous corals” (Hoegh-Guldberg et al., 2007). In fact, frequency of bleaching events under global warming in even a 2°C world has been projected to exceed the ability of coral reefs to recover. The extinction of coral reefs would be catastrophic for entire coral reef ecosystems and the people who depend on them for food, income and shoreline. Reefs provide coastal protection against coastal floods and rising sea levels, nursery grounds and habitat for a variety of currently fished species, as well as an invaluable tourism asset. These valuable services to often subsistence-dependent coastal and island societies will most likely be lost well before a 4°C world is reached. The preceding discussion reviewed the implications of a 4°C world for just a few examples of important ecosystems. The section below examines the effects of climate on biological diversity Ecosystems are composed ultimately of the species and interactions between them and their physical environment. Biologically rich ecosystems are usually diverse and it is broadly agreed that there exists a strong link between this biological diversity and ecosystem productivity, stability and functioning (McGrady-Steed, Harris, and Morin, 1997; David Tilman, Wedin, and Knops, 1996)(Hector, 1999; D Tilman et al., 2001). Loss of species within ecosystems will hence have profound negative effects on the functioning and stability of ecosystems and on the ability of ecosystems to provide goods and services to human societies. It is the overall diversity of species that ultimately characterizes the biodiversity and evolutionary legacy of life on Earth. As was noted at the outset of this discussion, species extinction rates are now at very high levels compared to the geological record. Loss of those species presently classified as ‘critically endangered’ would lead to mass extinction on a scale that has happened only five times before in the last 540 million years. The loss of those species classified as ‘endangered’ and ‘vulnerable’ would confirm this loss as the sixth mass extinction episode (Barnosky 2011). Loss of biodiversity will challenge those reliant on ecosystems services. Fisheries (Dale, Tharp, Lannom, and Hodges, 2010), and agronomy (Howden et al., 2007) and forestry industries (Stram & Evans, 2009), among others, will need to match species choices to the changing climate conditions, while devising new strategies to tackle invasive pests (Bellard, Bertelsmeier, Leadley, Thuiller, and Courchamp, 2012). These challenges would have to be met in the face of increasing competition between natural and agricultural ecosystems over water resources. Over the 21st-century climate change is likely to result in some bio-climates disappearing, notably in the mountainous tropics and in the poleward regions of continents, with new, or novel, climates developing in the tropics and subtropics (Williams, Jackson, and Kutzbach, 2007). In this study novel climates are those where 21st century projected climates do not overlap with their 20th century analogues, and disappearing climates are those 20th century climates that do not overlap with 21st century projected climates. The projections of Williams et al (2007) indicate that in a 4°C world (SRES A2), 12–39 percent of the Earth’s land surface may experience a novel climate compared to 20th century analogues. Predictions of species response to novel climates are difficult because researchers have no current analogue to rely upon. However, at least such climates would give rise to disruptions, with many current species associations being broken up or disappearing entirely. Under the same scenario an estimated 10–48 percent of the Earth’s surface including highly biodiverse regions such as the Himalayas, Mesoamerica, eastern and southern Africa, the Philippines and the region around Indonesia known as Wallacaea would lose their climate space. With limitations on how fast species can disperse, or move, this indicates that many species may find themselves without a suitable climate space and thus face a high risk of extinction. Globally, as in other studies, there is a strong association apparent in these projections between regions where the climate disappears and biodiversity hotspots. Limiting warming to lower levels in this study showed substantially reduced effects, with the magnitude of novel and disappearing climates scaling linearly with global mean warming. More recent work by Beaumont and colleagues using a different approach confirms the scale of this risk (Beaumont et al., 2011, Figure 36). Analysis of the exposure of 185 eco-regions of exceptional biodiversity (a subset of the so-called Global 200) to extreme monthly temperature and precipitation conditions in the 21st century compared to 1961–1990 conditions shows that within 60 years almost all of the regions that are already exposed to substantial environmental and social pressure, will experience extreme temperature conditions based on the A2 emission scenario (4.1°C global mean temperature rise by 2100) (Beaumont et al., 2011). Tropical and sub-tropical eco-regions in Africa and South America are particularly vulnerable. Vulnerability to such extremes is particularly acute for high latitude and small island biota, which are very limited in their ability to respond to range shifts, and to those biota, such as flooded grassland, mangroves and desert biomes, that would require large geographical displacements to find comparable climates in a warmer world. The overall sense of recent literature confirms the findings of the AR4 summarized at the beginning of the section, with a number of risks such as those to coral reefs occurring at significantly lower temperatures than estimated in that report. Although non-climate related human pressures are likely to remain a major and defining driver of loss of ecosystems and biodiversity in the coming decades, it is also clear that as warming rises so will the predominance of climate change as a determinant of ecosystem and biodiversity survival. While the factors of human stresses on ecosystems are manifold, in a 4°C world, climate change is likely to become a determining driver of ecosystem shifts and large-scale biodiversity loss (Bellard et al., 2012; New et al., 2011). Recent research suggests that large-scale loss of biodiversity is likely to occur in a 4°C world, with climate change and high CO2 concentration driving a transition of the Earth´s ecosystems into a state unknown in human experience. Such damages to ecosystems would be expected to dramatically reduce the provision of ecosystem services on which society depends (e.g., hydrology—quantity flow rates, quality; fisheries (corals), protection of coastline (loss of mangroves). Barnosky has described the present situation facing the biodiversity of the planet as “the perfect storm” with multiple high intensity ecological stresses because of habitat modification and degradation, pollution and other factors, unusually rapid climate change and unusually high and elevated atmospheric CO2 concentrations. In the past, as noted above, this combination of circumstances has led to major, mass extinctions with planetary consequences. Thus, there is a growing risk that climate change, combined with other human activities, will cause the irreversible transition of the Earth´s ecosystems into a state unknown in human experience (Barnosky et al., 2012).

#### Oceans – 4 degrees trumps resilience

Potsdam Institute, 2012 (Potsdam Institute for Climate Impact Research and Climate Analytics, “Turn Down the Heat: Why a 4°C Warmer World Must be Avoided”, A report for the World Bank, November, http://climatechange.worldbank.org/sites/default/files/Turn\_Down\_the\_heat\_Why\_a\_4\_degree\_centrigrade\_warmer\_world\_must\_be\_avoided.pdf)

The high emission scenarios would also result in very high carbon dioxide concentrations and ocean acidification, as can be seen in Figure 25 and Figure 26. The increase of carbon dioxide concentration to the present-day value of 390 ppm has caused the pH to drop by 0.1 since preindustrial conditions. This has increased ocean acidity, which because of the logarithmic scale of pH is equivalent to a 30 percent increase in ocean acidity (concentration of hydrogen ions). The scenarios of 4°C warming or more by 2100 correspond to a carbon dioxide concentration of above 800 ppm and lead to a further decrease of pH by another 0.3, equivalent to a 150 percent acidity increase since preindustrial levels. Ongoing ocean acidification is likely to have very severe consequences for coral reefs, various species of marine calcifying organisms, and ocean ecosystems generally (for example, Vézina & Hoegh-Guldberg 2008; Hofmann and Schellnhuber 2009). A recent review shows that the degree and timescale of ocean acidification resulting from anthropogenic CO2 emissions appears to be greater than during any of the ocean acidification events identified so far over the geological past, dating back millions of years and including several mass extinction events (Zeebe 2012). If atmospheric CO2 reaches 450 ppm, coral reef growth around the world is expected to slow down considerably and at 550 ppm reefs are expected to start to dissolve (Cao and Caldeira 2008; Silverman et al. 2009). Reduced growth, coral skeleton weakening, and increased temperature dependence would start to affect coral reefs already below 450 ppm. Thus, a CO2 level of below 350 ppm appears to be required for the long-term survival of coral reefs, if multiple stressors, such as high ocean surface-water temperature events, sea-level rise, and deterioration in water quality, are included (Veron et al. 2009). Based on an estimate of the relationship between atmospheric carbon dioxide concentration and surface ocean acidity (Bernie, Lowe, Tyrrell, and Legge 2010), only very low emission scenarios are able to halt and ultimately reverse ocean acidification (Figure 26). An important caveat on these results is that the approach used here is likely to be valid only for relatively short timescales. If mitigation measures are not implemented soon to reduce carbon dioxide emissions, then ocean acidification can be expected to extend into the deep ocean. The calculations shown refer only to the response of the ocean surface layers, and once ocean acidification has spread more thoroughly, slowing and reversing this will be much more difficult. This would further add significant stress to marine ecosystems already under pressure from human influences, such as overfishing and pollution.

**Extinction**

Kristof 6 (NICHOLAS D. KRISTOF, American journalist, author, op-ed columnist, and a winner of two Pulitzer Prizes, “Scandal Below the Surface”, Oct 31, 2006, http://select.nytimes.com/2006/10/31/opinion/31kristof.html?\_r=1, CMR)

If you think of the earth’s surface as a great beaker, then it’s filled mostly with ocean water. It is slightly alkaline, and that’s what creates a hospitable home for fish, coral reefs and plankton — and indirectly, higher up the food chain, for us. But scientists have discovered that the carbon dioxide **(CO2) we’re spewing** into the air doesn’t just heat up the atmosphere and lead to rising seas. Much of that carbon is absorbed by the oceans, and there it produces carbonic acid — the same stuff found in soda pop. That **makes oceans** a bit **more acidic**, impairing the ability of certain shellfish to produce shells, which, like coral reefs, are made of calcium carbonate. A recent article in Scientific American explained the indignity of being a dissolving mollusk in an acidic ocean: “Drop a piece of chalk (calcium carbonate) into a glass of vinegar (a mild acid) if you need a demonstration of the general worry: the chalk will begin dissolving immediately.” The more acidic waters may spell the end, at least in higher latitudes, of some of the tiniest variations of shellfish — certain plankton and tiny snails called pteropods. **This would** **disrupt the food chain,** possibly killing off many whales and fish, and **rippling up all the way to humans**. We stand, so to speak, on the shoulders of plankton. “There have been a couple of very big events in geological history where the carbon cycle changed dramatically,” said Scott Doney, senior scientist at the Woods Hole Oceanographic Institution in Massachusetts. One was an abrupt warming that took place 55 million years ago in conjunction with acidification of the oceans and **mass extinctions**. Most scientists don’t believe we’re headed toward a man-made variant on that episode — not **yet**, at any rate. But many worry that **we’re hurtling into unknown dangers.** “Whether in 20 years or 100 years, I think marine **ecosystems are going to be dramatically different** by the end of this century, **and that’ll lead to extinction events**,” Mr. Doney added. “This is the only habitable planet we have,” he said. “The damage we do is going to be felt by all the generations to come.” So that should be one of the great political issues for this century — the vandalism we’re committing to our planet because of our refusal to curb greenhouse gases. Yet the subject is barely debated in this campaign. Changes in ocean chemistry are only one among many damaging consequences of carbon emissions. Evidence is also growing about the more familiar dangers: melting glaciers, changing rainfall patterns, rising seas and more powerful hurricanes. Last year, the World Health Organization released a study indicating that climate change results in an extra 150,000 deaths and five million sicknesses each year, by causing the spread of malaria, diarrhea, malnutrition and other ailments. A report prepared for the British government and published yesterday, the Stern Review on the Economics of Climate Change, warned that inaction “could create risks of major disruption to economic and social activity, on a scale similar to those associated with the great wars and the economic depression of the first half of the 20th century.” If emissions are not curbed, climate change will cut 5 percent to 20 percent of global G.D.P. each year, declared the mammoth report. “In contrast,” it said, “the costs of action — reducing greenhouse gas emissions to avoid the worst impacts of climate change — can be limited to around 1 percent of global G.D.P. each year.” Some analysts put the costs of action higher, but most agree that it makes sense to invest far more in alternative energy sources, both to wean ourselves of oil and to reduce the strain on our planet. We know what is needed: a carbon tax or cap-and-trade system, a post-Kyoto accord on emissions cutbacks, and major research on alternative energy sources. But as The Times’s Andrew Revkin noted yesterday, spending on energy research and development has fallen by more than half, after inflation, since 1979.

### Contention Two is Competitiveness

**Nuclear power development is hampered by ineffective incentives and low natural gas prices – failure to stimulate development collapses US nuclear leadership**

**Domenici and Miller, 2012** (Pete, former senator and senior fellow at the Bipartisan Policy Center; Warren F, PhD in Engineering Sciences from Northwestern and recently served as assistant secretary for nuclear energy at the U.S. Department of Energy; “Maintaining U.S. Leadership in Global Nuclear Energy Markets”, Report of the Bipartisan Policy Center’s Nuclear Initiative, July, http://bipartisanpolicy.org/sites/default/files/Leadership%20in%20Nuclear%20Energy%20Markets.pdf)

**Set against this** considerable **legacy** **of** institutional and **technological dominance**, however, **are the** **many** real **challenges the U.S. industry confronts today**, on multiple fronts—poor economics, increased safety and security requirements, and uncertainty about the resolution of the waste management issue. **The crisis at** **the** **Fukushima** Daiichi **plant** **focused** the **attention** of regulators and the public **on the need for continued attention to safety and security at existing reactors**, particularly as some of the older plants approach the end of their extended 60-year license periods. **In 2029**, **the earliest licensed plant will reach the 60-year operation limit, and, after that, approximately one-third of the fleet will quickly follow**. While some plants may engage in another round of relicensing for up to 80 years, a significant fraction likely will be retired and replaced by newer-generation resources (potentially including some nuclear replacements). **Prospects for new reactor construction in the U**nited **St**ates **have constricted significantly** in recent years. In the years following passage of EPACT05, 18 utilities applied for combined construction and operating licenses (COLs) to build a total of 28 reactors. 2 In addition, DOE received 19 applications for loan guarantees to support financing for 21 proposed reactors. **A combination of factors—including downward revisions to electricity demand projections, difficulty executing the** **EPACT05 loan guarantee program** as intended, **and drastically reduced natural gas prices—has put all but two projects on hold.** While these projects, comprising four reactors, have received NRC licenses and are currently under construction in Georgia and South Carolina, **these plants still face financial, regulatory, and construction challenges**. 3 And, though natural gas prices have historically been quite volatile, **the ability to tap large shale gas reserves will likely keep natural gas prices sufficiently low to make financing additional new reactor construction very difficult for at least the next decade, if not longer**. Another critical factor for the nuclear energy industry—one that affects both existing reactors and the prospects for building new reactors—is the need to execute an effective strategy for storing and disposing spent nuclear fuel. While the current practice of storing this material on-site at operating and at shut-down reactors is safe, it is not an acceptable long-term strategy. The federal government is legally obligated to take title to the spent fuel and its failure to do so has made American taxpayers liable for billions of dollars in damages. **With the world’s largest commercial nuclear fleet, the United States was once the world’s leader in nuclear technology development and operations. In recent years**, **other countries**, notably France and South Korea, **have risen in international prominence**; these countries will continue to develop technologies for domestic markets as well as to export. **It will be increasingly difficult for the United States to maintain its technological leadership without some near-term domestic demand for new construction**. Diminished U.S. leadership will make U.S. firms less competitive in nuclear export markets while also reducing U.S. influence over nuclear developments abroad. **As more countries seek to develop nuclear capacity, the United States must work with the international community to minimize the risk of nuclear weapons proliferation.**

#### DOE development of floating nuclear power critical to military readiness – prevents energy shocks, cost overruns, and supply chain restrictions

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The Army Transformation initiative of Chief of Staff General Eric K. Shinseki represents a significant change in how the Army will be structured and conduct operations. Post-Cold War threats have forced Army leaders to think "outside the box" and develop the next-generation Objective Force, a lighter and more mobile fighting army that relies heavily on technology and joint-force support. More changes can be anticipated. As we consider what the Army might look like beyond the Objective Force of 2010, nuclear power could play a major role in another significant change: the shift of military energy use away from carbon-based resources. Nuclear reactor technology could be used to generate the ultimate fuels for both vehicles and people: environmentally neutral hydrogen for equipment fuel and potable water for human consumption. Evolving Energy Sources Over the centuries, energy sources have been moving away from carbon and toward pure hydrogen. Wood (which has about 10 carbon atoms for every hydrogen atom) remained the primary source of energy until the 1800s, when it was replaced with coal (which has 1 or 2 carbon atoms for every hydrogen atom). In less than 100 years, oil (with two hydrogen atoms for every carbon atom) began to replace coal. Within this first decade of the new millennium, natural gas (with four hydrogen atoms for every carbon atom) could very well challenge oil's dominance. In each case, the natural progression has been from solid, carbon-dominated, dirty fuels to more efficient, cleaner-burning hydrogen fuels. Work already is underway to make natural gas fuel cells the next breakthrough in portable power. However, fuel cells are not the final step in the evolution of energy sources, because even natural gas has a finite supply. Fuel cells are merely another step toward the ultimate energy source, seawater, and the ultimate fuel derived from it, pure hydrogen (H2). Environmental Realities There are three geopolitical energy facts that increasingly are affecting the long-term plans of most industrialized nations— Worldwide coal reserves are decreasing. At the present rate of consumption, geological evidence indicates that worldwide low-sulfur coal reserves could be depleted in 20 to 40 years. This rate of depletion could accelerate significantly as China, India, and other Third World countries industrialize and use more coal. Most major oil reserves have been discovered and are controlled by just a few OPEC [Organization of Petroleum-Exporting Countries] nations. Some of these reserves are now at risk; Bahrain, for example, estimates that its oil reserves will be depleted in 10 to 13 years at the current rate of use. The burning of carbon-based fuels continues to add significant pollutants to the atmosphere. These and other socioeconomic pressures are forcing nations to compete for finite energy sources for both fixed-facility and vehicle use. For the United States, the demand for large amounts of cheap fuel to generate electricity for industry and fluid fuel to run vehicles is putting considerable pressure on energy experts to look for ways to exploit alternate energy sources. The energy crisis in California could be the harbinger of things to come. The threat to affordable commercial power could accelerate development of alternative fuels. It is here that private industry may realize that the military's experience with small nuclear power plants could offer an affordable path to converting seawater into fuel. Military Realities Today, the military faces several post-Cold War realities. First, the threat has changed. Second, regional conflicts are more probable than all-out war. Third, the United States will participate in joint and coalition operations that could take our forces anywhere in the world for undetermined periods of time. Finally, the U.S. military must operate with a smaller budget and force structure. These realities already are forcing substantial changes on the Army. So, as we consider future Army energy sources, we foresee a more mobile Army that must deploy rapidly and sustain itself indefinitely anywhere in the world as part of a coalition force. In addition, this future Army will have to depend on other nations to provide at least some critical logistics support. An example of such a cooperative effort was Operation Desert Storm, where coalition forces (including the United States) relied on some countries to supply potable water and other countries to provide fuel. This arrangement allowed U.S. cargo ships to concentrate on delivering weapon systems and ammunition. But consider the following scenario. The U.S. military is called on to suppress armed conflict in a far-off region. The coalition forces consist of the United States and several Third World countries in the region that have a vested interest in the outcome of the conflict. Our other allies are either unwilling or unable to support the regional action, either financially or militarily. The military effort will be a challenge to support over time, especially with such basic supplies as fuel and water. How can the United States sustain its forces? One way to minimize the logistics challenge is for the Army to produce fuel and potable water in, or close to, the theater. Small nuclear power plants could convert seawater into hydrogen fuel and potable water where needed, with less impact on the environment than caused by the current production, transportation, and use of carbon-based fuels. Seawater: The Ultimate Energy Source Industrial nations are seeing severe energy crises occur more frequently worldwide, and, as world population increases and continues to demand a higher standard of living, carbon-based fuels will be depleted even more rapidly. Alternative energy sources must be developed. Ideally, these sources should be readily available worldwide with minimum processing and be nonpolluting. Current options include wind, solar, hydroelectric, and nuclear energy, but by themselves they cannot satisfy the energy demands of both large, industrial facilities and small, mobile equipment. While each alternative energy source is useful, none provides the complete range of options currently offered by oil. It is here that thinking "outside the box" is needed. As difficult as the problem seems, there is one energy source that is essentially infinite, is readily available worldwide, and produces no carbon byproducts. The source of that energy is seawater, and the method by which seawater is converted to a more direct fuel for use by commercial and military equipment is simple. The same conversion process generates potable water. Seawater Conversion Process Temperatures greater than 1,000 degrees Celsius, as found in the cores of nuclear reactors, combined with a thermochemical water-splitting process, is probably the most efficient means of breaking down water into its component parts: molecular hydrogen and oxygen. The minerals and salts in seawater would have to be removed by a desalination process before the water-splitting process and then burned or returned to the sea. Sodium iodide (NaI) and other compounds are being investigated as possible catalysts for high-temperature chemical reactions with water to release the hydrogen, which then can be contained and used as fuel. When burned, hydrogen combines with oxygen and produces only water and energy; no atmospheric pollutants are created using this cycle. Burning coal or oil to generate electricity for production of hydrogen by electrolysis would be wasteful and counterproductive. Nuclear power plants, on the other hand, can provide safe, efficient, and clean power for converting large quantities of seawater into usable hydrogen fuel. For the military, a small nuclear power plant could fit on a barge and be deployed to a remote theater, where it could produce both hydrogen fuel and potable water for use by U.S. and coalition forces in time of conflict. In peacetime, these same portable plants could be deployed for humanitarian or disaster relief operations to generate electricity and to produce hydrogen fuel and potable water as necessary. Such dual usage (hydrogen fuel for equipment and potable water for human consumption) could help peacekeepers maintain a fragile peace. These dual roles make nuclear-generated products equally attractive to both industry and the military, and that could foster joint programs to develop modern nuclear power sources for use in the 21st century. So What's Next? The Army must plan for the time when carbon-based fuels are no longer the fuel of choice for military vehicles. In just a few years, oil and natural gas prices have increased by 30 to 50 percent, and, for the first time in years, the United States last year authorized the release of some of its oil reserves for commercial use. As the supply of oil decreases, its value as a resource for the plastics industry also will increase. The decreasing supply and increasing cost of carbon-based fuels eventually will make the hydrogen fuel and nuclear power combination a more attractive alternative. One proposed initiative would be for the Army to enter into a joint program with private industry to develop new engines that would use hydrogen fuel. In fact, private industry already is developing prototype automobiles with fuel cells that run on liquefied or compressed hydrogen or methane fuel. BMW has unveiled their hydrogen-powered 750hL sedan at the world's first robotically operated public hydrogen fueling station, located at the Munich, Germany, airport. This prototype vehicle does not have fuel cells; instead, it has a bivalent 5.4-liter, 12-cylinder engine and a 140-liter hydrogen tank and is capable of speeds up to 140 miles per hour and a range of up to 217.5 miles. Another proposed initiative would exploit previous Army experience in developing and using small, portable nuclear power plants for the future production of hydrogen and creation of a hydrogen fuel infrastructure. Based on recent advances in small nuclear power plant technology, it would be prudent to consider developing a prototype plant for possible military applications. The MH-1A Sturgis floating nuclear power plant, a 45-MW pressurized water reactor, was the last nuclear power plant built and operated by the Army. The MH-1A Sturgis floating nuclear power plant, a 45-MW pressurized water reactor, was the last nuclear power plant built and operated by the Army. The Army Nuclear Power Program The military considered the possibility of using nuclear power plants to generate alternate fuels almost 50 years ago and actively supported nuclear energy as a means of reducing logistics requirements for coal, oil, and gasoline. However, political, technical, and military considerations forced the closure of the program before a prototype could be built. The Army Corps of Engineers ran a Nuclear Power Program from 1952 until 1979, primarily to supply electric power in remote areas. Stationary nuclear reactors built at Fort Belvoir, Virginia, and Fort Greeley, Alaska, were operated successfully from the late 1950s to the early 1970s. Portable nuclear reactors also were operated at Sundance, Wyoming; Camp Century, Greenland; and McMurdo Sound in Antarctica. These small nuclear power plants provided electricity for remote military facilities and could be operated efficiently for long periods without refueling. The Army also considered using nuclear power plants overseas to provide uninterrupted power and defense support in the event that U.S. installations were cut off from their normal logistics supply lines. In November 1963, an Army study submitted to the Department of Defense (DOD) proposed employing a military compact reactor (MCR) as the power source for a nuclear-powered energy depot, which was being considered as a means of producing synthetic fuels in a combat zone for use in military vehicles. MCR studies, which had begun in 1955, grew out of the Transportation Corps' interest in using nuclear energy to power heavy, overland cargo haulers in remote areas. These studies investigated various reactor and vehicle concepts, including a small liquid-metal-cooled reactor, but ultimately the concept proved impractical. The energy depot, however, was an attempt to solve the logistics problem of supplying fuel to military vehicles on the battlefield. While nuclear power could not supply energy directly to individual vehicles, the MCR could provide power to manufacture, under field conditions, a synthetic fuel as a substitute for conventional carbon-based fuels. The nuclear power plant would be combined with a fuel production system to turn readily available elements such as hydrogen or nitrogen into fuel, which then could be used as a substitute for gasoline or diesel fuel in cars, trucks, and other vehicles. Of the fuels that could be produced from air and water, hydrogen and ammonia offer the best possibilities as substitutes for petroleum. By electrolysis or high- temperature heat, water can be broken down into hydrogen and oxygen and the hydrogen then used in engines or fuel cells. Alternatively, nitrogen can be produced through the liquefaction and fractional distillation of air and then combined with hydrogen to form ammonia as a fuel for internal-combustion engines. Consideration also was given to using nuclear reactors to generate electricity to charge batteries for electric-powered vehicles—a development contingent on the development of suitable battery technology. By 1966, the practicality of the energy depot remained in doubt because of questions about the cost-effectiveness of its current and projected technology. The Corps of Engineers concluded that, although feasible, the energy depot would require equipment that probably would not be available during the next decade. As a result, further development of the MCR and the energy depot was suspended until they became economically attractive and technologically possible. Other efforts to develop a nuclear power plant small enough for full mobility had been ongoing since 1956, including a gas-cooled reactor combined with a closed- cycle gas-turbine generator that would be transportable on semitrailers, railroad flatcars, or barges. The Atomic Energy Commission (AEC) supported these developments because they would contribute to the technology of both military and small commercial power plants. The AEC ultimately concluded that the probability of achieving the objectives of the Army Nuclear Power Program in a timely manner and at a reasonable cost was not high enough to justify continued funding of its portion of projects to develop small, stationary, and mobile reactors. Cutbacks in military funding for long-range research and development because of the Vietnam War led the AEC to phase out its support of the program in 1966. The costs of developing and producing compact nuclear power plants were simply so high that they could be justified only if the reactor had a unique capability and filled a clearly defined objective backed by DOD. After that, the Army's participation in nuclear power plant research and development efforts steadily declined and eventually stopped altogether. Nuclear Technology Today The idea of using nuclear power to produce synthetic fuels, originally proposed in 1963, remains feasible today and is gaining significant attention because of recent advances in fuel cell technology, hydrogen liquefaction, and storage. At the same time, nuclear power has become a significant part of the energy supply in more than 20 countries—providing energy security, reducing air pollution, and cutting greenhouse gas emissions. The performance of the world's nuclear power plants has improved steadily and is at an all-time high. Assuming that nuclear power experiences further technological development and increased public acceptance as a safe and efficient energy source, its use will continue to grow. Nuclear power possibly could provide district heating, industrial process heating, desalination of seawater, and marine transportation. Demand for cost-effective chemical fuels such as hydrogen and methanol is expected to grow rapidly. Fuel cell technology, which produces electricity from low-temperature oxidation of hydrogen and yields water as a byproduct, is receiving increasing attention. Cheap and abundant hydrogen eventually will replace carbon-based fuels in the transportation sector and eliminate oil's grip on our society. But hydrogen must be produced, since terrestrial supplies are extremely limited. Using nuclear power to produce hydrogen offers the potential for a limitless chemical fuel supply with near-zero greenhouse gas emissions. As the commercial transportation sector increasingly moves toward hydrogen fuel cells and other advanced engine concepts to replace the gasoline internal combustion engine, DOD eventually will adopt this technology for its tactical vehicles. The demand for desalination of seawater also is likely to grow as inadequate freshwater supplies become an urgent global concern. Potable water in the 21st century will be what oil was in the 20th century—a limited natural resource subject to intense international competition. In many areas of the world, rain is not always dependable and ground water supplies are limited, exhausted, or contaminated. Such areas are likely to experience conflict among water-needy peoples, possibly prompting the deployment of U.S. ground forces for humanitarian relief, peacekeeping, or armed intervention. A mobile desalination plant using waste heat from a nuclear reactor could help prevent conflicts or provide emergency supplies of freshwater to indigenous populations, and to U.S. deployed forces if necessary. Promising Technology for Tomorrow Compact reactor concepts based on high-temperature, gas-cooled reactors are attracting attention worldwide and could someday fulfill the role once envisioned for the energy depot. One proposed design is the pebble bed modular reactor (PBMR) being developed by Eskom in South Africa. Westinghouse, BNFL Instruments Ltd., and Exelon Corporation currently are supporting this project to develop commercial applications. A similar design is the remote site-modular helium reactor (RS-MHR) being developed by General Atomics. If proven feasible, this technology could be used to replace retiring power plants, expand the Navy's nuclear fleet, and provide mobile electric power for military or disaster relief operations. Ideally, modular nuclear power plants could be operated by a small staff of technicians and monitored by a central home office through a satellite uplink. The technology of both the PBMR and the RS-MHR features small, modular, helium-cooled reactors powered by ceramic-coated fuel particles that are inherently safe and cannot melt under any scenario. This results in simpler plant design and lower capital costs than existing light water reactors. The PBMR, coupled with a direct-cycle gas turbine generator, would have a thermal efficiency of about 42 to 45 percent and would produce about 110 megawatts of electricity (MWe). The smaller RS-MHR would produce about 10 to 25 MWe, which is sufficient for powering remote communities and military bases. Multiple modules can be installed on existing sites and refueling can be performed on line, since the fuel pebbles recycle through the reactor continuously until they are expended. Both designs also feature coolant exit temperatures high enough to support the thermochemical water-splitting cycles needed to produce hydrogen. For military applications, RS-MHR equipment could be transported inland by truck or railroad, or single modules could be built on barges and deployed as needed to coastal regions. The Army's nuclear reactor on the barge Sturgis, which provided electric power to the Panama Canal from 1968 to 1976, demonstrated the feasibility of this concept. In fact, the military previously used several power barges (oil-fired, 30-MWe power plants) during World War II and in Korea and Okinawa as emergency sources of electric power. Research teams around the world also are examining other reactor concepts based on liquid-metal-cooled reactor systems with conventional sodium or lead-alloy coolants and advanced water-cooled systems. The Department of Energy (DOE) is supporting research and development of innovative concepts that are based on ultra-long-life reactors with cartridge cores. These reactors would not require refueling, and they could be deployed in the field, removed at the end of their service life, and replaced by a new system. The proposed international reactor innovative and secure (IRIS) design, funded by DOE's Nuclear Energy Research Initiative, would have a straight burn core lasting 8 years and may be available by 2010. Based on increasing costs of fossil fuels, a growing consensus that greenhouse gas emissions must be reduced, and a growing demand for energy, there is little doubt that we will continue to see significant advances in nuclear energy research and development. Nuclear power is expected to grow in the 21st century, with potential benefits applicable to the military. Small, modular nuclear power reactors in mobile or portable configurations, coupled with hydrogen production and desalination systems, could be used to produce fuel and potable water for combat forces deployed in remote areas and reduce our logistics requirements. Assuming the inevitability of hydrogen fuel replacing fossil fuels, a clearly defined objective that was missing in 1966 now exists. The partnership between DOD and the former AEC to develop Army nuclear reactors contributed to the technology of both military and small commercial power plants. This historical relationship should be renewed based on recent technological advances and projected logistics requirements. DOD logistics planners should reconsider military applications of nuclear power and support ongoing DOE research and development initiatives to develop advanced reactors such as RS-MHR, IRIS, and others. For the Army to fight and win on tomorrow's distant battlefields, nuclear power will have to play a significant role. Would this necessarily lead to a rebirth of the old Army Nuclear Power Program, with soldiers trained as reactor operators and reactor facilities managed by the Corps of Engineers? Probably not. A more likely scenario would be a small fleet of nuclear power barges or other portable power plant configurations developed by DOE, operated and maintained by Government technicians or civilian contractors, and deployed as necessary to support the Federal Emergency Management Agency, the Department of State, and DOD. Construction, licensing, refueling, and decommissioning issues would be managed best under DOE stewardship or Nuclear Regulatory Commission oversight. As an end user of these future nuclear reactors, however, the Army should understand their proposed capabilities and limitations and provide planners with appropriate military requirements for their possible deployment to a combat zone.

#### Military readiness is key to prevent extinction

Brzezinski 12 Zbigniew K. Brzezinski (CSIS counselor and trustee and cochairs the CSIS Advisory Board, holds honorary degrees from Georgetown University, Williams College, Fordham University, College of the Holy Cross, Alliance College, the Catholic University of Lublin, Warsaw University, and Vilnius University. He is the recipient of numerous honors and awards) February 2012 “After America” http://www.foreignpolicy.com/articles/2012/01/03/after\_america?page=0,0

For if America falters, the world is unlikely to be dominated by a single preeminent successor -- not even China. International uncertainty, increased tension among global competitors, and even outright chaos would be far more likely outcomes. While a sudden, massive crisis of the American system -- for instance, another financial crisis -- would produce a fast-moving chain reaction leading to global political and economic disorder, a steady drift by America into increasingly pervasive decay or endlessly widening warfare with Islam would be unlikely to produce, even by 2025, an effective global successor. No single power will be ready by then to exercise the role that the world, upon the fall of the Soviet Union in 1991, expected the United States to play: the leader of a new, globally cooperative world order. More probable would be a protracted phase of rather inconclusive realignments of both global and regional power, with no grand winners and many more losers, in a setting of international uncertainty and even of potentially fatal risks to global well-being. Rather than a world where dreams of democracy flourish, a Hobbesian world of enhanced national security based on varying fusions of authoritarianism, nationalism, and religion could ensue. RELATED 8 Geopolitically Endangered Species The leaders of the world's second-rank powers, among them India, Japan, Russia, and some European countries, are already assessing the potential impact of U.S. decline on their respective national interests. The Japanese, fearful of an assertive China dominating the Asian mainland, may be thinking of closer links with Europe. Leaders in India and Japan may be considering closer political and even military cooperation in case America falters and China rises. Russia, while perhaps engaging in wishful thinking (even schadenfreude) about America's uncertain prospects, will almost certainly have its eye on the independent states of the former Soviet Union. Europe, not yet cohesive, would likely be pulled in several directions: Germany and Italy toward Russia because of commercial interests, France and insecure Central Europe in favor of a politically tighter European Union, and Britain toward manipulating a balance within the EU while preserving its special relationship with a declining United States. Others may move more rapidly to carve out their own regional spheres: Turkey in the area of the old Ottoman Empire, Brazil in the Southern Hemisphere, and so forth. None of these countries, however, will have the requisite combination of economic, financial, technological, and military power even to consider inheriting America's leading role. China, invariably mentioned as America's prospective successor, has an impressive imperial lineage and a strategic tradition of carefully calibrated patience, both of which have been critical to its overwhelmingly successful, several-thousand-year-long history. China thus prudently accepts the existing international system, even if it does not view the prevailing hierarchy as permanent. It recognizes that success depends not on the system's dramatic collapse but on its evolution toward a gradual redistribution of power. Moreover, the basic reality is that China is not yet ready to assume in full America's role in the world. Beijing's leaders themselves have repeatedly emphasized that on every important measure of development, wealth, and power, China will still be a modernizing and developing state several decades from now, significantly behind not only the United States but also Europe and Japan in the major per capita indices of modernity and national power. Accordingly, Chinese leaders have been restrained in laying any overt claims to global leadership. At some stage, however, a more assertive Chinese nationalism could arise and damage China's international interests. A swaggering, nationalistic Beijing would unintentionally mobilize a powerful regional coalition against itself. None of China's key neighbors -- India, Japan, and Russia -- is ready to acknowledge China's entitlement to America's place on the global totem pole. They might even seek support from a waning America to offset an overly assertive China. The resulting regional scramble could become intense, especially given the similar nationalistic tendencies among China's neighbors. A phase of acute international tension in Asia could ensue. Asia of the 21st century could then begin to resemble Europe of the 20th century -- violent and bloodthirsty. At the same time, the security of a number of weaker states located geographically next to major regional powers also depends on the international status quo reinforced by America's global preeminence -- and would be made significantly more vulnerable in proportion to America's decline. The states in that exposed position -- including Georgia, Taiwan, South Korea, Belarus, Ukraine, Afghanistan, Pakistan, Israel, and the greater Middle East -- are today's geopolitical equivalents of nature's most endangered species. Their fates are closely tied to the nature of the international environment left behind by a waning America, be it ordered and restrained or, much more likely, self-serving and expansionist. A faltering United States could also find its strategic partnership with Mexico in jeopardy. America's economic resilience and political stability have so far mitigated many of the challenges posed by such sensitive neighborhood issues as economic dependence, immigration, and the narcotics trade. A decline in American power, however, would likely undermine the health and good judgment of the U.S. economic and political systems. A waning United States would likely be more nationalistic, more defensive about its national identity, more paranoid about its homeland security, and less willing to sacrifice resources for the sake of others' development. The worsening of relations between a declining America and an internally troubled Mexico could even give rise to a particularly ominous phenomenon: the emergence, as a major issue in nationalistically aroused Mexican politics, of territorial claims justified by history and ignited by cross-border incidents. Another consequence of American decline could be a corrosion of the generally cooperative management of the global commons -- shared interests such as sea lanes, space, cyberspace, and the environment, whose protection is imperative to the long-term growth of the global economy and the continuation of basic geopolitical stability. In almost every case, the potential absence of a constructive and influential U.S. role would fatally undermine the essential communality of the global commons because the superiority and ubiquity of American power creates order where there would normally be conflict. None of this will necessarily come to pass. Nor is the concern that America's decline would generate global insecurity, endanger some vulnerable states, and produce a more troubled North American neighborhood an argument for U.S. global supremacy. In fact, the strategic complexities of the world in the 21st century make such supremacy unattainable. But those dreaming today of America's collapse would probably come to regret it. And as the world after America would be increasingly complicated and chaotic, it is imperative that the United States pursue a new, timely strategic vision for its foreign policy -- or start bracing itself for a dangerous slide into global turmoil.

#### Independently- SMRs solve competitiveness

Fleischmann ’11 (Chuck, Representative from the 3rd District in Tennessee, “Small Modular Reactors Could Help With U.S. Energy Needs”, American Physical Society, Vol. 6, No. 2, http://www.aps.org/publications/capitolhillquarterly/201110/backpage.cfm, October 2011)

**The timely implementation of small reactors could position the U**nited **S**tates **on the** cutting edge **of nuclear technology**. As the world moves forward in developing new forms of nuclear power, **the U**nited **S**tates **should set a high standard in safety and regulatory process**. Other nations have not been as rigorous in their nuclear oversight with far reaching implications. As we consider the disastrous events at the Fukushima Daiichi nuclear facility**, it is imperative that power companies and regulatory agencies around the world adequately ensure reactor and plant safety to protect the public. Despite terrible tragedies** like the natural disaster in Japan, **nuclear power is** still **one of the safest and cleanest energy resources available. The plan to administer these small reactors would create technologically advanced U.S. jobs and** improve our global competitiveness. Our country needs quality, high paying jobs. **Increasing our competitive edge** in rapidly advancing industries **will put the** United States in **a strategic position on the forefront of** expanding global technologies **in the nuclear arena.**

#### Competitiveness is key to leadership

Rocco Martino (Ph.D. in astrophysics from the Institute of Aerospace Studies, Senior Fellow at the Foreign Policy Research Institute) Spring 2007 “A Strategy for Success: Innovation Will Renew American Leadership”, Orbis, Vol. 51, No. 2

Much of the foreign policy discussion in the United States today is focused upon the dilemma posed by the Iraq War and the threat posed by Islamist terrorism. These problems are, of course, both immediate and important. However, America also faces other challenges to its physical security and economic prosperity, and these are more long-term and probably more profound. There is, first, the threat posed by our declining competitiveness in the global economy, a threat most obviously represented by such rising economic powers as China and India.1 There is, second, the threat posed by our increasing dependence on oil imports from the Middle East. Moreover, these two threats are increasingly connected, as China and India themselves are greatly increasing their demand for Middle East oil.2 The United States of course faced great challenges to its security and economy in the past, most obviously from Germany and Japan in the first half of the twentieth century and from the Soviet Union in the second half. Crucial to America's ability to prevail over these past challenges was our technological and industrial leadership, and especially our ability to continuously recreate it. Indeed, the United States has been unique among great powers in its ability to keep on creating and recreating new technologies and new industries, generation after generation. Perpetual innovation and technological leadership might even be said to be the American way of maintaining primacy in world affairs. They are almost certainly what America will have to pursue in order to prevail over the contemporary challenges involving economic competitiveness and energy dependence.

#### And, Competitiveness is key to benign leadership – Solves your impact turns

Richard Armitage (Former Deputy Secretary of State) and Joseph Nye (Professor of Political Science at Harvard) December 12 2007 “Why So Angry, America?” http://www.atimes.com/atimes/South\_Asia/IL12Df01.html

The world is dissatisfied with American leadership. Shocked and frightened after September 11, 2001, we put forward an angry face to the globe, not one that reflected the more traditional American values of hope and optimism, tolerance and opportunity. This fearful approach has hurt the United States' ability to bring allies to its cause, but it is not too late to change. The nation should embrace a smarter strategy that blends our "hard" and "soft" power - our ability to attract and persuade, as well as our ability to use economic and military might. Whether it is ending the crisis in Pakistan, winning the wars in Iraq and Afghanistan, deterring Iran's and North Korea's nuclear ambitions, managing China's rise or improving the lives of those left behind by globalization, the US needs a broader, more balanced approach. Lest anyone think that this approach is weak or naive, remember that Defense Secretary Robert Gates used a major speech on November 26 "to make the case for strengthening our capacity to use 'soft' power and for better integrating it with 'hard' power". We - one Republican, one Democrat - have devoted our lives to promoting American pre-eminence as a force for good in the world. But the US cannot stay on top without strong and willing allies and partners. Over the past six years, too many people have confused sharing the burden with relinquishing power. In fact, when we let others help, we are extending US influence, not diminishing it. Since September 11, the war on terrorism has shaped this isolating outlook, becoming the central focus of US engagement with the world. The threat from terrorists with global reach is likely to be with us for decades. But unless they have weapons of mass destruction, groups such as al-Qaeda pose no existential threat to the US - unlike our old foes Nazi Germany and the Soviet Union. In fact, al-Qaeda and its ilk hope to defeat us by using our own strength against us. They hope that we will blunder, overreact and turn world opinion against us. This is a deliberately set trap, and one whose grave strategic consequences extend far beyond the costs this nation would suffer from any small-scale terrorist attack, no matter how individually tragic and collectively painful. We cannot return to a nearsighted pre-September 11 mindset that underestimated the al-Qaeda threat, but neither can we remain stuck in a narrow post-September 11 mindset that alienates much of the world. More broadly, when our words do not match our actions, we demean our character and moral standing. We cannot lecture others about democracy while we back dictators. We cannot denounce torture and waterboarding in other countries and condone it at home. We cannot allow Cuba's Guantanamo Bay or Iraq's Abu Ghraib to become the symbols of American power. The United States has long been the big kid on the block, and it will probably remain so for years to come. But its staying power has a great deal to do with whether it is perceived as a bully or a friend. States and non-state actors can better address today's challenges when they can draw in allies; those who alienate potential friends stand at greater risk. The past six years have demonstrated that hard power alone cannot secure the nation's long-term goals. The US military remains the best in the world, even after having been worn down from years of war. We will have to invest in people and materiel to maintain current levels of readiness; as a percentage of gross domestic product, US defense spending is actually well below Cold War levels. But an extra dollar spent on hard power will not necessarily bring an extra dollar's worth of security. After all, security threats are no longer simply military threats. China is building two coal-fired power plants each week. US hard power will do little to curb this trend, but US-developed technology can make Chinese coal cleaner, which helps the environment and opens new markets for American industry. In a changing world, the US should become a smarter power by once again investing in the global good - by providing things that people and governments want but cannot attain without US leadership. By complementing US military and economic strength with greater investments in soft power, Washington can build the framework to tackle tough global challenges. We call this smart power. Smart power is not about getting the world to like us. It is about developing a strategy that balances our hard (coercive) power with our soft (attractive) power. During the Cold War, the US deterred Soviet aggression through investments in hard power. But as Gates noted late last month, US leaders also realized that "the nature of the conflict required us to develop key capabilities and institutions - many of them non-military". So the US used its soft power to rebuild Europe and Japan and to establish the norms and institutions that became the core of the international order for the past half-century. The Cold War ended under a barrage of hammers on the Berlin Wall rather than a barrage of artillery across the Fulda Gap precisely because of this integrated approach.

#### US leadership solves all other impacts – collapse of primacy results in nuclear war

Thayer, 2006 (Bradley A., Assistant Professor of Political Science at the University of Minnesota, Duluth, The National Interest, November -December, “In Defense of Primacy”, lexis)

A remarkable fact about international politics today--in a world where American primacy is clearly and unambiguously on display--is that countries want to align themselves with the United States. Of course, this is not out of any sense of altruism, in most cases, but because doing so allows them to use the power of the United States for their own purposes--their own protection, or to gain greater influence. Of 192 countries, 84 are allied with America--their security is tied to the United States through treaties and other informal arrangements--and they include almost all of the major economic and military powers. That is a ratio of almost 17 to one (85 to five), and a big change from the Cold War when the ratio was about 1.8 to one of states aligned with the United States versus the Soviet Union. Never before in its history has this country, or any country, had so many allies. U.S. primacy--and the bandwagoning effect--has also given us extensive influence in international politics, allowing the United States to shape the behavior of states and international institutions. Such influence comes in many forms, one of which is America's ability to create coalitions of like-minded states to free Kosovo, stabilize Afghanistan, invade Iraq or to stop proliferation through the Proliferation Security Initiative (PSI). Doing so allows the United States to operate with allies outside of the UN, where it can be stymied by opponents. American-led wars in Kosovo, Afghanistan and Iraq stand in contrast to the UN's inability to save the people of Darfur or even to conduct any military campaign to realize the goals of its charter. The quiet effectiveness of the PSI in dismantling Libya's WMD programs and unraveling the A. Q. Khan proliferation network are in sharp relief to the typically toothless attempts by the UN to halt proliferation. You can count with one hand countries opposed to the United States. They are the "Gang of Five": China, Cuba, Iran, North Korea and Venezuela. Of course, countries like India, for example, do not agree with all policy choices made by the United States, such as toward Iran, but New Delhi is friendly to Washington. Only the "Gang of Five" may be expected to consistently resist the agenda and actions of the United States. China is clearly the most important of these states because it is a rising great power. But even Beijing is intimidated by the United States and refrains from openly challenging U.S. power. China proclaims that it will, if necessary, resort to other mechanisms of challenging the United States, including asymmetric strategies such as targeting communication and intelligence satellites upon which the United States depends. But China may not be confident those strategies would work, and so it is likely to refrain from testing the United States directly for the foreseeable future because China's power benefits, as we shall see, from the international order U.S. primacy creates. The other states are far weaker than China. For three of the "Gang of Five" cases--Venezuela, Iran, Cuba--it is an anti-U.S. regime that is the source of the problem; the country itself is not intrinsically anti-American. Indeed, a change of regime in Caracas, Tehran or Havana could very well reorient relations. THROUGHOUT HISTORY, peace and stability have been great benefits of an era where there was a dominant power--Rome, Britain or the United States today. Scholars and statesmen have long recognized the irenic effect of power on the anarchic world of international politics. Everything we think of when we consider the current international order--free trade, a robust monetary regime, increasing respect for human rights, growing democratization--is directly linked to U.S. power. Retrenchment proponents seem to think that the current system can be maintained without the current amount of U.S. power behind it. In that they are dead wrong and need to be reminded of one of history's most significant lessons: Appalling things happen when international orders collapse. The Dark Ages followed Rome's collapse. Hitler succeeded the order established at Versailles. Without U.S. power, the liberal order created by the United States will end just as assuredly. As country and western great Ral Donner sang: "You don't know what you've got (until you lose it)." Consequently, it is important to note what those good things are. In addition to ensuring the security of the United States and its allies, American primacy within the international system causes many positive outcomes for Washington and the world. The first has been a more peaceful world. During the Cold War, U.S. leadership reduced friction among many states that were historical antagonists, most notably France and West Germany. Today, American primacy helps keep a number of complicated relationships aligned--between Greece and Turkey, Israel and Egypt, South Korea and Japan, India and Pakistan, Indonesia and Australia. This is not to say it fulfills Woodrow Wilson's vision of ending all war. Wars still occur where Washington's interests are not seriously threatened, such as in Darfur, but a Pax Americana does reduce war's likelihood, particularly war's worst form: great power wars. Second, American power gives the United States the ability to spread democracy and other elements of its ideology of liberalism. Doing so is a source of much good for the countries concerned as well as the United States because, as John Owen noted on these pages in the Spring 2006 issue, liberal democracies are more likely to align with the United States and be sympathetic to the American worldview.3 So, spreading democracy helps maintain U.S. primacy. In addition, once states are governed democratically, the likelihood of any type of conflict is significantly reduced. This is not because democracies do not have clashing interests. Indeed they do. Rather, it is because they are more open, more transparent and more likely to want to resolve things amicably in concurrence with U.S. leadership. And so, in general, democratic states are good for their citizens as well as for advancing the interests of the United States. Critics have faulted the Bush Administration for attempting to spread democracy in the Middle East, labeling such an effort a modern form of tilting at windmills. It is the obligation of Bush's critics to explain why democracy is good enough for Western states but not for the rest, and, one gathers from the argument, should not even be attempted. Of course, whether democracy in the Middle East will have a peaceful or stabilizing influence on America's interests in the short run is open to question. Perhaps democratic Arab states would be more opposed to Israel, but nonetheless, their people would be better off. The United States has brought democracy to Afghanistan, where 8.5 million Afghans, 40 percent of them women, voted in a critical October 2004 election, even though remnant Taliban forces threatened them. The first free elections were held in Iraq in January 2005. It was the military power of the United States that put Iraq on the path to democracy. Washington fostered democratic governments in Europe, Latin America, Asia and the Caucasus. Now even the Middle East is increasingly democratic. They may not yet look like Western-style democracies, but democratic progress has been made in Algeria, Morocco, Lebanon, Iraq, Kuwait, the Palestinian Authority and Egypt. By all accounts, the march of democracy has been impressive. Third, along with the growth in the number of democratic states around the world has been the growth of the global economy. With its allies, the United States has labored to create an economically liberal worldwide network characterized by free trade and commerce, respect for international property rights, and mobility of capital and labor markets. The economic stability and prosperity that stems from this economic order is a global public good from which all states benefit, particularly the poorest states in the Third World. The United States created this network not out of altruism but for the benefit and the economic well-being of America. This economic order forces American industries to be competitive, maximizes efficiencies and growth, and benefits defense as well because the size of the economy makes the defense burden manageable. Economic spin-offs foster the development of military technology, helping to ensure military prowess. Perhaps the greatest testament to the benefits of the economic network comes from Deepak Lal, a former Indian foreign service diplomat and researcher at the World Bank, who started his career confident in the socialist ideology of post-independence India. Abandoning the positions of his youth, Lal now recognizes that the only way to bring relief to desperately poor countries of the Third World is through the adoption of free market economic policies and globalization, which are facilitated through American primacy.4 As a witness to the failed alternative economic systems, Lal is one of the strongest academic proponents of American primacy due to the economic prosperity it provides. Fourth and finally, the United States, in seeking primacy, has been willing to use its power not only to advance its interests but to promote the welfare of people all over the globe. The United States is the earth's leading source of positive externalities for the world. The U.S. military has participated in over fifty operations since the end of the Cold War--and most of those missions have been humanitarian in nature. Indeed, the U.S. military is the earth's "911 force"--it serves, de facto, as the world's police, the global paramedic and the planet's fire department. Whenever there is a natural disaster, earthquake, flood, drought, volcanic eruption, typhoon or tsunami, the United States assists the countries in need. On the day after Christmas in 2004, a tremendous earthquake and tsunami occurred in the Indian Ocean near Sumatra, killing some 300,000 people. The United States was the first to respond with aid. Washington followed up with a large contribution of aid and deployed the U.S. military to South and Southeast Asia for many months to help with the aftermath of the disaster. About 20,000 U.S. soldiers, sailors, airmen and marines responded by providing water, food, medical aid, disease treatment and prevention as well as forensic assistance to help identify the bodies of those killed. Only the U.S. military could have accomplished this Herculean effort. No other force possesses the communications capabilities or global logistical reach of the U.S. military. In fact, UN peacekeeping operations depend on the United States to supply UN forces. American generosity has done more to help the United States fight the War on Terror than almost any other measure. Before the tsunami, 80 percent of Indonesian public opinion was opposed to the United States; after it, 80 percent had a favorable opinion of America. Two years after the disaster, and in poll after poll, Indonesians still have overwhelmingly positive views of the United States. In October 2005, an enormous earthquake struck Kashmir, killing about 74,000 people and leaving three million homeless. The U.S. military responded immediately, diverting helicopters fighting the War on Terror in nearby Afghanistan to bring relief as soon as possible. To help those in need, the United States also provided financial aid to Pakistan; and, as one might expect from those witnessing the munificence of the United States, it left a lasting impression about America. For the first time since 9/11, polls of Pakistani opinion have found that more people are favorable toward the United States than unfavorable, while support for Al-Qaeda dropped to its lowest level. Whether in Indonesia or Kashmir, the money was well-spent because it helped people in the wake of disasters, but it also had a real impact on the War on Terror. When people in the Muslim world witness the U.S. military conducting a humanitarian mission, there is a clearly positive impact on Muslim opinion of the United States. As the War on Terror is a war of ideas and opinion as much as military action, for the United States humanitarian missions are the equivalent of a blitzkrieg. THERE IS no other state, group of states or international organization that can provide these global benefits. None even comes close. The United Nations cannot because it is riven with conflicts and major cleavages that divide the international body time and again on matters great and trivial. Thus it lacks the ability to speak with one voice on salient issues and to act as a unified force once a decision is reached. The EU has similar problems. Does anyone expect Russia or China to take up these responsibilities? They may have the desire, but they do not have the capabilities. Let's face it: for the time being, American primacy remains humanity's only practical hope of solving the world's ills.

### Plan Text

#### Plan: The United States federal government should offer power-purchase agreements to companies that generate electricity from floating Small Modular Reactors.

### Contention Two is Solvency

#### Floating SMRs solve- DOE engagement key- collapse of nuclear industry means warming inevitable

John Licata (Founder & Chief Energy Strategist of Blue Phoenix Inc, Motley Fool) April 27 2014 “Can Small Modular Nuclear Reactors Find Their Sea Legs?”, <http://www.fool.com/investing/general/2014/04/27/can-small-modular-nuclear-reactors-find-their-sea.aspx>

Nuclear power plants do bring jobs to rural areas, and in some cases they actually boost local housing prices since these plants create jobs. However, whether or not you believe nuclear power does or does not emit harmful radiation, many people would likely opt to not live right next door to a nuclear power plant facility if they had the choice. Today, they may not even need to consider such a move thanks to a floating plant concept coming out of MIT, which largely builds on the success of the U.S. Army of Corp Engineers' MH-1A floating nuclear reactor, installed on the Sturgis, a vessel that provided power to military and civilians around the Panama Canal. The Sturgis was decommissioned, but only because there was ample power generation on land. So the viability of a floating nuclear plant does make a lot of sense. Presently the only floating nuclear plant is being constructed in Russia (expected to be in service in two years). However, that plant is slated to be moored on a barge in a harbor. That differs from MIT's idea to put a 200 MWe reactor on a floating platform roughly six miles out to sea. The problem with the floating reactor idea or land-based SMR version is most investors are hard-pressed to fork over money needed for a nuclear build-out that could cost billions of dollars and take over a decade to complete. That very problem is today plaguing the land-based mPower SMR program of The Babcock & Wilcox Co. (NYSE: BWC ) . Also, although the reactors would have a constant cooling source in the ocean water, I'd like to see studies that show that sea life is not disrupted. Then there is always the issue with security and power lines to the mainland which needs to be addressed. At a time when reducing global warming is becoming a hotly debated topic by the IPCC, these SMRs (land or sea based) can help reduce our carbon footprint if legislation would allow them to proceed. Instead, the government is taking perfectly good cathedral-sized nuclear power plants offline, something they will likely come to regret in coming years from an economic and environmental perspective. Just ask the Germans. SMRs can produce dependable baseload power that is more affordable for isolated communities, and they can be used in remote areas by energy and metals production companies while traditional reactors cannot. So the notion of plopping SMRs several miles offshore so they can withstand tsunami swells is really interesting. If the concept can actually gain momentum that would help Babcock, Westinghouse, and NuScale Power. I would also speculate that technology currently being used in the oil and gas drilling sector, possibly even from the robotics industry, could be integrated into offshore light water nuclear designs for mooring, maintenance, and routine operational purposes. In today's modern world, we have a much greater dependence on consumer electronics, we are swapping our dependence of foreign oil with a growing reliance for domestic natural gas, and we face increasing pressures to combat climate change here at home as well as meet our own 2020 carbon goals. With that said, we need to think longer term and create domestic clean energy industries that can foster new jobs, help keep the power on even when blackouts occur and produce much less carbon at both the private and public sector levels. Therefore to me, advancing the SMR industry on land or by sea is a nice way to fight our archaic energy paradigm and move our energy supply into a modern era. Yet without the government's complete commitment to support nuclear power via legislation and a much needed expedited certification process, the idea of a floating SMR plant will be another example of wasted energy innovation that could simply get buried at sea.

#### SMRs are critical to reducing emissions and preventing catastrophic global warming – any alternative fails

Cohen 2012

[Armond, Executive Director, Clean Air Task Force, 2-13, “Decarbonization: The Nuclear Option,” http://energy.nationaljournal.com/2012/02/is-america-poised-for-nuclear.php?print=true&printcomment=2161670]

Three years ago, MIT’sRichard Lester published a simple analysis of what would be required to meet President Obama’s 83%-by-2050 greenhouse gas emission reduction target. The results were stark: Even if energy efficiency were to improve at rates 50% better than historical averages, and biofuels were able to meaningfully reduce transportation emissions in the near term (a proposition with which we disagree), meeting Obama’s goal would require retrofitting every existing coal plant in the country with carbon capture and sequestration (CCS), building twice again that much fossil capacity with CCS, building close to 3,000 wind farms the size of Massachusetts’ Cape Wind, and building nearly 4,000 solar farms the size of California’s Ivanpah. And**,** having done all that, increasing the amount of nuclear power we generate by a factor of five. Just on its face, this is a tall order. The capital investment is jaw-dropping, and it is becoming increasingly difficult to site new energy projects, regardless of whether they are solar or wind farms, transmission lines, CCS infrastructure, shale gas drilling, or nuclear facilities. More subtly, integrating these various energy sources—especially balancing output of intermittent renewables in an electric grid with no significant ability to store energy—is a major challenge; it is far from certain it can even be done at very large scale. To maximize our odds of meeting the target, we will need to prioritize development and deployment of technologies that appear capable of growing economically to full scale.**¶** Cheap unscrubbed natural gas is a “McSolution” to the problem—tempting, but probably not the healthiest long-term choice. In order to make a major contribution to climate abatement, methane emissions from natural gas production and distribution will need to be reduced, and gas-fired power plants will need to use CCS technologies. And**,** although gas in the United States today is sold at prices below production costs, that cannot continue for long, especially in increasingly international markets. Similarly**,** “soft energy paths” like PV power(also sometimes today sold below cost) will need significant grid support and zero-carbon balancing to generate meaningful emission reductions. The economic supply curve for large, attractive sites for these projects is bound to bend sharply upwards over time as well**.** In this context, nuclear power has potentially significant advantages to offer: It is demonstrably low-carbon; it provides baseload energy; unlike wind and solar, it has high power density; and, although gas is cheap today, the price of new nuclear power appears to approach that of new coal. Perhaps more importantly, the price of new nuclear plants will decline as years pass. Standardization will lead to some cost reductions; factory assembly of small, modular units could bring about further step-change reductions (as it has for automobiles and airplanes) in production costs. None of this means that nuclear is poised for a renaissance in the United States. Utilities and their regulators won’t argue with $3 gas, Congress is unwilling to put a price on carbon, and some people remain vehemently opposed to nuclear energy. Ultimately, however, nuclear energy isprobably an indispensible element of any credible plan to substantially decarbonize the country. The Nuclear Regulatory Commission’s recent approval of the new Westinghouse reactor design is good news in this regard, as it should help revitalize the American nuclear industry and keep it moving on a path of continuous improvement. In the longer term, a host of newer technologies, including passively cooled small reactors, gas-cooled reactors, and reactors with liquid fuels offer significant potential for further improvements in cost and safety. The country would do well to support continued development and deployment of these designs.In an ideal world, we might wait to scale up nuclear power until after we’ve exhausted all efficiency and renewables options. Unfortunately, however, we don’t have decades to do this, even if we thought traditional green sources would eventually fill the zero-carbon void, which seems unrealistic. Half of the CO2 emitted today will still be warming the planet 1,000 years from now, and these legacy emissions won’t erase themselves. We need to develop all low-carbon energy options now to hedge against the risk of serious climate consequences; nuclear power, despite its genuine challenges, cannot be left off the table.

#### Nuclear’s inevitable globally but won’t solve warming until the US develops SMR’s

Lovering et al 2012

[Michael, – et al and Ted Nordhaus—co-founders of American Environics and the Breakthrough Institute a think tank that works on energy and climate change – AND – Jesse Jenkins-Director of Energy and Climate Policy, the Breakthrough Institute, Why We Need Radical Innovation to Make New Nuclear Energy Cheap, 9/11, thebreakthrough.org/index.php/programs/energy-and-climate/new-nukes/]

Arguably, the biggest impact of Fukushima on the nuclear debate, ironically, has been to force a growing number of pro-nuclear environmentalists out of the closet, including us. The reaction to the accident by anti-nuclear campaigners and many Western publics put a fine point on the gross misperception of risk that informs so much anti-nuclear fear. Nuclear remains the only proven technology capable of reliably generating zero-carbon energy at a scale that can have any impact on global warming. Climate change -- and, for that matter, the enormous present-day health risks associated with burning coal, oil, and gas-- simply dwarf any legitimate risk associated with the operation of nuclear power plants. About 100,000 people die every year due to exposure to air pollutants from the burning of coal. By contrast, about 4,000 people have died from nuclear energy -- ever -- almost entirely due to Chernobyl.¶ But rather than simply lecturing our fellow environmentalists about their misplaced priorities, and how profoundly inadequate present-day renewables are as substitutes for fossil energy, we would do better to take seriously the real obstacles standing in the way of a serious nuclear renaissance. Many of these obstacles have nothing to do with the fear-mongering of the anti-nuclear movement or, for that matter, the regulatory hurdles imposed by the U.S. Nuclear Regulatory Commission and similar agencies around the world**.¶** As long as nuclear technology is characterized by enormous upfront capital costs**,** it is likely toremain just a hedge against overdependence on lower-cost coal and gas, not the wholesale replacement it needs to be to make a serious dent in climate change. Developing countries need large plants capable of bringing large amounts of **new** power to their fast-growing economies. But they also need power to be cheap. So long as coal remains the cheapest source of electricity in the developing world, it is likely to remain king.**¶** The most worrying threat to the future of nuclearisn't the political fallout from Fukushima -- it's economic reality**.** Even as new nuclear plants are built in the developing world, old plants are being retired in the developed world. For example, Germany's plan to phase-out nuclear simply relies on allowing existing plants to be shut down when they reach the ends of their lifetime. Given the size and cost of new conventional plants today, those plants are unlikely to be replaced with new ones. As such, the combined political and economic constraints associated with current nuclear energy technologies mean that nuclear energy's share of global energy generation is unlikely to grow in the coming decades, as global energy demand is likely to increase faster than new plants can be deployed.¶To move the needle on nuclear energy to the point that it might actually be capable of displacing fossil fuels, we'll need new nuclear technologies that are cheaper and smaller. Today, there are a range of nascent, smaller nuclear power plant designs, some of them modifications of the current light-water reactor technologies used on submarines, and others, like thorium fuel and fast breeder reactors, which are based on entirely different nuclear fission technologies. Smaller, modular reactors can be built much faster and cheaper than traditional large-scale nuclear power plants. Next-generation nuclear reactors are designed to be incapable of melting down, produce drastically less radioactive waste, make it very difficult or impossible to produce weapons grade material, useless water, and require less maintenance.¶ Most of these designs still face substantial technical hurdles before they will be ready for commercial demonstration. That means a great deal of research and innovation will be necessary to make these next generation plants viable and capable of displacing coal and gas. The United States could be a leader on developing these technologies, but unfortunately U.S. nuclear policy remains mostly stuck in the past**.** Rather than creating new solutions, efforts to restart the U.S. nuclear industry have mostly focused on encouraging utilities to build the next generation of large, light-water reactors with loan guarantees and various other subsidies and regulatory fixes. With a few exceptions, this is largely true elsewhere around the world as well.¶ Nuclear has enjoyed bipartisan support in Congress for more than 60 years, but the enthusiasm is running out. The Obama administration deserves credit for authorizing funding for two small modular reactors, which will be built at the Savannah River site in South Carolina. But a much more sweeping reform of U.S. nuclear energy policy is required. At present, the Nuclear Regulatory Commission has little institutional knowledge of anything other than light-water reactors and virtually no capability to review or regulate alternative designs. This affects nuclear innovation in other countries as well, since the NRC remains, despite its many critics, the global gold standard for thorough regulation of nuclear energy. Most other countries follow the NRC's lead when it comes to establishing new technical and operational standards for the design, construction, and operation of nuclear plants.¶ What's needed now is a new national commitment to the development, testing, demonstration, and early stage commercialization of a broad range of new nuclear technologies -- from much smaller light-water reactors to next generation ones -- in search of a few designs that can be mass produced and deployed at a significantly lower cost than current designs. This will require both greater public support for nuclear innovation and an entirely different regulatory framework to review and approve new commercial designs.¶ In the meantime, developing countries will continue to build traditional, large nuclear power plants. But time is of the essence. With the lion's share of future carbon emissions coming from those emerging economic powerhouses, the need to develop smaller and cheaper designs that can scale faster is all the more important.¶ A true nuclear renaissance can't happen overnight. And it won't happen so long as large and expensive light-water reactors remain our only option. But in the end, there is no credible path to mitigating climate change without a massive global expansion of nuclear energy. If you care about climate change, nothing is more important than developing the nuclear technologies we will need to get that job done.

#### Federal purchase agreements are key to create a market for SMRs and spur private investment

Rosner and Goldberg, 2011 (Robert, senator of the Helmholtz Association for the Research Field Structure of Matter and is currently the William E. Wrather Distinguished Service Professor at the University of Chicago; Stephen, Senior Advisor to the American Academy of Arts & Sciences; “Small Modular Reactors – Key to Future Nuclear Power Generation in the U.S.”, Energy Policy Institute at Chicago (EPIC), The University of Chicago, Contributor: Joseph S. Hezir, Pricipal, EOP Foundation, Inc., Technical Paper, Revision 1, November, <https://epic.sites.uchicago.edu/sites/epic.uchicago.edu/files/uploads/EPICSMRWhitePaperFinalcopy.pdf>)

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

## Warming EXTs

### 2AC – Case Outweighs

#### Warming makes extinction inevitable –

#### a. Biodiversity – warming ruins ecosystems and makes it impossible for large portions of the planet to survive – that ruins the food chain and causes massive die offs

#### b. Agriculture – global food development will decline because of decreases in arable land and heat that prevents plants growing – Ag collapse is the key internal link to societal collapse and global conflict

#### c. CO2 – independently increases in CO2 acidifies the oceans and they absorb more and more than they can handle – that collapses marine biodiversity which is uniquely key to the global food chain

#### d. We control the direction of conflict impacts – warming makes instability in the CCP increase to the brink because of riots over decreased food production – CCP collapse creates massive instability in Asia which spills over and escalates globally – Also CO2 causes accidental war with Russia because it creates debris that hits satellites

#### Climate change is the only high probability high magnitude scenario – comparatively outweighs

Sullivan in ‘7 (Gen. Gordon, Chair of CNA Corporation Military Advisory Board and Former Army Chief of Staff, in "National Security and the Threat of Climate Change",<http://securityandclimate.cna.org/report/National%20Security%20and%20the%20Threat%20of%20Climate%20Change>)

“We seem to be standing by and, frankly, asking for perfectness in science,” Gen. Sullivan said. “People are saying they want to be convinced, perfectly. They want to know the climate science projections with 100 percent certainty. Well, we know a great deal, and even with that, there is still uncertainty. But the trend line is very clear.” “We never have 100 percent certainty,” he said. “We never have it. If you wait until you have 100 percent certainty, something bad is going to happen on the battlefield. That’s something we know. You have to act with incomplete information. You have to act based on the trend line. You have to act on your intuition sometimes.” In discussing how military leaders manage risk, Gen. Sullivan noted that significant attention is often given to the low probability/high consequence events. These events rarely occur but can have devastating consequences if they do. American families are familiar with these calculations. Serious injury in an auto accident is, for most families, a low probability/high consequence event. It may be unlikely, but we do all we can to avoid it. During the Cold War, much of America’s defense efforts focused on preventing a Soviet missile attack—the very definition of a low probability/high consequence event. Our effort to avoid such an unlikely event was a central organizing principle for our diplomatic and military strategies. When asked to compare the risks of climate change with those of the Cold War, Gen. Sullivan said, “The Cold War was a specter, but climate change is inevitable. If we keep on with business as usual, we will reach a point where some of the worst effects are inevitable.” “If we don’t act, this looks more like a high probability/high consequence scenario,” he added. Gen. Sullivan shifted from risk assessment to risk management. “In the Cold War, there was a concerted effort by all leadership—political and military, national and international—to avoid a potential conflict,” he said. “I think it was well known in military circles that we had to do everything in our power to create an environment where the national command authority—the president and his senior advisers—were not forced to make choices regarding the use of nuclear weapons.

#### Warming outweighs – conflict takes concerted action but warming only requires inaction – scientific debate key

Hanson et al, 2007 (James, NASA Goddard Institute for Space Studies; M. Sato, Columbia University Earth Institute; R. Ruedy, Sigma Space Partners LLC; P. Kharecha, Columbia University Earth Institute; A. Lacis, Department of Earth and Environmental Scientists at Columbia University; R. Miller, Department of Applied Physics and Applied Mathematics at Columbia University; L. Nazarenko, Columbia University Earth Institute; K. Lo, Sigma Space Partners LLC; G. A. Schmidt, NASA Goddard Institute for Space Studies; G. Russell, NASA Goddard Institute for Space Studies; I. Aleinov, Columbia University Earth Institute; S. Bauer, Columbia University Earth Institute; E. Baum, Clean Air Task Force in Boston; B. Cairns, Department of Applied Physics and Applied Mathematics at Columbia University; V. Canuto, NASA Goddard Institute for Space Studies; M. Chandler, Columbia University Earth Institute; Y. Cheng, Sigma Space Partners LLC; A. Cohen, Clean Air Task Force in Boston; A. Del Genio, NASA Goddard Institute for Space Studies; G. Faluvegi, Columbia University Earth Institute; E. Fleming, NASA Goddard Space Flight Center; A. Friend, Laboratoire des Sciences du Climat et de l’Environment; T. Hall, NASA Goddard Institute for Space Studies; C. Jackman, NASA Goddard Space Flight Center; J. Jonas, Columbia University Earth Institute; M. Kelley, Laboratoire des Sciences du Climat et de l’Environment; N. Y. Kiang, NASA Goddard Institute for Space Studies; D. Koch, Department of Geology at Yale, G. Labow, NASA Goddard Space Flight Center; J. Lerner, Columbia University Earth Institute; S. Menon, Lawrence Berkeley National Laboratory; T. Novakov, Lawrence Berkeley National Laboratory; V. Oinas, Sigma Space Partners LLC; Ja. Perlwitz, Department of Applied Physics and Applied Mathematics at Columbia University; Ju. Perlwitz, Columbia University Earth Institute; D. Rind, NASA Goddard Institute for Space Studies; A. Romanou, Department of Earth and Environmental Scientists at Columbia University; R. Schmunk, Sigma Space Partners LLC; D. Shindell, NASA Goddard Institute for Space Studies; P. Stone, Massachusetts Institute of Technology; S. Sun, Massachusetts Institute of Technology; D. Streets, Argonne National Laboratory; N. Tausnev, Sigma Space Partners LLC; D. Thresher, Department of Earth and Environmental Scientists at Columbia University; N. Unger, Columbia University Earth Institute; M. Yao, Sigma Space Partners LLC; S. Zhang, Columbia University Earth Institute; “Dangerous human-made interference with climate: a GISS modelE Study”, Atmospheric Chemistry and Physics, Vol. 7, No. 9, http://www.atmos-chem-phys.net/7/2287/2007/acp-7-2287-2007.html)

These stark conclusions about the threat posed by global climate change and implications for fossil fuel use are not yet appreciated by essential governing bodies, as evidenced by ongoing plans to build coal-ﬁred power plants without CO2 capture and sequestration. In our view, there is an acute need for science to inform society about the costs of failure to address global warming, because of a fundamental difference between the threat posed by climate change and most prior global threats. In the nuclear standoff between the Soviet Union and United States, a crisis could be precipitated only by action of one of the parties. In contrast, the present threat to the planet and civilization, with the United States and China now the principal players (though, as Fig. 10 shows, Europe also has a large responsibility), requires only inaction in the face of clear scientiﬁc evidence of the danger. Thus scientists are faced with difﬁcult choices between communication of scientiﬁc information to the public and focus on basic research, as there are inherent compromises in any speciﬁc balance. Former American Vice President Al Gore, at a plenary session of the December 2006 meeting of the American Geophysical Union, challenged earth scientists to become involved in informing the public about global climate change. The overwhelmingly positive audience reaction to his remarks provides hope that the large gap between scientiﬁc understanding and public knowledge about climate change may yet be closed.

#### Extinction outweighs – future lives are affected by the actions taken today

Jason G. Matheny 2007 Department of Health Policy and Management, Bloomberg School of Public Health, Johns Hopkins University “Reducing the Risk of Human Extinction” Risk Analysis, Vol. 27, No. 5, 2007

Even if extinction events are improbable, the expected values of countermeasures could be large, as they include the value of all future lives. This introduces a discontinuity between the CEA of extinction and nonextinction risks. Even though the risk to any existing individual of dying in a car crash is much greater than the risk of dying in an asteroid impact, asteroids pose a much greater risk to the existence of future generations (we are not likely to crash all our cars at once) (Chapman, 2004). The “death-toll” of an extinction-level asteroid impact is the population of Earth, plus all the descendents of that population who would otherwise have existed if not for the impact. There is thus a discontinuity between risks that threaten 99% of humanity and those that threaten 100%.

#### Err aff – looking at long timeframe impacts is necessary to solve problems like global warming

Brand ’99 (Stewart, Futurist, President of the Long Now Foundation, “The Clock of the Long Now”, pg 122)

Such debates indicate that the way the future is viewed and used is in transition. Some say that a sense of any future at all was extinguished for three generations in the twentieth century by the dread of nuclear Armageddon, from which we have not yet recovered. At the same time, increasing reports of incremental loss—of atmospheric ozone, of species diversity, of rural village stability—tell us that long-term maintenance issues are accumulating to crisis proportions that short-term thinking is powerless to address. “For most of civilization’s history,” observes Kelly, “Tomorrow was going to be no different than today, so the future was owed nothing. Suddenly, in the technological age, our power of disruption become so great, there was guarantee that we’d have any future whatsoever. We now know we are stuck with having a future, and thus are obliged to it, but we have no idea what that means.”¶ Some of what the future means can be revived from traditional ethics, such as Samuel Johnson’s admonition, “The future is purchased by the present. It is not possible to secure distant or permanent happiness but by the forbearance of some immediate gratification.” Some way we learn from the emerging field of future studies. “The first thing you learn in forecasting,” says Paul Saffo, “is the longer view you take, the more is in your self-interest. Seemingly altruistic acts are not altruistic if you take a long enough view.” In the long run saving yourself requires saving the whole world.

### 2AC – Anthropogenic

#### 1. Warming is happening and is human induced – Berkeley Earth Surface Temperature project studied warming data over the past 250 years and concluded CO2 increases have rapidly increased the rate of warming past natural fluctuations – prefer our evidence – it cites the most recent studies and comes from a former skeptic who attempted to explain the data any other way – That’s Muller

#### 2. Scientific consensus is on our side

**Lewandowsky and Ashley 2011** [Stephan Lewandowsky, Professor of Cognitive Studies at the University of Western Australia, and Michael Ashley, Professor of Astrophysics at the University of New South Wales, June 24, 2011, “The false, the confused and the mendacious: how the media gets it wrong on climate change,” http://goo.gl/u3nOC]

But despite these complexities, some aspects of climate science are thoroughly settled. We know that atmospheric CO2 is increasing due to humans. We know that this CO2, while being just a small fraction of the atmosphere, has an important influence on temperature. We can calculate the effect, and predict what is going to happen to the earth’s climate during our lifetimes, all based on fundamental physics that is as certain as gravity. The consensus opinion of the world’s climate scientists is that climate change is occurring due to human CO2 emissions. The changes are rapid and significant, and the implications for our civilisation may be dire. The chance of these statements being wrong is vanishingly small. Scepticism and denialism Some people will be understandably sceptical about that last statement. But when they read up on the science, and have their questions answered by climate scientists, they come around. These people are true sceptics, and a degree of scepticism is healthy. Other people will disagree with the scientific consensus on climate change, and will challenge the science on internet blogs and opinion pieces in the media, but no matter how many times they are shown to be wrong, they will never change their opinions. These people are deniers. The recent articles in The Conversation have put the deniers under the microscope. Some readers have asked us in the comments to address the scientific questions that the deniers bring up. This has been done. Not once. Not twice. Not ten times. Probably more like 100 or a 1000 times. Denier arguments have been dealt with by scientists, again and again and again. But like zombies, the deniers keep coming back with the same long-falsified and nonsensical arguments. The deniers have seemingly endless enthusiasm to post on blogs, write letters to editors, write opinion pieces for newspapers, and even publish books. What they rarely do is write coherent scientific papers on their theories and submit them to scientific journals. The few published papers that have been sceptical about climate change have not withstood the test of time. The phony debate on climate change So if the evidence is this strong, why is there resistance to action on climate change in Australia? At least two reasons can be cited. First, as The Conversation has revealed, there are a handful of individuals and organisations who, by avoiding peer review, have engineered a phony public debate about the science, when in fact that debate is absent from the one arena where our scientific knowledge is formed. These individuals and organisations have so far largely escaped accountability. But their free ride has come to an end, as the next few weeks on The Conversation will continue to show. The second reason, alas, involves systemic failures by the media. Systemic media failures arise from several presumptions about the way science works, which range from being utterly false to dangerously ill-informed to overtly malicious and mendacious. The false Let’s begin with what is merely false. A tacit presumption of many in the media and the public is that climate science is a brittle house of cards that can be brought down by a single new finding or the discovery of a single error. Nothing could be further from the truth. Climate science is a cumulative enterprise built upon hundreds of years of research. The heat-trapping properties of CO₂ were discovered in the middle of the 19th century, pre-dating even Sherlock Holmes and Queen Victoria.

#### 3. Carbon dioxide accounts for 60% of the human induced GHG emissions – this outweighs all other causes of warming – studies of carbon composition prove this is caused by human energy consumption – that’s Vertessy and Clark

#### 4. Anthropogenic emissions massively outweigh natural emissions.

**American Geophysical Union 2011** [ “Volcanic Versus Anthropogenic Carbon Dioxide,” 6/14, <http://www.agu.org/pubs/pdf/2011EO240001.pdf>]

The projected 2010 anthropogenic CO2 emission rate of 35 gigatons per year is 135 times greater than the 0.26-gigaton-per-year preferred estimate for volcanoes. This ratio of anthropogenic to volcanic CO2 emissions defines the anthropogenic CO2 multiplier (ACM), an index of anthropogenic CO2 ’s dominance over volcanic CO2 emissions. Figure 1 shows the ACM as a time series calculated from time series data on anthropogenic CO2 emissions and Marty and Tolstikhin’s [1998] preferred and plausible range of emission estimates for global volcanic CO2 . The ACM values related to the preferred estimate rise gradually from about 18 in 1900 to roughly 38 in 1950; thereafter they rise rapidly to approximately 135 by 2010. This pattern mimics the pattern of the anthropogenic CO2 emissions time series. It reflects the 650% growth in anthropogenic emissions since 1900, about 550% of which has occurred since 1950. ACM plots related to the preferred estimates of global volcanic CO2 in the four other studies (not shown) exhibit the same pattern but at higher values; e.g., the 2010 ACM values based on their preferred estimates range from 167 to 233, compared to the 135 based on Marty and Tolstikhin’s [1998] preferred estimate.

### 2AC – Positive Feedbacks

#### 1. Feedbacks are net positive – as temperature increases land and ocean carbon sinks release carbon and can’t store more of it and as permafrost thaws or wetlands warm methane is released which quickly increases the rate of climate change – melting ice removes the Earth’s ability to reflect UV rays – ensures warming speeds up and causes extinction – that’s Speth

#### 2. Melting permafrost releases mass amounts of methane – causes runaway warming

**von Deimling** 3-14-**2012** [Thomas Schneider, Potsdam Institute for Climate Impact Research, “Is there enough time to prevent widespread thawing of permafrost?”, http://www.guardian.co.uk/environment/2012/mar/14/permafrost-feedback-timing]

As we've noted in this series, scientists are concerned that global warming could cause much of the world's permafrost (deep-frozen soils) to thaw, releasing vast quantities of greenhouse gases that would accelerate climate change – an example of a positive feedback loop. Measurements have shown that southerly permafrost regions have already started to thaw and some additional thawing is unavoidable. Even if all man-made emissions ceased today, an additional global warming of about 0.6C would be expected due to the inertia of the climate system. Furthermore, due to polar amplification, man-made warming affects permafrost regions disproportionately: they warm around 50% more than the globe as a whole. However, according to recent modeling work, if global emissions are cut rapidly and deeply enough to meet the world's stated target of limiting the average global temperature rise to 2C above pre-industrial levels, the majority of the world's permafrost will remain frozen. By contrast, in a scenario without polities to reduce emissions, future warming is very likely to lead to a widespread disintegration of permafrost by the end of this century. In this scenario, the Arctic, which currently is an overall carbon sink, is expected to turn into a carbon source, because the carbon uptake from Arctic vegetation will be smaller than the release of carbon from thawing permafrost soils. The loss of permafrost carbon to the atmosphere would be irreversible on a human timescale and would mean that larger reductions in man-made emissions would be needed to achieve any target for CO2 concentration or global temperature rise.

#### 3. Warming decreases the ocean’s CO2 storage capacity – accelerates the rate

Venkataramanan and Smitha 2011[M., Department of Economics, D.G. Vaishnav College “Causes and effects of global warming, Indian Journal of Science p.226-229 <http://www.indjst.org/archive/vol.4.issue.3/mar11-pages159-265.pdf>]

Causes of global warming: The buildup of carbon dioxide in the atmosphere, mainly from your fossil fuel emissions, is the most significant human cause of global warming. Carbon dioxide is released every you burn something, be it a car, airplane or coal plant. This means you must burn less fossil fuel if you want the Earth's climate to remain stable! And unfortunately, we are currently destroying some of the best known mechanisms for storing that carbon-plants. Deforestation increases the severity of global warming as well. Carbon dioxide is released from the human conversion of forests and grasslands into farmland and cities. All living plants store carbon. When those plants die and decay, carbon dioxide is released back into the atmosphere. As forests and grasslands are cleared for your use, enormous amounts of stored carbon enter the atmosphere. An unstoppable feedback loop may happen if you let this continue. If the activities mentioned above warm the Earth just enough, it could cause natural carbon sinks to fail. A "carbon sink" is a natural system that stores carbon over thousands of years. Such sinks include peat bogs and the arctic tundra. But if these sinks destabilize, that carbon will be released, possibly causing an unstoppable and catastrophic warming of the Earth. The oceans are no longer able to store carbon as they have in the past. The ocean is a huge carbon sink, holding about 50 times as much carbon as the atmosphere. But now scientists are realizing that the increased thermal stratification of the oceans has caused substantial reductions in levels of phytoplankton, which store CO2. Increased atmospheric carbon is also causing an acidification of the ocean, since carbon dioxide forms carbonic acid when it reacts with water. The tiny plants of the ocean, the very bottom of that vast watery food chain, are suffering from the effects of global warming, which means they are becoming less able to store carbon, further contributing to climate change. As carbon sinks fail, the amount of carbon in the atmosphere climbs!

#### 4. We must act now – positive feedbacks mean the tipping point is going to happen soon – action taken to reduce emissions within the next decade is key – That’s Tohill

### 2AC – Too Late

#### 1. It’s not too late – positive feedbacks guarantee extinction if we don’t do anything but action now will be able to prevent catastrophic warming – that’s Tohill

#### 2. Drastic cuts now key to prevent 500ppm tipping point

Hansen5-9-2012[James, professor in the Department of Earth and Environmental Sciences at Columbia University and at Columbia’s Earth Institute, and director of the NASA Goddard Institute for Space Studies, “Game Over for the Climate”, http://www.nytimes.com/2012/05/10/opinion/game-over-for-the-climate.html]

The concentration of carbon dioxide in the atmosphere has risen from 280 parts per million to 393 p.p.m. over the last 150 years. The tar sands contain enough carbon — 240 gigatons — to add 120 p.p.m. Tar shale, a close cousin of tar sands found mainly in the United States, contains at least an additional 300 gigatons of carbon. If we turn to these dirtiest of fuels, instead of finding ways to phase out our addiction to fossil fuels, there is no hope of keeping carbon concentrations below 500 p.p.m. — a level that would, as earth’s history shows, leave our children a climate system that is out of their control. We need to start reducing emissions significantly, not create new ways to increase them. We should impose a gradually rising carbon fee, collected from fossil fuel companies, then distribute 100 percent of the collections to all Americans on a per-capita basis every month. The government would not get a penny. This market-based approach would stimulate innovation, jobs and economic growth, avoid enlarging government or having it pick winners or losers. Most Americans, except the heaviest energy users, would get more back than they paid in increased prices. Not only that, the reduction in oil use resulting from the carbon price would be nearly six times as great as the oil supply from the proposed pipeline from Canada, rendering the pipeline superfluous, according to economic models driven by a slowly rising carbon price.

#### 3. Not a reason to do nothing – there is only a risk that the aff can do something positive by curbing carbon emissions – voting neg guarantees extinction

#### 4. Must take action now – delay guarantees the worst impacts

**Gines 2011** [Julie K. PhD in earth science University of Utah with an emphasis in remote sensing satellite technology, “Climate Management Issues: Economics, Sociology, and Politics”, p. 403]

Each day corrective action is delayed puts life on earth at greater risk. What is important to realize is the climate system’s inertia. Because it responds slowly, positive action taken today will not be realized for decades to come. In addition, the longer the delay, the greater the risks become and the more difficult it will be to respond effectively. Even worse, if the delay becomes too long, it may never be possible to stabilize the climate at a safe level for life to exist as it presently does. Tipping points become a serious issue—when the system tips or shifts into an entirely new state, such as the major collapse of ice sheets causing rapid sea-level rise or massive thawing of permafrost releasing huge amounts of stored methane into the atmosphere.

### 2AC – A2 Climate Skeptics

#### Climate science is true – skeptics have become marginalized from mainstream science

**Banning ‘9**, Professor of Communication at the University of Colorado (Elisabeth, “When Poststructural Theory and Contemporary Politics Collide-The Vexed Case of Global Warming”, September)

I do not mean to deny the existence of individuals who genuinely disagree with the conclusions or the scientific paradigm of their field. There will always be outliers, as Thomas Kuhn established in The Structure of Scientific Revolutions, scientists who adhere to an older scientific paradigm and who dismiss developments in their scientific areas. Those scientists that genuinely disbelieve the conclusion of climate change scientist today that global warming is happening and is due to human activities, such as Richard Lindzen of MIT for example, are not subject to questions of bias due to funding, but their commitments no longer reflect the developments produced by and accepted in their field. 38 Scientists who continue to resist ‘‘after his [or her] whole profession has been converted,’’ like Lindzen and others, Kuhn suggests, may be earnest, but they also have ‘‘ipso facto ceased to be a scientist.’**’** 39 This seems a bit harsh, using Lindzen as an example, given that he occupies an endowed chair position at the Massachusetts Institute of Technology and is an award-winning scientist and a member of the National Academy of Sciences. 40 Perhaps it is more circumspect to say that individuals who continue to reject majority positions will become progressively less central in their scientific area\*if not marginalized\*by their peers’ overwhelming acceptance of conclusions that outliers themselves reject.

### 2AC – Nuke Power Solves

#### 1. Nuclear power is critical to shift to carbon free energy production – right now is key because of a renewed push in the US – that’s Deutch

#### 2. Nuclear power is critical to reduce energy emissions – currently Nuclear power produces 15% of the worlds energy and prevents two billion tonnes of carbon dioxide emissions – that’s the WNA evidence

#### 3. Nothing else can reduce emissions fast enough

McCarthy 4 (Michael, “Lovelock: 'Only nuclear power can now halt global warming'” Published May 23 2004 by [Independent UK](http://news.independent.co.uk/uk/environment/story.jsp?story=524313), http://www.energybulletin.net/node/320)

On that basis, he says, there is simply not enough time for renewable energy, such as wind, wave and solar power - the favoured solution of the Green movement - to take the place of the coal, gas and oil-fired power stations whose waste gas, carbon dioxide (CO2), is causing the atmosphere to warm. He believes only a massive expansion of nuclear power, which produces almost no CO2, can now check a runaway warming which would raise sea levels disastrously around the world, cause climatic turbulence and make agriculture unviable over large areas. He says fears about the safety of nuclear energy are irrational and exaggerated, and urges the Green movement to drop its opposition.¶ In today's Independent, Professor Lovelock says he is concerned by two climatic events in particular: the melting of the Greenland ice sheet, which will raise global sea levels significantly, and the episode of extreme heat in western central Europe last August, accepted by many scientists as unprecedented and a direct result of global warming.

#### 4. Their life cycle arguments are wrong - Nuclear power results in a fraction of the emissions

Gronlund 7 Nuclear power in a Warming world: Assessing the Risks, Addressing the Challenges, Lisbeth Gronlund; David Lochbaum; Edwin Lyman, Union of Concerned Scientists, http://www.ucsusa.org/assets/documents/nuclear\_power/nuclear-power-in-a-warming-world.pdf

Nuclear power plants do not produce global warming emissions when they operate. However, producing nuclear power requires mining and processing uranium ore, enriching uranium to create reactor fuel, manufacturing and transporting fuel, and building plants—all of which consume energy. Today much of that energy is provided by fossil fuels (although that may change if the United States takes steps to address global warming). However, the global warming emissions associated with nuclear power even now are relatively modest. Indeed, its life cycle emissions are comparable to those of wind power and hydropower. While estimates of life cycle greenhousegas emissions vary with different assumptions and methodologies, the basic conclusions of most analyses are consistent: for each unit of electricity generated, natural gas combustion results in roughly half the global warming emissions of coal combustion, while wind power, hydropower, and nuclear power produce only a few percent of emissions from coal combustion. The life cycle emissions of photovoltaics (PVs) are generally somewhat higher than those for wind power, hydropower, and nuclear power, because manufacture of PVs entails greater global warming emissions.5 The greenhouse gas emissions stemming from nuclear power depend greatly on the technology used to enrich uranium. The technology now used in the United States—gaseous diffusion—requires a large amount of electricity: roughly 3.4 percent of the electricity generated by a typical U.S. reactor would be needed to enrich the uranium in the reactor’s fuel. 6 Because fossil fuels generate 70 percent of U.S. electricity, emissions from that enrichment would account for some 2.5 percent of the emissions of an average U.S. fossil fuel plant. However, in the near future, U.S. uranium will be enriched using gaseous centrifuge technology, which consumes only 2.5 percent of the energy used by a diffusion plant. Thus this part of the nuclear power life cycle would result in very low emissions. 7

## Competitiveness EXTs

### 2AC – Oil Destroy Readiness

#### Dependency on oil collapses the military

Voth ‘12 (Jeffrey M. Voth is the president of Herren Associates leading a team of consultants advising the federal government on issues of national security, energy and environment, health care and critical information technology infrastructure, George Washing University Homeland Security Policy Institute, “In Defense of Energy – A Call to Action”, <http://securitydebrief.com/2012/04/11/in-defense-of-energy-a-call-to-action/>, April 11, 2012)

Last month, the Pentagon released its widely anticipated roadmap to transform operational energy security. As published in a World Politics Review briefing, **energy security has become a strategic** as well as an operationalimperative **for** U.S. **national security.** **As tensions** continue to **escalate** with Iran **in the Strait** of Hormuz, it hasbecome clear that **the** U.S. **military** urgently **requires new** approaches and innovative **technologies to improve fuel efficiency**, increase **endurance**, enhance **operational flexibility** and support a forward presence for allied forces **while reducing** the **vulnerability inherent in a** long supply-line tether**.** **Assured access to** reliable and sustainable supplies of **energy is** central **to the military’s ability to meet operational requirements** globally, whether keeping the seas safe of pirates operating off the coast of Africa, providing humanitarian assistance in the wake of natural disasters in the Pacific or supporting counterterrorism missions in the Middle East. From both a strategic and an operational perspective, the call to action is clear. Rapid employment of energy-efficient technologies and smarter systems will be required to transform the military’s energy-security posture while meeting the increasing electric-power demands required for enhanced combat capability. As recently outlined by Chairman of the Joint Chiefs of Staff Gen. Martin Dempsey, “Without improving our energy security, we are not merely standing still as a military or as a nation, we are falling behind.”

#### Independently- fuel cost wrecks the DOD’s budget - spills over

Freed ‘12 (Josh Freed, Vice President for Clean Energy, Third Way, “Improving capability, protecting 'budget”, <http://energy.nationaljournal.com/2012/05/powering-our-military-whats-th.php>, May 21, 2012)

As Third Way explains in a digest being released this week by our National Security Program, the Pentagon’s **efforts to reduce energy** demand and find alternative energy sources **could keep** rising fuel **costs from encroaching on the budgets of** other important defense programs. And the payoff could be massive. The Air Force has already been able to implement behavioral and technology changes that will reduce its fuel costs by $500 million over the next five years. The Army has invested in better energy distribution systems at several bases in Afghanistan, which will save roughly $100 million each year. And, using less than 10% of its energy improvement funds, the Department has begun testing advanced biofuels for ships and planes. This relatively small investment could eventually provide the services with a cost-effective alternative to the increasingly expensive and volatile oil markets. These actions are critical tothe Pentagon’s ability to focus on its defense priorities. As Secretary Panetta recently pointed out, he’s facing a $3 billion budget shortfall caused by “higher-than-expected fuel costs.” The Department’s energycosts could rise even furtherif action isn’t taken. DOD expects to spend $16 billion on fuel next year. TheEnergy InformationAdministration **predicts** the price of **oil will rise** 23% by 2016**,** without a major disruption in oil supplies, like the natural disasters, wars, and political upheaval the oil producing states have seen during the last dozen years. Meanwhile, the Pentagon’s planned budget, which will remain flat for the foreseeable future, will require significant adjustment to the Department’s pay-any-price mindset, even if sequestration does not go into effect. **Unless** energy **costs are curbed, they could** begin to **eat into** other budget priorities **for DOD.** In addition, the Pentagon’s own Defense Science Board acknowledges that using energy more efficiently makes our forces more flexible and resilient in military operations, and can provide them with greater endurance during missions. Also, by reducing energy demand in the field, DOD can minimize the number of fuel convoys that must travel through active combat zones, reducing the chances of attack to avoiding casualties and destruction of material. At our domestic bases, DOD is employing energy conservation, on-site clean energy generation, and smart grid technology to prevent disruptions to vital activities in case the civilian grid is damaged by an attack or natural disaster. The bottom line is, developing methods and technologies to reduce our Armed Forces’ use of fossil fuels and increase the availability of alternative energy makes our military stronger. That’s why the Pentagon has decided to invest in these efforts. End of story.

### 2AC – Pfeffer Says Hydrogen

#### The plan solves- Pfeffer says new nuclear tech comes with desal tech

#### Reactors make hydrogen feasible and economical

Science 2.0 ’12 (quoting Dr. Ibrahim Khamis of the International Atomic Energy Agency (IAEA), 3/26/12, One Day, You May Thank Nuclear Power For The Hydrogen Economy, [www.science20.com/news\_articles/one\_day\_you\_may\_thank\_nuclear\_power\_hydrogen\_economy-88334](http://www.science20.com/news_articles/one_day_you_may_thank_nuclear_power_hydrogen_economy-88334)

The hydrogen economy has been ready to start for decades and could begin commercial production of hydrogen in this decade but, says Dr. Ibrahim Khamis of the International Atomic Energy Agency (IAEA) in Vienna, Austria, it will take heat from existing nuclear plants to make hydrogen economical. Khamis said scientists and economists at IAEA and elsewhere are working intensively to determine how current nuclear power reactors — 435 are operational worldwide — and future nuclear power reactors could be enlisted in hydrogen production. Most hydrogen production at present comes from natural gas or coal and results in releases of the greenhouse gas carbon dioxide. On a much smaller scale, some production comes from a cleaner process called electrolysis, in which an electric current flowing through water splits the H2O molecules into hydrogen and oxygen. This process, termed electrolysis, is more efficient and less expensive if water is first heated to form steam, with the electric current passed through the steam. "There is rapidly growing interest around the world in hydrogen production using nuclear power plants as heat sources," Khamis said. "Hydrogen production using nuclear energy could reduce dependence on oil for fueling motor vehicles and the use of coal for generating electricity. In doing so, hydrogen could have a beneficial impact on global warming, since burning hydrogen releases only water vapor and no carbon dioxide, the main greenhouse gas. There is a dramatic reduction in pollution." Khamis said that nuclear power plants are ideal for hydrogen production because they already produce the heat for changing water into steam and the electricity for breaking the steam down into hydrogen and oxygen. Experts envision the current generation of nuclear power plants using a low-temperature electrolysis which can take advantage of low electricity prices during the plant's off-peak hours to produce hydrogen. Future plants, designed specifically for hydrogen production, would use a more efficient high-temperature electrolysis process or be coupled to thermochemical processes, which are currently under research and development. "Nuclear hydrogen from electrolysis of water or steam is a reality now, yet the economics need to be improved," said Khamis. He noted that some countries are considering construction of new nuclear plants coupled with high-temperature steam electrolysis (HTSE) stations that would allow them to generate hydrogen gas on a large scale in anticipation of growing economic opportunities.

#### Tech is viable—just need hydrogen fuel

Squatriglia ’11 (Chuck Squatriglia, Wired, 4/22/11, Discovery Could Make Fuel Cells Much Cheaper, www.wired.com/autopia/2011/04/discovery-makes-fuel-cells-orders-of-magnitude-cheaper/)

One of the biggest issues with hydrogen fuel cells, aside from the lack of fueling infrastructure, is the high cost of the technology. Fuel cells use a lot of platinum, which is frightfully expensive and one reason we’ll pay $50,000 or so for the hydrogen cars automakers say we’ll see in 2015. That might soon change. Researchers at Los Alamos National Laboratory have developed a platinum-free catalyst in the cathode of a hydrogen fuel cell that uses carbon, iron and cobalt. That could make the catalysts “two to three orders of magnitude cheaper,” the lab says, thereby significantly reducing the cost of fuel cells.Although the discovery means we could see hydrogen fuel cells in a wide variety of applications, it could have the biggest implications for automobiles. Despite the auto industry’s focus on hybrids, plug-in hybrids and battery-electric vehicles — driven in part by the Obama administration’s love of cars with cords — several automakers remain convinced hydrogen fuel cells are the best alternative to internal combustion. Hydrogen offers the benefits of battery-electric vehicles — namely zero tailpipe emissions — without the drawbacks of short range and long recharge times. Hydrogen fuel cell vehicles are electric vehicles; they use a fuel cell instead of a battery to provide juice. You can fill a car with hydrogen in minutes, it’ll go about 250 miles or so and the technology is easily adapted to everything from forklifts to automobiles to buses. Toyota, Mercedes-Benz and Honda are among the automakers promising to deliver hydrogen fuel cell vehicles in 2015. Toyota has said it has cut the cost of fuel cell vehicles more than 90 percent by using less platinum — which currently goes for around $1,800 an ounce — and other expensive materials. It plans to sell its first hydrogen vehicle for around $50,000, a figure Daimler has cited as a viable price for the Mercedes-Benz F-Cell (pictured above in Australia). Fifty grand is a lot of money, especially something like the F-Cell — which is based on the B-Class compact — or the Honda FCX Clarity. Zelenay and Wu in the lab. In a paper published Friday in Science, Los Alamos researchers Gang Wu, Christina Johnston and Piotr Zelenay, joined by Karren More of Oak Ridge National Laboratory, outline their platinum-free cathode catalyst. The catalysts use carbon, iron and cobalt. The researchers say the fuel cell provided high power with reasonable efficiency and promising durability. It provided currents comparable to conventional fuel cells, and showed favorable durability when cycled on and off — a condition that quickly damages inferior catalysts. The researchers say the carbon-iron-cobalt catalyst completed the conversion of hydrogen and oxygen into water, rather than producing large amounts of hydrogen peroxide. They claim the catalyst created minimal amounts of hydrogen peroxide — a substance that cuts power output and can damage the fuel cell — even when compared to the best platinum-based fuel cells. In fact, the fuel cell works so well the researchers have filed a patent for it. The researchers did not directly quantify the cost savings their cathode catalyst offers, which would be difficult because platinum surely would become more expensive if fuel cells became more prevalent. But the lab notes that iron and cobalt are cheap and abundant, and so the cost of fuel cell catalysts is “definitely two to three orders of magnitude cheaper.” “The encouraging point is that we have found a catalyst with a good durability and life cycle relative to platinum-based catalysts,” Zelenay said in a statement. “For all intents and purposes, this is a zero-cost catalyst in comparison to platinum, so it directly addresses one of the main barriers to hydrogen fuel cells.”

#### New fuel cell tech makes that affordable—old evidence irrelevant

Commodity Online ‘11, US researchers claim breakthrough in Hydrogen Fuel Cell tech , [www.commodityonline.com/news/us-researchers-claim-breakthrough-in-hydrogen-fuel-cell-tech-37501-3-37502.html](http://www.commodityonline.com/news/us-researchers-claim-breakthrough-in-hydrogen-fuel-cell-tech-37501-3-37502.html), 2011)

U.S. researchers say they've made a breakthrough in the development of low-cost hydrogen fuel cells that one day could power electric cars. Researchers at Case Western Reserve University in Cleveland say catalysts made of carbon nanotubes dipped in a polymer solution can outperform traditional platinum catalysts in fuel cells at a fraction of the cost.The scientists say the new technology can remove one of the biggest roadblocks to widespread cell use: the cost of the catalysts. Platinum, which represents at least a quarter of the cost of fuel cells, currently sells for about $30,000 per pound, while the activated carbon nanotubes cost about $45 per pound, a Case release said Tuesday. "This is a breakthrough," Liming Dai, a professor of chemical engineering and the research team leader, said.

### 2AC – Natural Gas Glut AC

#### SMR key to help nuclear beat-out natural gas

Lamonica ’12 (Tech Review Writer. 20 years of experience covering technology and business (8/9/12, Martin, A Glut of Natural Gas Leaves Nuclear Power Stalled, [www.technologyreview.com/news/428737/a-glut-of-natural-gas-leaves-nuclear-power/](http://www.technologyreview.com/news/428737/a-glut-of-natural-gas-leaves-nuclear-power/))

The nuclear renaissance is in danger of petering out before it has even begun, but not for the reasons most people once thought. Forget safety concerns, or the problem of where to store nuclear waste—the issue is simply cheap, abundant natural gas.¶ General Electric CEO Jeffrey Immelt caused a stir last month when he told the Financial Times that it's "hard to justify nuclear" in light of low natural gas prices. Since GE sells all manner of power generation equipment, including components for nuclear plants, Immelt's comments hold a lot of weight.¶ Cheap natural gas has become the fuel of choice with electric utilities, making building expensive new nuclear plants an increasingly tough sell. The United States is awash in natural gas largely thanks to horizontal drilling and hydraulic fracturing, or "fracking" technology, which allows drillers to extract gas from shale deposits once considered too difficult to reach. In 2008, gas prices were approaching $13 per million BTUs; prices have now dropped to around $3. ¶ When gas prices were climbing, there were about 30 nuclear plant projects in various stages of planning in the United States. Now the Nuclear Energy Institute estimates that, at most, five plants will be built by 2020, and those will only be built thanks to favorable financing terms and the ability to pay for construction from consumers' current utility bills. Two reactors now under construction in Georgia, for example, moved ahead with the aid of an $8.33 billion loan guarantee from the U.S. Department of Energy. ¶ What happens after those planned projects is hard to predict. "The question is whether we'll see any new nuclear," says Revis James, the director of generation research and development at the Electric Power Research Institute. "The prospects are not good."¶ Outside the United States, it's a different story. Unconventional sources of natural gas also threaten the expansion of nuclear, although the potential impact is less clear-cut. Around the world, there are 70 plants now under construction, but shale gas also looms as a key factor in planning for the future. Prices for natural gas are already higher in Asia and Europe, and shale gas resources are not as fully developed as they are the United States.¶ Some countries are also blocking the development of new natural gas resources. France, for instance, which has a strong commitment to nuclear, has banned fracking in shale gas exploration because of concerns over the environmental impact.¶ Fast-growing China, meanwhile, needs all the energy sources available and is building nuclear power plants as fast as possible.¶ Even in United States, of course, super cheap natural gas will not last forever. With supply exceeding demand, some drillers are said to be losing money on natural gas, which could push prices back up. Prices will also be pushed upward by utilities, as they come to rely on more natural gas for power generation, says James.¶ Ali Azad, the chief business development officer at energy company Babcock & Wilcox, thinks the answer is making nuclear power smaller, cheaper, and faster. His is one of a handful of companies developing small modular reactors that can be built in three years, rather than 10 or more, for a fraction of the cost of gigawatt-size reactors. Although this technology is not yet commercially proven, the company has a customer in the Tennessee Valley Authority, which expects to have its first unit online in 2021 (see "A Preassembled Nuclear Reactor").¶ "When we arrive, we will have a level cost of energy on the grid, which competes favorably with a brand-new combined-cycle natural gas plants when gas prices are between $6 to $8," said Azad. He sees strong demand in power-hungry China and places such as Saudia Arabia, where power is needed for desalination.¶ Even if natural gas remains cheaper, utilities don't want to find themselves with an overreliance on gas, which has been volatile on price in the past, so nuclear power will still contribute to the energy mix. "[Utilities] still continue [with nuclear] but with a lower level of enthusiasm—it's a hedging strategy," says Hans-Holger Rogner from the Planning and Economics Studies section of the International Atomic Energy Agency. "They don't want to pull all their eggs in one basket because of the new kid on the block called shale gas."

### Oil Entanglement Add-on

#### Plan solves military oil entanglement

Buis ’12 (Tom Buis, CEO, Growth Energy, Co-written by Buis and Growth Energy Board Co-Chair Gen. Wesley K. Clark (Ret.), “American Families Need American Fuel”, <http://energy.nationaljournal.com/2012/05/powering-our-military-whats-th.php>, May 23, 2012)

**Our nation is dangerously dependent on foreign oil**. We import some 9 million barrels per day, or over 3 billion barrels per year; the **U.S. military itself comprises two percent of the nation’s total petroleum use**, making it the world’s largest consumer of energy and oil imports. **Of U.S. foreign oil imports, one out of five barrels comes from unfriendly nations and volatile areas**, including at least 20 percent stemming from the Persian Gulf, including Bahrain, Iraq, Iran, Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates. Further, our nation heavily relies on hot-beds of extremism, as Saudi Arabia, Venezuela, Nigeria are our third, fourth, and fifth, respectively, largest exporters of oil. How dangerous is this? Very! Not only does **America’s huge appetite for oil entangle us into complicated relationships with nations marred by unstable political, economic, and security situations**, it also gravely impacts our military, who risk their lives daily to protect foreign energy supply routes. **Because of** our addiction to oil**, we have been in almost** constant **military conflict**, lost more than 6,500 soldiers and created a whole new class of wounded warriors, thousands of whom will need long-term care funded by our government. One in eight soldiers killed or wounded in Iraq from 2003-2007 were protecting fuel convoys, with a total of 3,000 Army casualties alone. **We maintain extra military forces at an annual cost of about $150 billion annually, just to assure access to foreign oil** - **because we know** that **if** **that stream** of 9 million barrels per day **is** seriously **interrupted, our economy will crash. That's what I call dangerously dependent.** Even worse, according to a new Bloomberg Government analysis, Pentagon spending on fuel is dramatically increasing. This will force the military to dedicate even more funds toward energy costs, at the expense of other priorities, like training and paying soldiers. In fact, every $.25 increase in the cost of jet fuel makes a $1 billion difference in the Department of Defense’s bottom line – a debt that will be passed along to the American taxpayer. And if that's not enough to make you want to avoid foreign oil, then consider this: every dollar hike in the international, politically-rigged price of oil hands Iran about $3 million more per day, that their regime can use to sow mischief, fund terrorism, and develop missiles and nuclear weapons. Enough is enough! We have domestic alternatives that can protect American interests, and promote prosperity and security – including, more domestic oil production, using natural gas and biofuels, like ethanol, as fuel, converting coal to liquid fuel, and moving as rapidly as possible to vehicles powered by green energy. By introducing clean energy and **fuel alternatives**, this **would rapidly** reduce both the strain of securing foreign energy supply routes **in unstable regions, as well as** unnecessary economic and political entanglement with volatile regimes. It is imperative the U.S. military leverage its position as a leader and enact pertinent energy policies to best enhance American energy – and national – security.

#### These escalate

Collina ‘5 (Executive Director of 20-20 Vision, Tom Z. Collina, Executive Director of 20-20Vision; testimony in front of Committee on Foreign Relations Subcommittee on Near Eastern and South Asian Affairs United States Senate “Oil Dependence and U.S. Foreign Policy: Real Dangers, Realistic Solutions”. October 19, 2005 <http://www.globalsecurity.org/military/library/congress/2005_hr/051020-collina.pdf>)

More conflicts in the Middle East America imports almost 60% of its oil today and, at this rate, we’ll import 70% by 2025. Where will that oil come from? Two-thirds of the world’s oil is in the Middle East, primarily in Saudi Arabia, Iran and Iraq. **The United States has less than 3% of global oil. The Department of Energy predicts that North American oil imports from the Persian Gulf will double from 2001 to 2025**.i **Other oil suppliers**, such as Venezuela, Russia, and West Africa, **are also politically unstable and hold no significant long-term oil reserves compared to those in the Middle East**. Bottom line: **our economy and security are increasingly dependent on one of the most unstable regions on earth. Unless we change our ways, we will find ourselves even more at the mercy of Middle East oil and thus more likely to get involved in future conflicts**. **The greater our dependence** on oil, **the greater the pressure to protect and control that oil**. **The growing American dependence on imported oil is the primary driver of U.S.** foreign and **military policy** today, particularly in the Middle East, **and motivates an aggressive military policy** now on display in Iraq. **To help avoid similar wars in the future and to encourage a more cooperative, responsible, and multilateral foreign policy the United States must significantly reduce its oil use.** Before the Iraq war started, Anthony H. Cordesman of the Center for Strategic and International Studies said: “Regardless of whether we say so publicly, we will go to war, because Saddam sits at the center of a region with more than 60 percent of all the world's oil reserves.” Unfortunately, he was right. In fact, **the use of military power to protect the flow of oil has been a central tenet of U.S. foreign policy since 1945**. That was the year that President Franklin D. Roosevelt promised King Abdul Aziz of Saudi Arabia that the United States would protect the kingdom in return for special access to Saudi oil—a promise that governs U.S. foreign policy today. This policy was formalized by President Jimmy **Carter** in 1980 when he **announced that the secure flow of oil from the Persian Gulf was in “the vital interests of the United States of America” and that America would use “any means necessary, including military force” to protect those interests** from outside forces. This doctrine was expanded by President Ronald Reagan in 1981 to cover internal threats, and was used by the first President Bush to justify the Gulf War of 1990-91, and provided a key, if unspoken rationale for the second President Bush’s invasion of Iraq in 2003.ii The Carter/Reagan Doctrine also led to the build up of U.S. forces in the Persian Gulf on a permanent basis and to the establishment of the Rapid Deployment Force and the U.S. Central Command (CENTCOM). **The United States now spends over $50 Billion per year (in peacetime) to maintain our readiness to intervene in the Gulf.**iii **America has tried to address its oil vulnerability by using our military to protect supply routes and to prop up or install friendly regimes. But** as Iraq shows the price is astronomical—$200 Billion and counting. Moreover, **it doesn’t work**—**Iraq is now producing less oil than it did before the invasion.** While the reasons behind the Bush administration’s decision to invade Iraq may be complex, can anyone doubt that we would not be there today if Iraq exported coffee instead of oil? **It is time for a new approach.** Americans are no longer willing to support U.S. misadventures in the Persian Gulf. Recent polls show that almost two-thirds of Americans think the Iraq war was not worth the price in terms of blood and treasure. Lt. Gen William Odom, director of the National Security Agency during President Reagan's second term, recently said: "The invasion of Iraq will turn out to be the greatest strategic disaster in U.S. history." The nation is understandably split about what to do now in Iraq, but there appears to be widespread agreement that **America should not make the same mistake again—and we can take a giant step toward that goal by reducing our dependence on oil.**

## Solvency EXTs

### 2AC – Tech Now

#### Tech now- economically feasible

Wellock ’13 (Thomas Wellock, NRC Historian, “Floating Nuclear Power Plants: A Technical Solution to a Land-based Problem (Part I)”, <http://public-blog.nrc-gateway.gov/2013/09/24/floating-nuclear-power-plants-a-technical-solution-to-a-land-based-problem-part-i-2/>, September 24, 2013)

In July, Russia announced it planned to build the world’s first floating nuclear power plant to supply 70 megawatts of electricity to isolated communities. If successful, the plan would bring to fruition an idea hatched in the United States nearly a half-century ago. It’s not widely known, but in 1971, Offshore Power Systems (OPS), a joint venture by Westinghouse Corporation and Tenneco, proposed manufacturing identical 1,200 MW plants at a $200 million facility near Jacksonville, Fla. Placed on huge concrete barges, the plants would be towed to a string of breakwater-protected moorings off the East Coast. Using a generic manufacturing license and mass production techniques, Westinghouse President John Simpson predicted this approach could cut in half typical plant construction time and make floating reactors economical. While Simpson touted their economic advantages, utilities wanted floating power plants to overcome mounting opposition to land-based reactors. Site selection had ground to a near halt in the Northeast and the West Coast due to public opposition, seismic worries and environmental concerns. In July 1971, a federal court complicated siting further by forcing the NRC’s predecessor, the Atomic Energy Commission, to develop thorough Environmental Impact Statements for nuclear plant projects. In fact, West Coast utilities met defeat so often on proposed coastal power plant sites they turned inland in an ill-fated move to find acceptable arid locations. By heading out to sea, Northeast utilities hoped they could overcome their political problems. New Jersey’s Public Service Electric and Gas Corporation (PSEG) responded enthusiastically and selected the first site, the Atlantic Generating Station, about 10 miles north of Atlantic City at the mouth of Great Bay. A PSEG spokesman said floating reactors were “the only answer to the problem of siting nuclear power plants.” Other reactor vendors, including General Electric, also studied the possibility of floating reactors. A supportive regulatory response heartened OPS officials. The AEC’s Advisory Committee for Reactor Safeguards issued a fairly positive assessment of floating reactors in late 1972. “We think this is a very favorable letter,” a Westinghouse official said of the committee response, “and we don’t see any delay whatsoever.” Westinghouse moved forward with its grand plan and built its manufacturing facility near Jacksonville. The facility included a gigantic crane that was 38 stories high — the world’s tallest. It appeared to be smooth sailing ahead for floating plants with a RAND Corporation study that touted their superior ability to withstand earthquakes and other natural hazards. Spoiler alert: RAND selected for floating power plants one of the most ill-conceived yet prescient of acronyms, FLOPPS.

### Modelling Exts

#### And United States creates a massive export market for SMR’s – latent nuclear capability ensures speed- significant reduction of emissions

Rosner, Goldberg, and Hezir et. al. 2011 (Robert Rosner, Robert Rosner is an astrophysicist and founding director of the Energy Policy Institute at Chicago. He was the director of Argonne National Laboratory from 2005 to 2009, and Stephen Goldberg, Energy Policy Institute at Chicago, The Harris School of Public Policy Studies, Joseph S. Hezir, Principal, EOP Foundation, Inc “Small Modular Reactors – Key to Future Nuclear Power”, <http://epic.uchicago.edu/sites/epic.uchicago.edu/files/uploads/SMRWhite_Paper_Dec.14.2011copy.pdf>, November 2011)

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

#### Small reactors are key to jumpstarting a global industry –NRC sends a global signal

Michael Shellenberger September 7 2012 (president of the breakthrough institute, Jessica Lovering, policy analyst at the breakthough institute, Ted Nordhaus, chairman of the breakthrough institute. [“Out of the Nuclear Closet,” http://www.foreignpolicy.com/articles/2012/09/07/out\_of\_the\_nuclear\_closet?page=0,0)

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

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

James Traub December 4 2012 ( fellow of the Centre on International Cooperation. He writes Terms of Engagement for Foreign Policy,” “Transforming the future lies in our hands,” <http://gulfnews.com/opinions/columnists/transforming-the-future-lies-in-our-hands-1.1118704>

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

### Cost Share Exts

#### DOE cost sharing solves cost overrun- licensing and technology barriers have already been overcome – action *now* key to develop tech that will prevent a nuclear energy crunch in 2019 when licenses will exist

Marv Fertel April 8 2014 (NEI President and CEO, Nuclear Energy Institute, “Why DOE Should Back SMR Development”, <http://neinuclearnotes.blogspot.com/2014/04/why-doe-should-back-smr-development.html>,

Nuclear energy is an essential source of base-load electricity and 64 percent of the United States’ greenhouse gas-free electricity production. Without it, the United States cannot meet either its energy requirements or the goals established in the President’s Climate Action Plan. In the decades to come, we predict that the country’s nuclear fleet will evolve to include not only large, advanced light water reactors like those operating today and under construction in Georgia, Tennessee, and South Carolina, but also a complementary set of smaller, modular reactors. Those reactors are under development today by companies like Babcock &Wilcox (B&W), NuScale and others that have spent hundreds of millions of dollars to develop next-generation reactor concepts. Those companies have innovative designs and are prepared to absorb the lion’s share of design and development costs, but the federal government should also play a significant role given the enormous promise of small modular reactor technology for commercial and other purposes. Most important, partnerships between government and the private sector will enable the full promise of this technology to be available in time to ensure U.S. leadership in energy, the environment, and the global nuclear market. The Department of Energy’s Small Modular Reactor (SMR) program is built on the successful Nuclear Power 2010 program that supported design certification of the Westinghouse AP-1000 and General Electric ESBWR designs. Today, Southern Co. and South Carolina Electric & Gas are building four AP-1000s for which they submitted license applications to the Nuclear Regulatory Commission in 1998. Ten years earlier, in the early years of the Nuclear Power 2010 program, it was clear that there would be a market for the AP-1000 and ESBWR in the United States and overseas, but it would have been impossible to predict which companies would build the first ones, or where they would be built, and it was even more difficult to predict the robust international market for that technology. The SMR program is off to a promising start. To date, B&W’s Generation mPower joint venture has invested $400 million in developing its mPower design; NuScale approximately $200 million in its design. Those companies have made those investments knowing they will not see revenue for approximately 10 years. That is laudable for a private company, but, in order to prepare SMRs for early deployment in the United States and to ensure U.S. leadership worldwide, investment by the federal government as a cost-sharing partner is both necessary and prudent. Some have expressed concern about the potential market and customers for SMR technology given Babcock & Wilcox’s recent announcement that it will reduce its level of investment in the mPower technology, and thus the pace of development. This decision reflects B&W’s revised market assessment, particularly the slower-than-expected growth in electricity demand in the United States following the recession. But that demand will eventually occur, and the American people are best-served – in terms of cost and reliability of service – when the electric power industry maintains a diverse portfolio of electricity generating technologies. The industry will need new, low-carbon electricity options like SMRs because America’s electric generating technology options are becoming more challenging. For example: While coal-fired generation is a significant part of our base-load generation, coal-fired generation faces increasing environmental restrictions, including the likelihood of controls on carbon and uncertainty over the commercial feasibility of carbon capture and sequestration. The U.S. has about 300,000 MW of coal-fired capacity, and the consensus is that about one-fifth of that will shut down by 2020 because of environmental requirements. In addition, development of coal-fired projects has stalled: Less than 1,000 megawatts of new coal-fired capacity is under construction. Natural gas-fired generation is a growing and important component of our generation portfolio and will continue to do so given our abundant natural gas resources. However, prudence requires that we do not become overly dependent on any given energy source particularly in order to maintain long-term stable pricing as natural gas demand grows in the industrial sector and for LNG exports. Renewables will play an increasingly large role but, as intermittent sources, cannot displace the need for large-scale, 24/7 power options. Given this challenging environment, the electric industry needs as many electric generating options as possible, particularly zero-carbon options. Even at less-than-one-percent annual growth in electricity demand, the Energy Information Administration forecasts a need for 28 percent more power by 2040. That’s the equivalent of 300 one-thousand-megawatt power plants. America’s 100 nuclear plants will begin to reach 60 years of operation toward the end of the next decade. In the five years between 2029 and 2034, over 29,000 megawatts of nuclear generating capacity will reach 60 years. Unless those licenses are extended for a second 20-year period, that capacity must be replaced. If the United States hopes to contain carbon emissions from the electric sector, it must be replaced with new nuclear capacity. The runway to replace that capacity is approximately 10 years long, so decisions to replace that capacity with either large, advanced light-water reactors or SMRs must be taken starting in 2019 and 2020 – approximately the time that the first SMR designs should be certified by the Nuclear Regulatory Commission.

### A2 No Market

#### The plan jump starts the nuclear industry – government demonstrations key to investor confidence

William Madia 2012 (Chairman of the Board of Overseers and Vice President for the NAL at Stanford and was the Laboratory Director at the Oak Ridge National Laboratory and the Pacific Northwest National Laboratory) “SMALL MODULAR REACTORS: A POTENTIAL GAME-CHANGING TECHNOLOGY”, <http://energyclub.stanford.edu/index.php/Journal/Small_Modular_Reactors_by_William_Madia>,

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

### 2ac – Safety

#### Floating nuclear safe – no risk of accidents- use of pre-existing technology from offshore drilling and nuclear submarines mean fast development

David Chandler April 17 2014 (David L. Chandler, MIT News Office) “Floating Nuclear Plants Could Ride Out Tsunamis”, <http://theenergycollective.com/energyatmit/369266/floating-nuclear-plants-could-ride-out-tsunamis>,

When an earthquake and tsunami struck the Fukushima Daiichi nuclear plant complex in 2011, neither the quake nor the inundation caused the ensuing contamination. Rather, it was the aftereffects — specifically, the lack of cooling for the reactor cores, due to a shutdown of all power at the station — that caused most of the harm. A new design for nuclear plants built on floating platforms, modeled after those used for offshore oil drilling, could help avoid such consequences in the future. Such floating plants would be designed to be automatically cooled by the surrounding seawater in a worst-case scenario, which would indefinitely prevent any melting of fuel rods, or escape of radioactive material. Floating Nuclear Plants Cutaway view of the proposed plant shows that the reactor vessel itself is located deep underwater, with its containment vessel surrounded by a compartment flooded with seawater, allowing for passive cooling even in the event of an accident. Illustration courtesy of Jake Jurewicz/MIT-NSE The concept is being presented this week at the Small Modular Reactors Symposium, hosted by the American Society of Mechanical Engineers, by MIT professors Jacopo Buongiorno, Michael Golay, and Neil Todreas, along with others from MIT, the University of Wisconsin, and Chicago Bridge and Iron, a major nuclear plant and offshore platform construction company. Such plants, Buongiorno explains, could be built in a shipyard, then towed to their destinations five to seven miles offshore, where they would be moored to the seafloor and connected to land by an underwater electric transmission line. The concept takes advantage of two mature technologies: light-water nuclear reactors and offshore oil and gas drilling platforms. Using established designs minimizes technological risks, says Buongiorno, an associate professor of nuclear science and engineering (NSE) at MIT. Although the concept of a floating nuclear plant is not unique — Russia is in the process of building one now, on a barge moored at the shore — none have been located far enough offshore to be able to ride out a tsunami, Buongiorno says. For this new design, he says, “the biggest selling point is the enhanced safety.” A floating platform several miles offshore, moored in about 100 meters of water, would be unaffected by the motions of a tsunami; earthquakes would have no direct effect at all. Meanwhile, the biggest issue that faces most nuclear plants under emergency conditions — overheating and potential meltdown, as happened at Fukushima, Chernobyl, and Three Mile Island — would be virtually impossible at sea, Buongiorno says: “It’s very close to the ocean, which is essentially an infinite heat sink, so it’s possible to do cooling passively, with no intervention. The reactor containment itself is essentially underwater.” Buongiorno lists several other advantages. For one thing, it is increasingly difficult and expensive to find suitable sites for new nuclear plants: They usually need to be next to an ocean, lake, or river to provide cooling water, but shorefront properties are highly desirable. By contrast, sites offshore, but out of sight of land, could be located adjacent to the population centers they would serve. “The ocean is inexpensive real estate,” Buongiorno says. In addition, at the end of a plant’s lifetime, “decommissioning” could be accomplished by simply towing it away to a central facility, as is done now for the Navy’s carrier and submarine reactors. That would rapidly restore the site to pristine conditions. This design could also help to address practical construction issues that have tended to make new nuclear plants uneconomical: Shipyard construction allows for better standardization, and the all-steel design eliminates the use of concrete, which Buongiorno says is often responsible for construction delays and cost overruns. There are no particular limits to the size of such plants, he says: They could be anywhere from small, 50-megawatt plants to 1,000-megawatt plants matching today’s largest facilities. “It’s a flexible concept,” Buongiorno says. Most operations would be similar to those of onshore plants, and the plant would be designed to meet all regulatory security requirements for terrestrial plants. “Project work has confirmed the feasibility of achieving this goal, including satisfaction of the extra concern of protection against underwater attack,” says Todreas, the KEPCO Professor of Nuclear Science and Engineering and Mechanical Engineering. Buongiorno sees a market for such plants in Asia, which has a combination of high tsunami risks and a rapidly growing need for new power sources. “It would make a lot of sense for Japan,” he says, as well as places such as Indonesia, Chile, and Africa. This is a “very attractive and promising proposal,” says Toru Obara, a professor at the Research Laboratory for Nuclear Reactors at the Tokyo Institute of Technology who was not involved in this research. “I think this is technically very feasible. ... Of course, further study is needed to realize the concept, but the authors have the answers to each question and the answers are realistic.”

### 2AC – A2 Meltdowns

No risk of meltdowns.

Beller, ‘4

[Dr. Denis E., Department of Mechanical Engineering -- UNLV, “Atomic Time Machines: Back to the Nuclear Future,” 24 J. Land Resources & Envtl. L. 41, Lexis]

No caveats, no explanation, not from this engineer/scientist. It's just plain safe! All sources of electricity production result in health and safety impacts. However, at the National Press Club meeting, Energy Secretary Richardson indicated that nuclear power is safe by stating, "I'm convinced it is." [45](http://www.lexis.com/research/retrieve?_m=4a9f74e9d68358dde5b1da7c76fcc08d&docnum=42&_fmtstr=FULL&_startdoc=1&wchp=dGLbVlz-zSkAB&_md5=b940f69f179ebb657dc94d1baf8c0fbd" \l "n45" \t "_self) Every nuclear scientist and engineer should agree with that statement. Even mining, transportation, and waste from nuclear power have lower impacts because of the difference in magnitude of materials. In addition, emissions from nuclear plants are kept to near zero. [46](http://www.lexis.com/research/retrieve?_m=4a9f74e9d68358dde5b1da7c76fcc08d&docnum=42&_fmtstr=FULL&_startdoc=1&wchp=dGLbVlz-zSkAB&_md5=b940f69f179ebb657dc94d1baf8c0fbd" \l "n46" \t "_self) If you ask a theoretical scientist, nuclear energy does have a potential tremendous adverse impact. However, it has had that same potential for forty years, which is why we designed and operate nuclear plants with multiple levels of containment and safety and multiple backup systems. Even the country's most catastrophic accident, the partial meltdown at Three Mile Island in 1979, did not injure anyone. [47](http://www.lexis.com/research/retrieve?_m=4a9f74e9d68358dde5b1da7c76fcc08d&docnum=42&_fmtstr=FULL&_startdoc=1&wchp=dGLbVlz-zSkAB&_md5=b940f69f179ebb657dc94d1baf8c0fbd" \l "n47" \t "_self) The fact is, Western-developed and Western-operated nuclear power is the safest major source of electricity production. Haven't we heard enough cries of "nuclear wolf" from scared old men and "the sky is radioactive" from [\*50] nuclear Chicken Littles? We have a world of data to prove the fallacy of these claims about the unsafe nature of nuclear installations. [SEE FIGURE IN ORIGINAL] Figure 2. Deaths resulting from electricity generation. [48](http://www.lexis.com/research/retrieve?_m=4a9f74e9d68358dde5b1da7c76fcc08d&docnum=42&_fmtstr=FULL&_startdoc=1&wchp=dGLbVlz-zSkAB&_md5=b940f69f179ebb657dc94d1baf8c0fbd" \l "n48" \t "_self) Figure 2 shows the results of an ongoing analysis of the safety impacts of energy production from several sources of energy. Of all major sources of electricity, nuclear power has produced the least impact from real accidents that have killed real people during the past 30 years, while hydroelectric has had the most severe accident impact. [49](http://www.lexis.com/research/retrieve?_m=4a9f74e9d68358dde5b1da7c76fcc08d&docnum=42&_fmtstr=FULL&_startdoc=1&wchp=dGLbVlz-zSkAB&_md5=b940f69f179ebb657dc94d1baf8c0fbd" \l "n49" \t "_self) The same is true for environmental and health impacts. [50](http://www.lexis.com/research/retrieve?_m=4a9f74e9d68358dde5b1da7c76fcc08d&docnum=42&_fmtstr=FULL&_startdoc=1&wchp=dGLbVlz-zSkAB&_md5=b940f69f179ebb657dc94d1baf8c0fbd" \l "n50" \t "_self) Of all major sources of energy, nuclear energy has the least impacts on environment and health while coal has the greatest. [51](http://www.lexis.com/research/retrieve?_m=4a9f74e9d68358dde5b1da7c76fcc08d&docnum=42&_fmtstr=FULL&_startdoc=1&wchp=dGLbVlz-zSkAB&_md5=b940f69f179ebb657dc94d1baf8c0fbd" \l "n51" \t "_self) The low death [\*51] rate from nuclear power accidents in the figure includes the Chernobyl accident in the Former Soviet Union. [52](http://www.lexis.com/research/retrieve?_m=4a9f74e9d68358dde5b1da7c76fcc08d&docnum=42&_fmtstr=FULL&_startdoc=1&wchp=dGLbVlz-zSkAB&_md5=b940f69f179ebb657dc94d1baf8c0fbd" \l "n52" \t "_self)

#### Nuclear power is safe -- no meltdowns and no impact.

Svoboda, ‘10

[Elizabeth, Popular Mechanics, “Debunking the Top 10 Energy Myths”, 7-7, http://www.popularmechanics.com/science/energy/debunking-myths-about-nuclear-fuel-coal-wind-solar]

Myth No. 1 Nuclear Power Isn't a Safe Solution In a recent national poll, 72 percent of respondents expressed concern about potential accidents at nuclear power plants. Some opinion-makers have encouraged this trepidation: Steven Cohen, executive director of Columbia University's Earth Institute, has called nuclear power "dangerous, complicated and politically controversial." During the first six decades of the nuclear age, however, fewer than 100 people have died as a result of nuclear power plant accidents. And comparing modern nuclear plants to Chernobyl—the Ukrainian reactor that directly caused 56 deaths after a 1986 meltdown—is like comparing World War I fighter planes to the F/A-18. Newer nuclear plants, including the fast reactor now being developed at Idaho National Laboratory (INL), contain multiple auto-shutoff mechanisms that reduce the odds of a meltdown exponentially—even in a worst-case scenario, like an industrial accident or a terrorist attack. And some also have the ability to burn spent fuel rods, a convenient way to reuse nuclear waste instead of burying it for thousands of years. Power sources such as coal and petroleum might seem safer than nuclear, but statistically they're a lot deadlier. Coal mining kills several hundred people annually—mainly from heart damage and black lung disease, but also through devastating accidents like the April mine explosion in West Virginia. The sublethal effects of coal-power generation are also greater. "The amount of radiation put out by a coal plant far exceeds that of a nuclear power plant, even if you use scrubbers," says Gerald E. Marsh, a retired nuclear physicist who worked at Argonne National Laboratory. Particulate pollution from coal plants causes nearly 24,000 people a year to die prematurely from diseases such as lung cancer. Petroleum production also has safety and environmental risks, as demonstrated by the recent oil spill in the Gulf of Mexico. INL nuclear lab's deputy associate director, Kathryn McCarthy, thinks the industry can overcome its stigma. "It's been a long time since Chernobyl and Three Mile Island," McCarthy says, "and people are willing to reconsider the benefits of nuclear energy." Nuclear plants emit only a tiny fraction of the carbon dioxide that coal plants do, and a few hundred nuclear facilities could potentially supply nearly all the energy the United States needs, reducing our dependence on fossil fuels.

## Topicality

### 2AC T- “Non Military”

#### We meet- floating SMRs would be used for civilian and commercial purposes by the DOD

#### We meet- they would be owned by the DOE- thus could only be used to assist the DOD- makes it an effect and not a mandate of the plan- they conflate solvency and topicality- any affirmative that won a spill over claim would be untopical- kills logical affirmatives

#### Non-military is an adverb- their interpretation leads to a slippery slope that makes everything potentially untopical- non-military just means how its used not by whom

Malykhina 3/10 (Elena Malykhina began her career at The Wall Street Journal, and her writing has appeared in various news media outlets, including Scientific American, Newsday, and the Associated Press. For several years, she was the online editor at Brandweek and later Adweek. “Drones In Action: 5 Non-Military Uses”, <http://www.informationweek.com/government/mobile-and-wireless/drones-in-action-5-non-military-uses/d/d-id/1114175?image_number=3>, March 10, 2014)

At the moment, almost all commercial drones are banned by the FAA. But that should change in 2015, when the agency expects to release its guidelines for safely operating drones. In the meantime, government agencies, a number of universities, and a handful of private companies are putting robotic aircraft to good use -- and in some cases challenging the FAA's authority. A judge agreed March 6 the FAA had overreached fining businessman Raphael Pirker, who used a model aircraft to take aerial videos for an advertisement. The judge said the FAA lacked authority to apply regulations for aircraft to model aircraft. That may open the skies to a lot more privately controlled drones.

#### Default to reasonability- good is good enough- we aren’t stealing negative ground- specifying DOE solves- still get DOD CP

### 2AC T- Development

#### We meet- the plan increases development of the oceans through investment in float nuclear power

#### Counter-interpretation- development includes building things

Merriam-Webster No Date (<http://www.merriam-webster.com/dictionary/development>)

Full Definition of DEVELOPMENT 1 : the act, process, or result of developing <development of new ideas> <an interesting development> 2 : the state of being developed <a project in development> 3 : a developed tract of land; especially : one with houses built on it

#### Includes economic development

Longman No Date (Online Dictionary, <http://www.ldoceonline.com/Geography-topic/development>)

de‧vel‧op‧ment

1growth [uncountable] the process of gradually becoming bigger, better, stronger, or more advanced:

British Englishchild development

development of

British Englisha course on the development of Greek thought

professional/personal development

American Englishopportunities for professional development

2 economic activity [uncountable] the process of increasing business, trade, and industrial activity

economic/industrial/business etc development

#### Our topic is best- their interpretation kills best affirmative grounds- better debates outweigh more limited ones- the topic says development *of* the ocean- not the ocean itself- means their interpretation is contrived

#### Default to reasonability- good is good enough- competing interpretations incentivize a race to the bottom