ARTICLE

The National Security Threat of Energy Dependence: A Call for a Nuclear Renaissance

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Introduction

The Gulf of Mexico oil spill spread like a cancer, devastating thousands of American livelihoods, and wrecking havoc on this country's ecosystem. This disaster has brought into focus what many have for years called the greatest national security threat to the United States — its addiction to and utter dependence on oil to maintain the American way of life.

One only has to look out the window in any city in the United States to see that oil has a dramatic effect on how the United States does business. The people living near the Gulf now know this truth all too well. Consequently, energy dependence is a problem that can no longer be ignored or pushed off to the next generation, as American policy has done for the better half of a century. Because this dependence on oil enables the types of disasters seen in the Gulf and Alaska over a decade earlier, and fuels terrorism that can lead to a kinetic threat, the United States must change its mentality towards other energy sources. For the purposes of this article the focus will be nuclear energy. Specifically, the United States must develop

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and implement safe nuclear energy alternatives in order to reduce its dependence on oil and increase its national security from both terrorism and the environmental threat.

This article will begin with an explanation of both the environmental and foreign threats that energy dependency poses to the United States. Next, this article will argue that a nuclear renaissance would greatly increase the national security of the United States. The evidence will demonstrate that turning to nuclear generated energy to meet more of this nation's energy needs is a logical choice, because the technology to make large amounts of energy with a nuclear reaction is available now. But fully realizing such an energy renaissance requires dedicating more resources to nuclear technology and innovation. These resources, and the resulting innovation, will only come where there is demand. For example, Americans use lighter, faster, and more powerful computers today than they did ten years ago only because consumers demanded that such computers be built, which in turn motivated the industry to invent them. The same is true for nuclear energy: the non-critical reactor, which is the most promising nuclear technology available today, will only be built and improved upon if there is a demand for it.

Next, this article will discuss the three oft-cited drawbacks to nuclear energy: the disposal of nuclear waste, the safety of nuclear technology, and the threat of nuclear weapons proliferation. As this article will show, the benefit in increased national security to this country outweighs the potential problems that result from each of these concerns. Ultimately, this article will demonstrate how nuclear energy can help alleviate this threat by divesting America from foreign economies that hold the United States in contempt and shifting the oil-based national attitude toward nuclear energy. In addition, the probability of future oil spills like the one in the Gulf can be lessened if the demand for oil were reduced. Lastly, this article will conclude by exploring the energy decision-making process used in this country with regards to energy policy and suggest changes to that process in order to make America safer. More specifically, this article argues that more is needed then just a list of ideas and solutions to energy dependency — the United States needs to make a paradigm shift in the way it thinks and makes decisions about energy policy.

I. The National Security Implications of Energy Dependence

A. Addicted to Oil

The United States' economy is built heavily on the transportation industry, with the combustible engine as the reigning king.[1] As a result, oil plays a vital role in the United States economy.[2] Moreover, "not only do automobiles play a central role in the nation's economy as the primary source of transportation, but cars, trucks, and SUVs are essential to the American conception of mobility and personal autonomy."[3] This concept is inescapably linked to the American dogma of securing personal prosperity and suburban living.[4] Indeed, "the current economic recession has highlighted the importance of the automotive industry" in the United States.[5] There are 1.7 million individuals that are employed directly by the automotive industry and an additional 8 million jobs related to the sector.[6] In addition to jobs, the "automotive industry spends $16 to $18 billion dollars a year on research and product development, half a trillion dollars on employee compensation, and is a major driver of the overall manufacturing contribution to the GDP."[7] Kim Hill, the director of the Sustainable Transportation and Communities group at the Center for Automotive Research, a nonprofit research organization, stated "[i]t is difficult to imagine manufacturing surviving in this country without the automotive sector."[8] Hill added that "[t]he industry's impact is huge on a host of other sectors as diverse as raw materials, construction, machinery, legal, computers and semiconductors, financial, advertising, healthcare and education. In this time of national introspection concerning the value of the U.S.-based auto industry, it is clear the value is quite high."[9]

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[1] *See generally* Michael H. Schuitema, *Road Pricing as a Solution to the Harms of Traffic Congestion*, 34 TRANSP. L.J. 81, 83 (2007).
[2] *Id.*
[3] *Id.*
[4] *See id.*
[5] *Auto Industry Contributes Significantly to U.S. Economy, Employment, Study Says*, AFTERMARKET BUSINESS (Apr. 26, 2010), http://aftermarketbusiness.search-autoparts.com/aftermarketbusiness/Distribution/Auto-industry-contributes-significantly-to-US-econ/ArticleStandard/Article/detail/666647.
[6] *Id.*
[7] *Id.*
[8] *Id.*
[9] *Id.*

Accordingly, because the wealth of the United States is what gives it the ability to project power and influence around the world, the central role our oil-based automobile industry plays in our economy has the result of fusing our national security with our energy security.

This principle was validated when, for example, Saddam Hussein, then-dictator of Iraq, declared on April 8, 2002, that Iraq would halt its exports of oil for thirty days or until Israel stopped its military operations in Palestine.[10] Soon thereafter, Libya and Iran also declared they would halt oil exports "if other Muslim oil-exporting states joined the effort to use oil as a political weapon against Israel."[11] These declarations caused tremendous turmoil in the oil industry, which in turn, resulted in a spike in the price of a barrel of crude oil.[12] It was not until Saudi Arabia decided to increase its own production to counter Iraq's "oil weapon" that the prices returned to previous levels.[13]

Venezuela is the fourth largest exporter of oil to the United States, supplying over ten percent of this country's supply, despite the fact that President Hugo Chavez is an outspoken critic of the United States.[14] The oil market was once again turned upside down when Venezuelan oil workers went on strike.[15] Venezuela continues to be a disruptive factor in the oil business. Recently, President Chavez has warned that there would be "devastating consequences and send oil prices soaring" if the United States or its allies used military force against Iran to stop Iran's development of

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[10] CHARLI COON & JAMES PHILLIPS, THE HERITAGE FOUNDATION, STRENGTHENING NATIONAL ENERGY SECURITY BY REDUCING DEPENDENCE ON IMPORTED OIL (Apr. 24, 2002), *available at* http://www.heritage.org/research/reports/2002/04/reducing-dependence-on-imported-oil

[11] *Id.* at 10.

[12] *Id.* The price of a barrel of oil rose to $27.23 on the New York stock exchange, which by today's standards of $140 per barrel does not seem all that momentous. *Id.*

[13] *Id.*

[14] *See Chavez Warns US Over Iran Policy*, BBC NEWS, May 14, 2006, http://news.bbc.co.uk/2/hi/americas/4771229.stm. On the same trip that President Chavez warned the world about an Iran strike, he "called for a socialist new world order and said nations were cowards for not standing up to the 'American empire.'" *Id.; see also* Steven Mufson, *This Time, It's Different*, WASH. POST, July 27, 2008, http://www.washingtonpost.com/wp-dyn/content/article/2008/07/26/AR2008072601025.html [hereinafter *This Time*].

[15] Annie Schleicher, *Venezuelan Oil Strike*, PBS NEWSHOUR EXTRA (Jan. 22, 2003), http://www.pbs.org/newshour/extra/features/jan-june03/venezuela.html.

nuclear weapons.[16] The United States has no choice but to pay heed to such statements because of our dependence on Venezuelan oil. This kind of rhetoric is more troubling given the previously mentioned fact that Venezuela is the fourth largest exporter of oil to the United States.[17] Moreover, Venezuela is not the only oil-supplying country whose foreign policy reveals ill feelings toward the United States. Saudi Arabia, Venezuela, Nigeria, Iraq, and Angola are among America's top ten oil importers, who along with the more friendly countries of Canada, Mexico, Algeria, Brazil, and Kuwait, furnish seventy-five percent of the United States' oil supply, which according to current forecasts is expected to rise an additional forty-four percent by 2025.[18]

Compounding these numbers is the prediction from the Department of Energy that the United States will become even more dependent on oil from unstable and hostile countries, particularly those in the volatile Middle East.[19] Today, the United States imports roughly thirty percent of its oil from the Middle East.[20] Considering that the five countries with the largest oil stockpiles are Saudi Arabia, Iran, Iraq, Kuwait, and the United Arab Emirates, that number can only increase as time goes on.[21] It is more apparent than ever that the United States is increasingly dependent on countries for its most valuable commodity that are either openly hostile, or have conflicting objectives, to that of the United States.[22] In 1973, during the first oil embargo, the United States imported only 4.9 percent of its oil from the Middle East,[23] yet the oil embargo wreaked havoc. Consider how

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[16] *Chavez Warns US Over Iran Policy*, *supra* note 14.

[17] *See id.* On the same trip that President Chavez warned the world about an Iran strike, he "called for a socialist new world order and said nations were cowards for not standing up to the 'American empire.'" *Id; see also This Time*, *supra* note 14.

[18] *Chavez Warns US Over Iran Policy*, *supra* note 14.; *see also Safe, Strong and Secure: Reducing America's Oil Dependence*, NAT. RESOURCES DEF. COUNCIL, http://www.nrdc.org/air/transportation/aoilpolicy2.asp (last visited Nov. 24, 2010) (finding that "[w]hile domestic oil production peaked in the 1970s, consumption continues to grow at break-neck speed. In 2025 the United States is projected to consume 28.3 million barrels a day — 44 percent more oil than we do today. . . .").

[19] *See* COON & PHILLIPS, *supra* note 10.

[20] *This Time*, *supra* note 14.

[21] Steven Mufson, *Calif. Field Goes from Rush to Reflection of Global Limits*, WASH. POST, July 29, 2008, http://www.washingtonpost.com/wp-dyn/content/article/2008/07/28/AR2008072802905.html [hereinafter *California Field*].

[22] *Id.*

[23] Jim Hartnett, *National Energy Policy: Its History and the Need for an Increased Gasoline Tax*, 28 CAL. W. L. REV. 81, 83 (1992) (stating that "[i]n 1973, 36% of oil used in this country was

much greater the impact would be today when that number has increased six-fold.[24]

Another crucial factor to be considered is the fact that oil itself is becoming harder to find.[25] Compounding this problem is the consensus among experts that energy dependence worldwide is going to increase in the future; specifically states like China, whose thirst for oil is increasing at a tremendous rate.[26] Indeed, China is expected to be consuming 286 metric tons of oil by 2015, compared with 216 metric tons in 2010.[27] Despite this increase in consumption, the world's production of oil is expected to decrease.[28] The *Washington Post* reported that much of the world's "global oil comes from mature fields that are now approaching their peaks or are already in decline. Worldwide, output from existing fields is falling by as much as eight percent per year, which means oil companies must develop seven million barrels more a day to keep current output steady . . . ."[29] In addition, the amount of new fields being "discovered each year has steadily declined since the early 1960s."[30]

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imported oil . . . only 4.9% of the oil we used in this country in 1973 came from Arab nations belonging to the Organization of Petroleum Exporting Countries. . . .").

[24] The United States economy was again thrown into a tail spin in 1979, when the Iranian Revolution disrupted Middle East oil supplies. Unemployment increased to eight percent and inflation jumped to nine percent. COON & PHILLIPS, *supra* note 10.

[25] *See* Peter Fowler, *Obama Says World "Running Out" of Oil*, NEWSROOM AMERICA (Jun. 15, 2010), http://www.newsroomamerica.com/story/23181.html [hereinafter *Running Out of Oil*]; *California Field*, *supra* note 21.

[26] *See* Rachel Graham, *IEA Raises 2011 Global Oil Demand Forecast for a Third Month, Citing China*, BLOOMBERG (Dec. 10, 2010), http://www.bloomberg.com/news/2010-12-10/iea-raises-2011-global-oil-demand-forecast-for-a-third-month-citing-china.html.

[27] *China's Oil Demand Forecast to Grow at 5-6% Annually in 2011-15*, TRADINGMARKETS.COM (Nov. 30, 2010), http://www.tradingmarkets.com/news/stock-alert/snp_china-s-oil-demand-forecast-to-grow-at-5-6-annually-in-2011-15-1336201.html (estimating that China's "oil demand will reach 286 million metric [tons] and 336 million metric tons in 2015 and 2020 respectively, compared with the demand estimated at around 216 million metric tons in 2010."); *see also Energy Units*, BIOENERGY FEEDSTOCK INFORMATION NETWORK, http://bioenergy.ornl.gov/papers/misc/energy_conv.html (last visited Dec. 21, 2010) (stating that one ton of oil is the equivalent to 7.2 barrels of oil).

[28] *California Field*, *supra* note 21.

[29] *This Time*, *supra* note 14.

[30] *Id.*

Hence, regardless of where it comes from, because oil is such a crucial substance to the American way of life, the fact that accessible oil fields are becoming harder to exploit is a national security concern.[31]

B. Oil and War

"The decision to commit armed forces to war is the most momentous any leader can take."[32] The decision severely impacts both the war-making country's own citizens, especially the ones in uniform, and the citizenry of the country against whom war is made. The intent of this article is not to debate nor proffer an opinion on whether the decision by President George W. Bush to invade Iraq was the right one. This article's position is that the facts indicate that the decision was made, at least in part, because Iraq is a country of great oil wealth and stabilizing that wealth is in America's interests. President Bush's father, President George H.W. Bush, offered such a reason for his decision to remove Saddam Hussein from Kuwait, saying it would be unacceptable to have Hussein in Kuwait because it would put him in control of twenty percent of the world's oil reserves, and place him only twenty-five miles from another twenty-five percent of the world's oil reserves in Saudi Arabia.[33] Hence, America's leaders have decided that oil stability, at least in some circumstances, is a legitimate reason for going to war.[34]

Regardless of the reality behind the current Iraq war, the fact that many Americans and citizens of the world believe that oil was a paramount reason for invading Iraq makes the issue a significant concern.[35] Consequently, the willingness of the United States to fight wars over oil,

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[31] *See Running Out of Oil*, *supra* note 25; *see also California Field*, *supra* note 21.
[32] FOREIGN AFFAIRS COMMITTEE, THE DECISION TO GO TO WAR IN IRAQ, 2002-3, H.C. 813-I, at 7 (U.K.).
[33] Michael Klare, *Bush-Cheney Energy Strategy: Procuring the Rest of the World's Oil*, COMMONDREAM (Jan. 2004), http://www.commondreams.org/views04/0113-01.htm.
[34] *See id.*
[35] *See, e.g.*, James E. Hickey Jr., *Reviving the Nuclear Power Option in the U.S.: Using Domestic Energy Law to Cure Two Perceptions of International Law Illegality*, 35 HOFSTRA L. REV. 425, 435 (2006) (stating that there is a "widely held perceptions, right or wrong, that the United States violated international law on the use of force by invading Iraq to secure foreign oil sources and that it now is violating the letter and spirit of the emerging international law regime to deal with climate change."); Graham Paterson, *Alan Greenspan Claims Iraq War Was Really for Oil*, TIMES ONLINE (Sept. 16, 2007), http://www.timesonline.co.uk/tol /news /world/article2461214.ece.

whether real or perceived, indicates that under the very definition of "war," oil dependence is an imperative national security concern.

Moreover, the decrease in production and the increase in demand do not include future natural disasters, political unrest, and war, which in the past have proven to critically impact demand and production.[36] This thirst for oil by countries, balanced with the dwindling supply of oil as demand increases, creates a serious national security threat. After all, most wars are fought when two countries want the same thing, whether that be control of land, people, or natural resources.[37]

C. Oil and Terrorism

Today, groups of Islamic fundamentalists who use terrorism as a means to an end comprise one of the greatest threats to the United States' security.[38] However, the countries that give the most financial support to these terrorist groups, Saudi Arabia,[39] Iran,[40] and Iraq (before the 2003 invasion),[41] are the same countries that hold over forty percent of the world's oil reserves.[42] As an illustration of this point, fifteen of the nineteen September 11th hijackers were from Saudi Arabia.[43]

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[36] *See* Hickey, *supra* note 35, at 435.

[37] *See* Raimo Vayrynen, *Environment, Violence, and Political Change*, 15 NOTRE DAME J.L. ETHICS & PUB. POL'Y 593, 602–03 (2001).

[38] *See* Ravi Mahalingam, *Women's Rights and the "War on Terror": Why the United States Should View the Ratification of CEDAW as an Important Step in the Conflict with Militant Islamic Fundamentalism*, 34 CAL. W. INT'L L.J. 171, 208–09 (2004).

[39] *See Fueling Terror*, INST. FOR THE ANALYSIS FOR GLOBAL SECURITY, http://www.iags.org/fuelingterror.html (last visited Nov. 24, 2010).

[40] *See id.*

[41] *See* JENNIFER K. ELSEA, CONG. RESEARCH SERV., LAWSUITS AGAINST STATE SUPPORTERS OF TERRORISM: AN OVERVIEW 1 n.1 (2008) (listing Iraq as on the U.S. State Department's List of State Sponsors of Terrorism until removed in 2004).

[42] *George Bush – The Persian Gulf War*, PROFILES OF U.S. PRESIDENTS, http://www.presidentprofiles.com/Kennedy-Bush/George-Bush-The-persian-gulf-war.html (last visited Nov. 3, 2010).

[43] *Official: 15 of 19 Sept. 11 Hijackers Were Saudi*, USA TODAY, Feb. 6, 2002, http://www.usatoday.com/news/world/2002/02/06/saudi.htm. It is true that al-Qaeda has been attempting to overthrow the Saudi monarchy. Glen Carey & Mourad Haroutunian, *Al-Qaeda Seeks Overthrow of Saudi Arabia Monarchy, Killing of Christians*, BLOOMBERG (Aug. 11, 2010), http://www.bloomberg.com/news/2010-08-11/al-qaeda-seeks-overthrow-of-saudi-arabia-monarchy-killing-of-christians.html. However, "Saudi Arabia [still] remains the world's leading source of money for Al Qaeda and other extremist networks and has failed to take key steps requested by U.S. officials to stem the flow. . . ."

What is unique about the United States' dependency on foreign oil is that it allows such a vital national security interest to be controlled by other countries. The United States would never accept a system in which its national defense weapons *had* to be imported from hostile countries.[44] Yet the energy addiction of the United States has rendered its leaders seemingly oblivious to this obvious dual standard. For example, at the apex of the tension between Iraq and the United States, before the 2003 invasion, the United States was the number one importer of Iraqi oil. In other words, this country imported a great deal of oil from a sworn enemy, a country then-President Bush declared was a member of the axis of evil.[45]

The oil-supplying countries are wholly conscious of this chink in the United States' armor. Without doubt, the possibility of increasing his power and influence by controlling more oil in the world was a major factor for Saddam Hussein's decision to invade Kuwait.[46] Even allies in the Middle East, such as Saudi Arabia, use the United States' dependence on their oil as a method to get the superpower to act in their interest, a prime example being the first Gulf War.[47]

Moreover, these "friendly" countries have begun to realize that their own internal vulnerabilities — most significantly Islamic fundamentalists — are partly due to what is seen as an appeasement policy toward the United

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Josh Meyer, *Saudis Faulted for Funding Terror*, L.A. TIMES, Apr. 2, 2008, http://articles.latimes.com/2008/apr/02/nation/na-terror2.

[44] Officially, Saudi Arabia is an ally of the United States, yet unofficially the relationship is ambiguous and has been described as "'the ultimate marriage of convenience' which [is] now threatened. . . ." SHERIFA ZUHUR, U.S. ARMY WAR COLLEGE, SAUDI ARABIA: ISLAMIC THREAT, POLITICAL REFORM, AND THE GLOBAL WAR ON TERROR 39 (2005). While many in Saudi Arabia want to continue the close relationship with the United States, others see the dependence on the American military as "detrimental to Arab and Muslim unity. . . ." *Id.* at 39–40.

[45] COON & PHILLIPS, *supra* note 10 (stating that in 2000 "[d]isturbingly, despite its hard-line policy on Iraq, the United States is the biggest consumer of Iraqi crude oil, buying more than half of Iraq's oil exports and providing Baghdad with a rich source of funding.")

[46] *See* Rosemary E. Libera, *Divide, Conquer, and Pay: Civil Compensation for Wartime Damages*, 24 B.C. INT'L & COMP. L. REV. 291, 292 (2001).

[47] *See* John D. Z. Waszak, *The Obstacles to Suppressing Radical Islamic Terrorist Financing*, 36 CASE W. RES. J. INT'L L. 673, 705–07 (2004); *see also George Bush - The Persian Gulf War*, *supra* note 42.

States.[48] As a result, the internal strife of these nations threatens the flow of oil to the United States, which in turn "forces" the United States to become even more involved in the governance of Middle East allies in order to protect its oil interests, thereby pouring more fuel on the fire on the radical groups' message, creating a vicious cycle.[49]

The dependence on a critical national resource that is controlled by sometimes volatile, unfriendly, or unstable nations will only cause more strife for the United States in the future. In order to forestall this crisis, a new energy source that either replaces or supplements oil must be developed.

D. Oil and the Environment

Not only does buying oil from hostile countries fund the enemy, but burning that oil has led to global warming, an environmental impact that many believe transcends each individual nation's security interests and is a world crisis.[50] Climate change has moved from a pure environmental

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[48] *See* RACHEL BRONSON, THICKER THAN OIL: AMERICA'S UNEASY PARTNERSHIP WITH SAUDI ARABIA, 14–18 (2006); *see also* Waszak, *supra* note 47, at 706–07 (postulating that the heavy reliance on Saudi Arabian investment and oil supplies explains "why American policy has been as favorable as possible to Saudi Arabia, despite American criticism of Saudi Arabian counterterrorism efforts as seriously flawed." (footnotes and internal quotation marks omitted)).

[49] *See generally id. But see* GRAHAM ALLISON, NUCLEAR TERRORISM: THE ULTIMATE PREVENTABLE CATASTROPHE 42 (2004). Allison argues that even if we left these countries to their own devices and became totally energy independent, through for example nuclear power, these groups would still make war with the West. According to Allison:

> What all of these groups have in common is hatred of the United States or the West, along with sophisticated organizational structures and access to technical know-how. Though some observers may argue that a shift in American policies or activities might stem this hatred and thus diminish the threat, the uncomfortable fact is that being the world's only superpower is inevitably going to breed resentment of one form or another and it is impossible to mollify every single group. The challenge to the United States is to prevent these organizations from acquiring the means to threaten us with a nuclear attack. Focusing our minds on that task will require a new found appreciation and understanding of the unique destructive power of these terrible weapons.

Id.

[50] Global warming as a national security issue is outside the scope of this article, however there have been many articles written on this subject. *See, e.g.*, Jody Freeman & Andrew

concern into a security concern for every country. As global temperatures increase, many scientists believe water availability and food production will decrease.[51] While the United States will undoubtedly be affected by climate change, it is the poorest countries that will be least able to adapt to the change due to their geographical location and their heavy dependence on local agriculture to feed their populace.[52] This change will likely lead to wide scale migration with heavy competition over food and farmable land, which could potentially lead to violent conflicts between states and civilians trying to survive.[53]

In the United States, a group of retired generals and admirals issued a report arguing that climate change was a significant national security threat.[54] One general on the panel, retired General Anthony Zinni, who commanded U.S. forces in the Middle East, stated as an example that "climate change and its impact on already-scarce water resources could exacerbate the Israeli-Palestinian conflict . . . ."[55] Retired Admiral T. Joseph Lopez made the bold statement that global warming "will provide the conditions that will extend the war on terror."[56] Specifically, according to

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Guzman, *Climate Change & U.S. Interests*, 109 COLUM. L. REV. 1531 (2009). It has also been identified as a national security issued by U.S. leadership. *See, e.g.*, 155 CONG. REC. H4006 (daily ed. Mar. 25, 2009) (statement of Rep. Pelosi) (stating that global warming is a "national security issue, . . . an economic issue, . . . an environmental issue, and . . . a moral issue.").

[51] *See* GERMAN ADVISORY COUNCIL ON GLOBAL CHANGE, WORLD IN TRANSITION: CLIMATE CHANGE AS A SECURITY RISK 55–129 (2008). Crop ecologists agree that for every 1°C rise in temperature increase, we can expect certain crop yields to drop by ten percent. *See also* Lester Brown, *World Grain Stocks Fall to 57 Days of Consumption: Grain Prices Starting to Rise, Earth Polity Institute*, EARTH POLICY INST. (June 15, 2006), http://www.earth-policy.org/Indicators/Grain/2006.htm.

[52] *See* William Burns, *Potential Implications of Climate Change for the Coastal Resources of Pacific Island Developing Countries and Potential Legal and Policy Responses*, 8(1) HARV. ASIA PAC. REV. (2005); Ranee Khooshie Lal Panjabi, *Can International Law Improve the Climate? An Analysis of the United Nations Framework Convention on Climate Change Signed at the Rio Summit in 1992*, 18 N.C.J. INT'L & COMM. REG. 491, 500 (1993).

[53] Press Release, The Nobel Peace Prize Committee, The Nobel Peace Prize for 2007 (Oct. 12, 2007), *available at* http://nobelprize.org/nobel_prizes/peace/laureates/2007/press.html.

[54] CNA CORPORATION, NATIONAL SECURITY AND THE TREAT OF CLIMATE CHANGE (2007), *available at* http://securityandclimate.cna.org/report/National Security and the Threat of Climate Change.pdf; *see also Climate Change Worries Military Advisers*, NPR (Apr. 16, 2007), http://www.npr.org/templates/story/story.php?storyId=9580815.

[55] CNA CORPORATION, *supra* note 54, at 31.

[56] *Id.* at 17 (internal quotation marks omitted).

the senior officers, economic hardships fuel terrorism recruitment, and global warming will only exacerbate the situation.[57]

The generals' assessment was demonstrated in 1970 when a typhoon struck Bangladesh.[58] Before the typhoon, Bangladesh was part of Pakistan. However, when the government was unable to adequately respond to the devastation, a violent civil war broke out, ending with independence for Bangladesh a year later.[59] The tragedy in Darfur similarly demonstrates what can happen when basic necessities become limited.[60]

Officially, the United States now recognizes climate change as a national security threat: "For the first time, Pentagon planners in 2010 will include climate change among the security threats identified in the Quadrennial Defense Review, the Congress-mandated report that updates Pentagon priorities every four years."[61]

In addition to climate change, environmental disasters like the ones seen in the Gulf of Mexico and Alaska impact national security, because of the impact they have on the American economy and its way of life. It is likely that the dwindling supply of oil is one reason why BP drilled beyond its capability and took huge risks — it is where the oil was.[62] Therefore, one could deduce that in the future, as demand increases and easy-to-access supply decreases, oil companies will be forced to take similar risks, increasing the possibility of natural disasters.

II. A Case for Nuclear Energy

An aggressive use of nuclear energy to first replace our fossil-based electricity needs and, eventually, the fossil-based transportation energy needs of this country would not only quell the critics of this technology but

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[57] *Id.* at 16.
[58] A.C. Drury & R.S. Olson, *Disasters and Political Unrest: An Empirical Investigation*, 6 J. CONTINGENCIES & CRISIS MGMT. 153, 154 (1998).
[59] *Id.*
[60] United Nations Secretary General Ban Ki-Moon made the point that the Darfur conflict had started as an economic struggle. Ban Ki-Moon, *A Climate Culprit in Darfur*, WASH. POST, June 16, 2007, http://www.washingtonpost.com/wp-dyn/content/article/2007/06/15/AR2007061501857.html.
[61] Tom Gjelten, *Pentagon, CIA Eye New Threat: Climate Change*, NPR (Dec. 14, 2009), http://www.npr.org/templates/story/story.php?storyId=121352495.
[62] *See This Time*, *supra* note 14.

also increase the United States' national security.[63] This is not to say that other energy sources should not be explored; just the opposite, any energy source that could help break the oil addiction would serve as a national security conduit, but nuclear is ready now.

A. Ready To Work On Day One

There has been recent fanfare concerning alternative energy sources, due in part to gas prices cresting $4.00 in the summer of 2008,[64] and the election of President Barack Obama who touted alternative energy as a major platform in his campaign.[65] Nevertheless, the fact is that many of the much-hyped methods of creating alternative energy — particularly "clean" energy — involve technology that has yet to be invented or perfected. While solar energy has come a long way from only being able to power a small calculator, it is still many years away from being able to support the United States' energy needs in any meaningful way.[66] The same holds true for the much-hyped — though currently quasi-mythical — hydrogen car.[67] Nuclear energy technology, on the other hand, has an established presence in our electricity production scheme: there are

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[63] Hickey, *supra* note 35, at 426.

[64] *See* John O'Dell, *Hybrids Finish 2008 in the Dumps, With Prices Weakened and Sales Down*, EDMUNDS.COM (Jan. 6, 2009), http://blogs.edmunds.com/greencaradvisor/2009/01/hybrids-finish-2008-in-the-dumps-with-prices-weakened-and-sales-down.html.

[65] *See, e.g.*, *New Energy for America*, ORGANIZING FOR AMERICA, http://www.barackobama.com/issues/newenergy/index.php (last visited Nov. 15, 2010) [hereinafter Energy for America].

[66] *See, e.g.*, Martin Hickman, *Solar Panels 'take 100 years to pay back installation costs'*, THE INDEPENDENT, Sept. 3, 2008, http://www.independent.co.uk/environment/climate-change/solar-panels-take-100-years-to-pay-back-installation-costs-917202.html (stating that "Solar panels are one of the least cost-effective ways of combating climate change and will take 100 years to pay back their installation costs. . . .").

[67] *See* Larry E. Hall, *The Hydrogen Highway: Hype or Happening?*, MSN, http://editorial.autos.msn.com/article.aspx?cp-documentid=435039 ("[F]uel-cell vehicles for general consumption are still years away from showing up in car dealer showrooms. Yes, there are upwards of 125 of these vehicles that are being tested on streets . . . however, a real-world hydrogen fuel-cell electric car for everyday driving is still a long way off."); Steven Ashley, *Is the Hydrogen Car of the Future Running on Empty?*, SCIENTIFIC AMERICAN (Oct. 20, 2008), http://www.scientificamerican.com/article.cfm?id=is-the-hydrogen-car-running-on-empty (documenting the infrastructure issues that are keeping down demand for hydrogen cars).

currently 103 nuclear power plants[68] generating roughly twenty percent of the electricity in the United States today.[69] The history of this energy source provides important context that elucidate its importance to America's future energy independence.

The era of nuclear energy in the United States began with the Manhattan Project and the use of the atomic bomb over the city of Hiroshima.[70] It was not long after this cataclysmic event that, in an ironic twist, the technology that was originally invented to destroy would be used to create. To facilitate this, Congress in 1946 enacted the Atomic Energy Act ("AEA") in order to respond to the military and economic implications of the new technology.[71] Congress' overall goal in the AEA was to:

> (a) subject at all times to the paramount objective of assuring the common defense and security; and (b) the development and utilization of atomic energy shall, so far as practicable, be directed toward improving the public welfare, increasing the standard of living, strengthening free competition in private enterprise, and promoting world peace.[72]

One of the most noteworthy aspects of the AEA was the government's decision that the nuclear industry would be a "government monopoly that allowed for private groups to invest subject to a great deal of federal oversight. The AEA's purpose is to regulate the various materials involved in the nuclear process."[73] The nuclear business was not totally reserved to the military because Congress recognized private industry's ability to innovate, thus allowing the United States to stay ahead of the

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[68] Press Release, Nuclear Energy Institute, Electric Sector Report to DOE Spotlights Nuclear Energy's Role in Curbing Greenhouse Gas Emissions (Jan. 12, 2007), *available at* http://www.nei.org/newsandevents/electricsectorreport.

[69] U.S. ENERGY INFORMATION ADMINISTRATION, ELECTRIC POWER MONTHLY DECEMBER 2010 1 (2010), *available at* http://www.eia.doe.gov/cneaf/electricity/epm/execsum.pdf.

[70] Taylor Burke, *Nuclear Energy and Proliferation: Problems, Observations, and Proposals,* 12 B.U.J. SCI. & TECH. L. 1, 4 (2006).

[71] *Id.* (citing *Our Governing Legislation*, NUCLEAR REGULATORY COMM'N, http://www.nrc.gov/about-nrc/governing-laws.html#aea-1954 (last visited Nov. 24, 2010) (discussing how the Act formed the legal foundation for military and civilian applications of nuclear energy technology)).

[72] 42 U.S.C. § 2011(a) (2006).

[73] Burke, *supra* note 70, at 4 (citing 42 U.S.C. §§ 2013, 2017).

Soviet Union.[74] The Department of Energy — through the Nuclear Regulatory Commission ("NRC") — was given oversight authority over this relationship between government and private industry.[75]

From the 1950s until the 1970s nuclear power went through an energetic growth.[76] However, after the 1979 near-meltdown at Three Mile Island ("TMI") the idea of a nuclear America died.[77] Only recently are utilities even attempting to license new reactors.[78] The truth is, "in generating electricity, nuclear power is second only to coal, which produces about half the power we use. Nuclear today produces more electricity than it did at the time of the accident — about 20 percent compared with 12.5 percent in 1979."[79] Looking forward, nuclear is one of the most abundant energy sources available in the United States.[80] Specifically, "there are an estimated 498 million tons of uranium ore in the United States,"[81] available to fuel reactors, which approximately translates into power for more than 1.6 billion homes.[82] Moreover, unlike oil, where the countries with copious

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[74] *See id.* at 5.
[75] *Id.*
[76] Hickey, *supra* note 35, at 434.
[77] Todd Tucker, *5 Myths on Nuclear Power*, WASH. POST, Mar. 22, 2009, http://www.washingtonpost.com/wp-dyn/content/article/2009/03/20/AR2009032001781.html; *see also* Hickey, *supra* note 35, at 431 (stating that "the growth of the nuclear power industry has been moribund since the late 1970s"); James E. Hickey, Jr., *Mississippi Power & Light Company: A Departure Point for Extension of the "Bright Line" Between Federal and State Regulatory Jurisdiction over Public Utilities*, 10 J. ENERGY L. & POL'Y 57, 63–64 (1989) [hereinafter *Mississippi Power*]. It is also argued that the "[r]ising costs, construction delays, accidents, and waste disposal concerns shattered the pro-nuclear power consensus and stopped the growth of the industry in its tracks." Hickey, *supra* note 35, at 434–35. As a result of this lack of faith in nuclear power "the nuclear energy contribution to meet the nation's total electric demand hovers at about twenty percent." *Id.* at 431.
[78] Tucker, *supra* note 77. This notion that TMI killed nuclear power is perplexing considering that the TMI incident did not even kill the reactor itself. *Id.* Indeed, while reactor 2 was destroyed in the accident, reactor 1 is active today. *Id.*
[79] *Id.*
[80] Hickey, *supra* note 35, at 430.
[81] *Id.*
[82] While determining how much energy can be captured from uranium ore is difficult to identify, a report done concerning the Texas uranium reserves found that the state's eighteen tons of uranium ore could power more than sixty million homes. *The Energy Report, Nuclear Energy*, TEX. COMPTROLLER OF PUBLIC ACCOUNTS, http://www.window.state.tx.us/specialrpt/energy/exec/nuke.html (last visited Dec. 22, 2010). Hence each ton of ore produces electricity for more than 3.33 million homes and 498 tons of ore could power more than 1.6 billion homes. *Id.*

reserves are hostile toward the United States, the countries that are also rich with uranium are "Australia and Canada, two close allies of the United States."[83]

Without nuclear power, the United States will have no choice but to continue to rely on fossil fuels as its primary energy source.[84] Renewable energy sources include hydroelectric, geotheremal, solar, wind, and biomass. These renewable energy sources contribute only ten percent to the United States' total electric generation.[85] Even if renewable capacity were tripled, it would still constitute less than a third of the total electric energy needs of the country.[86]

Aside from the quasi-religious stance environmentalists take against nuclear power, most credible environmental scientists attest that global warming is the top environmental threat to this country.[87] Further, as seen by the Gulf spill, oil drilling has its own national security risks associated with it. Nuclear energy creates emission-free power that contributes none of the harmful greenhouse gases that come from coal plants; it is a wonder why more environmentalists do not support the technology.[88] According to Professor Hickey, "U.S. electric demand is expected to increase by forty-three percent over the next twenty years requiring between 1300 and 1900 new power plants."[89] If the trend continues, fossil fuels will provide 86 percent of the United States' energy by 2030.[90] In 2005, over 200 million barrels of imported oil were burned in order to generate electricity. If only this consumption could be replaced by nuclear energy, it would not only reduce the level of greenhouse gas (GHG) that is released but also help sever

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[83] Hickey, *supra* note 35, at 430.
[84] *Id.* at 431.
[85] *See* U.S. ENERGY INFORMATION ADMINISTRATION, ANNUAL ENERGY REVIEW 2009 7 (2010), *available at* http://www.eia.doe.gov/emeu/aer/pdf/aer.pdf [hereinafter 2009 REVIEW].
[86] Even such a monumental increase in capacity is further complicated by the fact that many experts agree that hydroelectric power, the most successful alternate energy source, will soon reach its maximum electric producing capacity, if it has not already. Hickey, *supra* note 35, at 431.
[87] Tucker, *supra* note 77.
[88] *Id.* Nuclear mining is also much cleaner and less dramatic then coal mining. *See id.* (contrasting with the perils of coal mining, stating that "nuclear power [does not] require the decapitation of Appalachian mountains or the construction of billion-gallon sludge ponds.").
[89] Hickey, *supra* note 35, at 431.
[90] *Id.* at 432.

the oil addiction that is crippling the nation's national security.[91] The average annual output of waste from a nuclear plant is twenty cubic meters, while the average annual waste from a coal plant is 500,000 metric tons.[92] Even more amazing is that a single enriched ceramic atomic pellet, although small, contains about the same amount of energy as one ton of coal.[93]

While currently the cost of nuclear power ($1500 per kilowatt) is almost double that of coal, those costs do not account for the environmental cost of coal, nor do they account for the fact that nuclear energy is costly partly because it has been abandoned as an industry. Imagine if Ford were to sell one model of each car per year — the cost for each car would be astronomical, even for a Ford Focus.[94] It goes to reason that if more nuclear plants were constructed the "production cost" would decrease as well as the per kilowatt cost.[95] Further, while the upfront cost of nuclear energy is relatively high due to construction costs, which represent some of the "largest capital construction projects that exist today," the overall cost of nuclear power is lower than solar or wind power projects.[96] "Without

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91 2009 REVIEW, *supra* note 85, at 129 (charting the United States' increasing use of combustible fuels for electricity generation, from over 235 million barrels of petroleum in 1949 to over 4.2 billion barrels of petroleum in 2009).

92 Richard Rhodes & Denis Beller, *The Need for Nuclear Power*, FOREIGN AFF., Jan.-Feb. 2000, at 30, 39.

93 David L. Foberg, Case Note, Nuclear Energy Institute, Inc. v. EPA, *373 F.3d 1251 (D.C. Cir. 2004) Will Science Triumph Over Policy? The Future of a Nuclear Waste Repository at Yucca Mountain, Nevada*, 24 TEMP. J. SCI. TECH. & ENVTL. L. 187, 190 (2005).

94 The Ford Focus has a base MSRP of $16,640. *Ford Focus*, FORD.COM, http://www.fordvehicles.com/cars/focussedan/ (last visited Nov. 3, 2010).

95 *See* ALAN M. HERBST & GEORGE W. HOPLEY, NUCLEAR ENERGY NOW: WHY THE TIME HAS COME FOR THE WORLD'S MOST MISUNDERSTOOD ENERGY SOURCE 12 (2007); *see also* Hickey, *supra* note 35, at 433. Hickey states:

> The cost comparisons also do not reflect any of the benefits achieved by curing the perceptions of illegality with regard to the use of force or to global warming. Cost calculations could also be reduced on a short term basis with government subsidies for the first few plants until economies of scale kick in with a revived nuclear industry, which would further reduce the cost per kilowatt hour.

Id.

96 ANDREW C. KLEIN, PROGRESSIVE POLICY INSTITUTE, CLEAN ENERGY, GUARANTEED: WHY NUCLEAR ENERGY IS WORTH THE COST (2010), *available at* http://www.progressivefix.com/clean-energy-guaranteed-why-nuclear-energy-is-worth-the-cost.

significant tax incentives, loan guarantees and power purchase requirements that have been given to developers of wind and solar farms to spur their growth, it is highly unlikely that we would have seen these large land-use icons pop up around the country."[97] Using 2008 dollars, the United States Energy Information Administration (EIA) estimated that in 2016, the levelized cost of Nuclear generated electricity, per megawatt-hour, had the lowest cost among the evaluated forms of energy.[98] Solar photovoltaic power was the most expensive at $396.10 per megawatt-hour. Solar thermal power was $256.60. Wind power did better at $191.10 for offshore wind and $149.30 for land wind.[99] Overall, the EIA found that nuclear power was the most efficient at $119.00 per megawatt-hour[100]

Lastly, with today's economic downturn, nuclear energy could create high paying and high tech jobs that cannot be outsourced, a goal stated several times by President Barack Obama in his 2008 campaign.[101]

There is no silver bullet to solve the national security threat caused by energy dependence. However, while nuclear technology is far from perfect, it is available now. Moreover, designs to create clean nuclear energy are on the horizon, but in order to develop these new energy innovations the United States needs to abandon is fearful frame of mind and adopt instead an attitude of exploration.

B. Necessary Evolution Through Innovation

1. U.S. Innovation

It would be an exaggeration to say that nuclear technology has not improved since the 1950s.[102] However, modern reactors produce energy

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[97] *Id.*
[98] *Id.*
[99] *Id.*
[100] *Id.*
[101] *Energy & Environment*, THE WHITE HOUSE, http://www.whitehouse.gov/agenda/energy_and_environment/ (last visited Apr. 20, 2009). It should be noted that with the expansion of green jobs other jobs in the energy industry, specifically the coal industry, could be threatened. *See* Nancy Lofholm, *Coal Miners Rally in Grand Junction Against Clean-Energy Plans*, DENV. POST, Aug. 31, 2010, http://www.steamboatpilot.com/news/2010/aug/31/coal-miners-rally-grand-junction-against-clean-ene/.
[102] HERBST & HOPLEY, *supra* note 95, at 1.

using exactly the same proccess used in the 1950s, and most if not all of the major technological advances in the civilian nuclear industry have occured in relation to massive power plants (like the one seen at Three Mile Island).[103] The United States has all but abandoned the cutting edge science behind nuclear energy, "which is ironic considering it was the initial developer of this technology."[104]

In the 1950s, some scientists theorized that Americans would be driving nuclear cars.[105] While the "nuc-car" is not advocated by this article, it is the position here that in order to explore the frontier of nuclear science, the nation must actively send explorers into the nuclear wilderness.

The United States Navy provides an example of what can be accomplished through innovation. The Navy, under the leadership of Captain Hyman G. Rickover, recognized the enormous potential and advantage that a nuclear-powered boat would provide.[106] The original goal of the Navy was to develop a nuclear-powered submarine.[107] Although there were several reactor concepts, Captain Rickover had to develop theory into practical engineering almost out of whole cloth:[108]

> New materials had to be developed, components designed, and fabrication techniques worked out. Further, installing and operating a steam propulsion plant inside the confines of a submarine and under the unique sub-sea pressure conditions, raised a number of technical challenges. Since there were many unknowns, he recommended undertaking two parallel reactor development projects: a pressurized water cooled reactor and a liquid metal cooled reactor.[109]

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[103] *Id.*
[104] *Id.* at 2.
[105] *See* Jacob Silverman, *Can a Car Run on Nuclear Power?*, HOWSTUFFWORKS.COM, http://auto.howstuffworks.com/nuclear-powered-car.htm (last visited Nov. 3, 2010).
[106] *Military, Nuclear Propulsion*, GLOBALSECURITY.ORG, http://www.globalsecurity.org/military/systems/ship/systems/nuclear-history.htm (last visited Apr. 26, 2009). [hereinafter Military Propulsion].
[107] *See id.*
[108] *Id.*
[109] *Id.*

On March 30, 1953, the first naval nuclear reactor was brought on-line and the "age of naval nuclear propulsion was born."[110] In 1954 the USS Nautilus was the first nuclear powered submarine to enter the fleet and it used the pressurized water design.[111] The USS Seawolf, using the liquid metal design, entered the fleet in 1957 and was in service for two years.[112] Through the test and trial method, the Navy learned that the pressurized water or light water technology was more conducive to naval operations and was adopted as the standard.[113] Within years of the first nuclear submarines, the Navy adapted the technology to run entire aircraft carriers, the first being the USS Enterprise.[114] To support its nuclear program, the Navy built the Expended Core Facility to "examine expended naval reactor fuel to aid in the improvement of future generations of naval reactors."[115]

Through nuclear energy, the Navy has been able to create the most powerful fleet the world has ever seen. It was able to do this through trial and error — creating new technology through aggressive innovation. The nation needed a fleet that could project U.S. power anywhere in the world and American ingenuity answered with nuclear naval propulsion as a means to that end.

This is not to say that the naval nuclear program did not run into problems. Indeed, with the demise of the civilian nuclear industry in the 1970s, the individuals in the "nuclear business" had no other work to "help absorb overhead and sustain a solid business base from which to compete for naval nuclear work."[116] As a result of the reduced competition, costs to develop nuclear technology soared, which is one complaint critics throw at

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[110] *Id.*

[111] Military Propulsion, *supra* note 106. Pressurized Water Reactors (PWR) "use nuclear-fission to heat water under pressure within the reactor. This water is then circulated through a heat exchanger (called a 'steam generator') where steam is produced to drive an electric generator." *New Reactor Designs*, U.S. ENERGY INFORMATION ADMINISTRATION, http://www.usnuclearenergy.org/pdf_library/new_reactor_designs.pdf. The coolant in the PWR and "the water used to provide steam to the electric turbines exists in separate closed loops that involve no substantial discharges to the environment." *Id.*

[112] Military Propulsion, *supra* note 106. Liquid Metal reactors or "[s]odium-cooled reactors use the molten (liquid) metal sodium as a coolant to transfer reactor generated heat to an electricity generation unit. Sodium-cooled reactors are often associated with 'fast breeder reactors (FBRs).'" *New Reactor Designs*, *supra* note 111.

[113] Military Propulsion, *supra* note 106.

[114] *Id.*

[115] *Id.*

[116] *Id.*

commercial nuclear energy.[117] Thus, it is reasonable to assume that if the people of the United States got serious about developing new nuclear technology, the famous American capitalism machine — the same machine that has helped reduce the price of a flat screen television by roughly 85% in 5 years[118] — would reduce the price of producing nuclear power.[119]

Despite the collapse of support for the nuclear industry in the 1970s, nuclear reactors have been able to improve their efficiency.[120] Indeed, "[o]perating costs are continually improving with each fuel cycle as better techniques are developed and deployed."[121] Moreover, notwithstanding the fact that "no new U.S. nuclear reactors have come on line since 1996, significant [improvements] have been made in the existing operating plants, increasing their capacity size as well as improving their structure to ensure full use of the 40-year license life, if not beyond."[122] If the industry is able to improve its effectiveness in the face of public and governmental resistance — and especially if the industry receives the same encouragement as it did in the 1950s — there will be a nuclear energy renaissance. Certainly when the American people want to do something, it can be done.

The most obvious improvements that this "use it or lose it" approach could make would be on the reactors themselves. There have been a number of different technologies used to create nuclear energy, each with its own advantages and disadvantages. However, the only way to mitigate the disadvantages of different technologies is through trial and error, a process that has slowed tremendously since the 1970s.[123]

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[117] *See id*; *see also* Arjun Makhijani, *Atomic Myths, Radioactive Realities: Why Nuclear Power is a Poor Way to Meet Energy Needs,* 24 J. LAND RESOURCES & ENVTL. L. 61–62 (2004).
[118] *Compare* LCD Television, http://abyssint.com/lcd-versus-oled-oled-tv-screens-will-make-a-huge-impact/ (last visited Nov. 14, 2010) (stating that a 50-inch plasma television about five years retailed for roughly $6000-$8000), *with* Walmart.com, Sanyo 50" Class Plasma HDTV with Digital Tuner, DP50747, http://www.walmart.com/catalog/product.do?product_id=5652238 (last visited Apr. 2, 2009) (pricing a Sanyo 50-inch television at $898.00).
[119] *See* HERBST & HOPLEY, *supra* note 95, at 12 ("[a] rebirth of the United States nuclear power market will be greatly influenced by its associated costs.").
[120] *Id.* at 166.
[121] *Id.*
[122] *Id.*
[123] *See supra* text accompanying notes 76–83.

There are three major nuclear technologies in use today. The first technology of note is natural uranium reaction.[124] With this process the reactor uses natural uranium instead of its isotope.[125] Because these reactors do not use refined uranium, they are not as efficient as more advanced reactors.[126] At the same time, because natural uranium reactors do not need refined uranium the fuel needed to run them is much cheaper and their "simple" design makes them easier and less expensive to build.[127]

With water reactors — the preferred reactor in the United States — "[f]uel rods are inserted into a reactor in a chamber filled with water. Water slows the pace of the uranium neutrons because they lose energy as they [*sic*] uranium neutrons react with the hydrogen in the water."[128] The steam that is generated from this process spins turbines creating electricity. While this process is considerably more efficient then the natural uranium process, it uses much more uranium, which is its fundamental flaw — there is a limited quantity of uranium in the world.[129] This is compounded by the estimates by many experts that suggest that "the supply of 'easy-to-reach' uranium material, given current demands, will only last another century."[130] In addition, as discussed in detail below, these reactors produce waste that is both dangerous for the environment and could potentially be turned into a weapon.[131]

The next type of technology that could be explored in a nuclear renaissance involves liquid metal reactors. As mentioned, these types of reactors were explored by the Navy in the 1950s and were found to not be optimal for naval service.[132] Yet, not being suitable for naval service, which values quiet, compact, shock-resistant reactors above all else, does not mean

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[124] Burke, *supra* note 70, at 10.
[125] *Id.*
[126] RICHARD L. GARWIN & GEORGES CHARPAK, MEGAWATTS AND MEGATONS: A TURNING POINT FOR THE NUCLEAR AGE? 81 (2001).
[127] *See* Burke, *supra* note 70, at 10.
[128] *Id.*
[129] *Id.*
[130] *Id.* at 10–11. Many opponents of nuclear energy claim this is a reason to avoid the energy source. However, it should be noted that oil has been the primary energy source for approximately a century, which is a significant amount of time. Further, just as harder-to-reach oil was exploited when the easy-to-drill supplies dried up, it is to be expected that as the easy-to-reach uranium supply runs low, technology will improve to mine the harder to reach ore.
[131] *Id.* at 11.
[132] *See supra* text accompanying notes 106–119.

that, given sufficient investment, they could not be turned into safe and efficient civilian reactors.[133] This is especially true considering the rigors a naval reactor must endure, as well as the fact that this technology was born sixty years ago. Surely the United States' other technical advancements could breathe new life into these types of reactors.

What is unique and desirable about liquid metal reactors is that they generate more plutonium than they consume uranium — and since plutonium is also a nuclear fuel, they produce a net gain in fissionable material.[134] After the uranium is burnt in the reactor, the spent fuel is chopped into smaller pieces and dissolved in acid and uranium and plutonium are recovered.[135] This technology may appear to be the most

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[133] *See* Military Propulsion, *supra* note 106.

[134] Burke, *supra* note 70, at 11. The author states:

> This might trouble some readers, given the Second Law of Thermodynamics: '[I]n all energy exchanges, if no energy enters or leaves the system, the potential energy of the state will always be less than that of the initial state.' The simple answer to this challenge to the Second Law of Thermodynamics is that it does not create an unlimited amount of nuclear energy; fuel rods still must be replaced after some time. Rather, the difference that accounts for the seeming violation of the Second Law is that breeder reactors reprocess the waste product of the fission reaction (plutonium) into fuel that other reactors cannot use. The reactor can generate more plutonium than the traditional reactors because it uses metal sodium as a coolant. Metal sodium has a higher melting point than water (208°F compared to 32°F). Metal sodium thus does not slow neutrons down as much as water does, making more neutrons available for the U-238 at the capture point, which creates more plutonium.

Id.

[135] *Id.; but see* Makhijani, *supra* note 117, at 67. This "breeder reactor" technology that "magically" makes more fuel then it burns is not without controversy:

> About $100 billion have been spent worldwide over half a century in the effort to commercialize plutonium fuel and reactors that will "breed" it from uranium-238. The effort has been a vast economic and technical failure. Plutonium fuel is used to supply part of the fuel of less than three dozen reactors, most of them in France, out of a world total of more than 400 commercial reactors. The fuel is subsidized by ratepayers and taxpayers to the tune of about one billion dollars per year in France alone.

Id.

obvious choice to generate energy — and many countries have tried to use these types of reactors.[136] However, because the process to capture the plutonium and uranium from the spent fuel is very expensive and dangerous there has been very little success in this area.[137] The "new" fuel is weapons grade plutonium.[138] In fact, in the United States, this technology was stopped by President Ford because of the nuclear proliferation implications (referred to as diversion) — a policy later continued by Presidents Carter and Clinton.[139]

The plight of the liquid metal reactor, demonstrates the point of this section perfectly. Instead of trying to innovate a method to mitigate the diversion issue, the United States simply abandoned the technology — a technology that generates more energy than it consumes and reuses some of its waste thus producing less of it. As a result, not only was the commercial industry not given a chance to solve the diversion issue (which could be solved by something as simple as more security) but it was also not given the opportunity to solve the cost and safety issues with which other countries are struggling.

2. World Innovation

This is not to say that the rest of the world has been idle while the United States has been sleeping at the proverbial nuclear wheel. Despite the fact that the worldwide nuclear energy generation capacity has only been 0.6% per year,[140] the International Atomic Energy Agency (IAEA) estimates that, around the world, 29 reactors will be coming on line soon and 130 more are under construction or in the planning stages.[141]

In addition to innovation with nuclear power, the world is primed to see the introduction of electric and possibly hydrogen cars on the market.[142]

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[136] Burke, *supra* note 70, at 12. England, France, India, Japan, China, and Russia have tried to build these reactors with minimal success "other than limited commercial use in Russia and Japan." *Id.*
[137] *Id.* at 11–12.
[138] *Id.* at 12.
[139] *Id.*
[140] INTERNATIONAL ATOMIC ENERGY AGENCY, ENERGY ELECTRICITY AND NUCLEAR POWER ESTIMATES FOR THE PERIOD UP TO 2030 (2008), *available at* http://www-pub.iaea.org/MTCD/publications/PDF/RDS1-28_web.pdf.
[141] HERBST & HOPLEY, *supra* note 95, at 28.
[142] Hall, *supra* note 67.

This is significant because the more the United States turns to electricity for transportation energy (hydrogen is made with electricity), the more relevant nuclear power becomes to the national security question.[143] This is especially true considering evidence that the world is about to see a generation shift in battery technology.[144] If that happens, nuclear power could be the link that literally runs the nation.

Ultimately, global problems require global solutions. The United States will likely be able to get itself out from under the energy dependence boot with technology — indeed, ingenuity has always been the backbone of American power. However, fixing the American dependence problem will not necessarily solve the world dependence problem; other countries may not be able to afford the new technology. Thus, as mentioned, because wars are almost always fought between two countries seeking the same land or resources, future wars will likely be fought over dwindling power supplies. As the sole superpower, it is to be expected that the United States will be pressured to intervene in other states' oil wars.[145] Thus, the world's energy dependence could be a security threat to the United States despite the steps it takes to reduce its own dependence. Consequently, American decision-makers need to take a broader view on the dependence issue and develop better nuclear answers to help solve the problem.

III. Nuclear Renaissance or Nuclear Proliferation?

Because a nuclear "incident" can be disastrous for the nuclear industry, if the three basic concerns posed by nuclear energy cannot be eliminated, mitigated, or disproved, nuclear energy is a dead end. Specifically, the nuclear waste, nuclear safety, and nuclear weapons issues must *all* be addressed.

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[143] *See* Hickey, *supra* note 35, at 431 ("In a revived nuclear power industry, additional GHG emission reductions could be achieved by recharging electric car batteries with electricity produced from nuclear power plants.").

[144] *See, e.g.*, David Derbyshire, *Scientists Develop Mobile Phone Battery that Can Be Charged in Just 10 Seconds*, DAILY MAIL, Mar. 11, 2009, http://www.dailymail.co.uk/sciencetech/article-1161274/Scientists-develop-mobile-phone-battery-charged-just-10-seconds.html.

[145] *See*, Waszak, *supra* note 47, at 705–07. Arguably the 1991 Persian Gulf War was one such war.

A. Waste

1. Not in My Back Yard

The first power plant in the United States began generating power on December 2, 1957.[146] From the moment the first switch was turned on, the debate over nuclear waste has persisted.[147] Unlike fossil fuels, such as coal and oil, nuclear energy does not emit "stack gasses to the ambient environment."[148] However, mining for nuclear material[149] and the nuclear fuel cycle do produce hazardous long-lasting byproducts known as nuclear waste.[150] One particular deadly source of waste is the spent fuel rods that cannot generate enough heat to make electricity but are still extremely radioactive.[151] "[A]fter three or four years in a reactor, the uranium is burned up and the trapped fission fragments decrease the efficiency of the reactor; hence the entire assembly is removed and new fuel is added."[152]

The nuclear industry produces approximately 2,000 metric tons of nuclear waste every year.[153] As of November 2009, the United States had

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146 Foberg, *supra* note 93, at 188 (citing *Unique Reactors*, U.S. ENERGY INFORMATION AGENCY, http://www.eia.doe.gov/cneaf/nuclear/page/nuc_reactors/superla.html (last modified Dec. 6, 2004)).

147 *Id.* at 187 ("Since the early 1950's scientists have been searching for a way to safely isolate the highly radioactive and potentially deadly waste that is a by-product of nuclear power.").

148 *See Nuclear Power and the Environment*, U.S. ENERGY INFORMATION AGENCY, http://www.eia.doe.gov/cneaf/nuclear/page/nuclearenvissues.html (last visited Feb. 15, 2009).

149 Makhijani, *supra* note 117, at 62–63. On the Colorado Plateau there are "approximately two hundred million tons of radioactive mill tailings and possibly a comparable amount of uranium mine waste." *Id.* at 62; *see also* NUCLEAR WASTELANDS: A GLOBAL GUIDE TO NUCLEAR WEAPONS PRODUCTION AND ITS HEALTH AND ENVIRONMENTAL EFFECTS 122 (Arjun Makhijani et al. eds., 2000). This waste, according to some commentators, "ha[s] injured health, polluted precious water supplies, and resulted in billions of dollars in clean-up costs." Makhijani, *supra* note 117, at 62 (citing ATOMIC AUDIT: THE COSTS AND CONSEQUENCES OF UNITED STATES NUCLEAR WEAPONS SINCE 1940 378 (1998)).

150 Foberg, *supra* note 93, at 188–89.

151 *See id.* (citing *What are Spent Nuclear Fuel and High-Level Radioactive Waste?*, OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT, http://web.archive.org/web/20080614182338/http://www.ocrwm.doe.gov/factsheets/doeymp0338.shtml. (last visited Nov. 24, 2010)).

152 Foberg, *supra* note 93, at 190.

153 Aletheia Gooden, *The 10,000 Year Guarantee: High-Level Radioactive Waste Disposal at Yucca Mountain, Nevada*, 26 ENVIRONS ENVTL. L. & POL'Y J. 95, 98 (2002); *see also* Amy Sypula,

generated 70,000 metric tons of nuclear waste.[154] To put this in perspective, if all of the waste currently being stored in the United States were stacked up side-by-side it would be "enough to fill a football field more than 15 feet deep."[155] Moreover, it is estimated by the Department of Energy that by 2055 there will be 153,000 metric tons of nuclear waste.[156] As Foberg notes:

> Nuclear waste can be in gas, liquid, or solid form — it presents a potential danger because it continues to emit radiation from periods between a few hours to several million years. 'Radioactive materials that decay spontaneously produce ionizing radiation, which has sufficient energy to strip away electrons from atoms . . . or to break some chemical bonds. Any living tissue in the human body can be damaged by ionizing radiation.' At extremely high levels of exposure, ionizing radiation can cause sudden death. At lower doses, radiation can have devastating health effects including increased cancer risks and serious birth defects.[157]

Because of these dangers, scientists since the 1950s have been researching the best method to dispose of nuclear waste.[158] "After researching a broad range of disposal options, the scientific community has determined that the best way to protect human health and safety, as well as the environment, would be to bury radioactive waste deep underground in a facility called a geologic repository."[159]

Currently, nuclear waste is handled in the following fashion. After a fuel rod is spent and removed from the reactor it is moved to a steel-lined

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Beyond Yucca Mountain: Split Liability Drives Action for Interim Nuclear Waste Storage, 6 U. HI. L. SCH. ROUNDTABLE 251, 253 (1999).

[154] GOVERNMENT ACCOUNTABILITY OFFICE, NUCLEAR WASTE MANAGEMENT: KEY ATTRIBUTES, CHALLENGES, AND COSTS FOR THE YUCCA MOUNTAIN REPOSITORY AND TWO POTENTIAL ALTERNATIVES (2009), *available at* http://www.gao.gov/new.items/d1048.pdf.

[155] *Id.*

[156] *Id.*

[157] Foberg, *supra* note 93, at 189 (quoting *Understanding Radiation*, *Health Effects*, ENVIRONMENTAL PROTECTION AGENCY, http://www.epa.gov/rpdweb00/understand/health_effects.html (last visited Nov. 18, 2010)).

[158] *See* GOVERNMENT ACCOUNTABILITY OFFICE, *supra* note 154, at 5.

[159] Foberg, *supra* note 93, at 187–88.

concrete vault that is filled with water.[160] Today, this waste is stored at nuclear reactor sites around the United States.[161] However, nearly eighty nuclear reactors do not have any more room to store their spent fuel or are critically short on space.[162]

These on-site storage facilities are considered "safe" by the experts — however because they "will not withstand rain, wind, and other environmental factors for the period during which the waste will be hazardous. . ." many question this assessment.[163] Indeed, only once the radioactive waste is fully decayed — several thousand years from now — will it be safe.[164] Thus "the spent nuclear fuel must be stored in a way that provides adequate protection for a very long period of time."[165]

What is more, if the United States turns to nuclear energy to reduce its dependence from fossil fuels, particularly coal for environmental reasons, the waste issue will only worsen.[166] However, "[i]n order to make a significant dent in CO^2 [*sic*] emissions, at least one-third, and perhaps one-half or more of the global growth in electricity demand must be supplied by nuclear power."[167] Globally, in order to maintain a two percent growth in electricity demand, some experts theorize that two thousand nuclear plants will be needed in the next forty years, which amounts to building about one

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[160] *Id.* at 190. The water acts as a coolant and helps prevent radiation from leaving the vault. *Id.*

[161] *Id.*

[162] *Id.* Because of this space storage, many power plants have begun removing the fuel from the water vaults after they cool and moving the waste to dry-storage containers called casks:

> Casks are made of steel or concrete in order to shield the public from radiation. The Nuclear Regulatory Commission ("NRC") designed the dry cask storage system in order to expand the interim storage of spent nuclear fuel until a more permanent solution could be achieved. Dry cask storage is initially licensed by NRC for twenty years, but it can be licensed for up to one hundred years with the review and approval of NRC. Currently, spent nuclear fuel is stored in these temporary facilities at some 125 sites in 39 states.

Id. at 190–91.

[163] *See id.* at 191.

[164] *Id.*

[165] Foberg, *supra* note 93, at 191.

[166] Makhijani, *supra* note 117, at 66.

[167] *Id.*

a week.[168] The amount of nuclear waste that would result from such an increase of nuclear plants would be staggering.

2. Mitigations and Misconceptions

The most obvious solution to the waste problem is to design a more efficient and safe storage system. The federal government, in order to facilitate the storage of current and future waste passed the Nuclear Waste Policy Act of 1982 ("NWPA")[169] obligating itself to care for spent fuel[170] and other radioactive waste.[171] However, this obligation is effective when a suitable long-term repository becomes operational — this has proven easier said than done.[172]

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[168] *Id.*

> In any scenario involving two percent or greater global electricity growth, the use of nuclear power will mean the construction of thousands of nuclear power plants in the next four decades. Consider for instance, an electricity growth rate of two percent, which is far less than that occurring in China and India, but more or less typical of recent United States trends. To make a substantial contribution to reducing greenhouse gas emissions, we might hypothesize that (i) all present day nuclear power plants will be replaced by new ones, (ii) half the electricity growth will be provided by nuclear power, and (iii) half of the world's coal-fired plants will be replaced by nuclear power plants. This would mean that about two thousand large (1,000 megawatts each) nuclear power plants would have to be built over the next four decades. That is a rate of about one per week. If small plants, like the proposed Pebble Bed Modular Reactor were built instead, the required rate of construction would be about three reactors every two days.

Id.

[169] Nuclear Waste Policy Act of 1982, Pub. L. 97-425, 96 Stat. 2201 (codified as amended at 42 U.S.C. §§ 10101-270 (2006)).

[170] Spent fuel specifically refers to the fuel that is removed from a nuclear reactor following irradiation, "the constituent elements of which have not been separated by reprocessing." *Id.* § 2(23), 42 U.S.C. § 10101(23).

[171] Radioactive waste or "high-level radioactive waste" is defined as highly radioactive material that is generated from reprocessing spent nuclear fuel and other radioactive material that is determined to require permanent isolation. *Id.* § 2(12), 42 U.S.C. § 10101(12).

[172] *See id.* § 111, 42 U.S.C. § 10131; see also Timothy P. Cairns, *Waiting For The Mountain To Come To DOE: Existing Options For Compromise Between The Dept. Of Energy & Nuclear Utilities Regarding The Disposal Of Spent Nuclear Fuel*, 26 WM. & MARY ENVTL. L. & POL'Y REV. 407 (2001) (describing the obligations of the United States when the long-term repository becomes operational).

The Department of Energy determined that Yucca Mountain was the best choice for a national waste disposal site.[173] Yucca Mountain is about 100 miles northwest of Las Vegas and is close to a site where the U.S. government tested over 900 nuclear weapons.[174] The storage facility is located in a desert, 15 miles from the nearest civilian population, and the federal government has spent about $6 billion over the last 20 years studying the site and preparing it to store nuclear waste.[175] The most recent plan was to bury up to 70,000 metric tons of dry radioactive waste deep in the mountain.[176] According to the Department of Energy, by burying the waste "underground, the nuclear waste would not be exposed to wind, rain, or other precipitation that could cause the waste to break down into radioactive particles and disperse into the environment."[177] The repository was to use both natural and manmade measures to ensure that the waste was contained in the mountain and did not "leak" into the environment.[178]

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[173] Foberg, *supra* note 93, at 188.
[174] *Id.* at 191.
[175] *Id.*
[176] *Id.* at 212. Although Yucca Mountain only has storage space for 70,000 metric tons of waste, the Department of Energy projects that by 2035 there will be 119,000 metric tons of nuclear waste. Thus, the nuclear waste problem will outgrow Yucca Mountain in a few short years. *See supra* text accompanying notes 127–28.
[177] *Id.* at 191–92.
[178] Foberg, *supra* note 93, at 192–93. Foberg states:

> Yucca Mountain uses two barriers to protect the waste. "The first system involves "natural" barriers, i.e., characteristics of the mountain itself – its location, configuration, composition, and climate, which in combination serve to contain and isolate the nuclear waste from the surrounding environment. Located in the arid Nevada desert, Yucca Mountain receives less than 7.5 inches of precipitation on average per year. This dry climate and the physical shape and configuration of Yucca Mountain limit the ability of water to infiltrate the surface and reach the nuclear waste below. . . . [T]he DOE estimates that any water that did penetrate the surface would take thousands of years to reach the level of the repository and thousands more to carry radioactive particles into the water table below.
>
> The second system, designed to enhance the mountain's natural barriers, will consist of a series of man-made, or "engineered," barriers. After the nuclear waste is transported to the site by truck or rail in specially designed and shielded shipping containers, it will be placed in double-layered, corrosion-resistant steel packages for burial deep underground. Rail cars will carry these waste packages deep below the surface of the

The ability to isolate the waste would not have depended on a "single barrier, natural or man-made."[179]

While repositories such as Yucca Mountain would greatly mitigate the nuclear waste problem, they do not come without drawbacks. Indeed, any time hazardous material is stored there is an inherent risk that all the security systems will fail or will simply not work as expected and the material will leak into the environment.[180] Critics of the Yucca Mountain project have been able to delay the opening of the site through legal challenges by alleging that the waste will not be safely stored.[181] Specific charges have been that because the mountain is porous and sits over an earthquake fault with an aquifer that feeds farms, it is intrinsically dangerous.[182] This is precisely why in February 2009, President Obama submitted a budget intended to end funding for Yucca Mountain — thus possibly adding another delay to the project.[183]

> desert, where remotely controlled equipment will place the waste in over 150 miles of service and storage tunnels. The nuclear waste will sit in a complex of over fifty horizontal tunnels, each measuring 16.5 feet in diameter and 2000 feet in length. The tunnels will be reinforced with steel sets, rock bolts, and wire mesh — which will prevent rocks from falling on the engineered features. These tunnels will also be designed to withstand the immense heat that emanates from the radioactive waste.

Id.

[179] *Id.* at 193.

[180] *See id.* at 193–94.

[181] Foberg, *supra* note 93, at 188 ("In *Nuclear Energy Institute, Inc. v. EPA*, the United States Court of Appeals for the District of Columbia Circuit considered multiple challenges to the statutory and regulatory system designed to govern an eventual nuclear waste repository at Yucca Mountain."); Nuclear Energy Inst., Inc. v. EPA, 373 F.3d 1251, 1257 (D.C. Cir. 2004). The decision in *Nuclear Energy Inst., Inc. v. EPA* essentially ended the Bush administration's goal of beginning operations at Yucca Mountain by 2010. Foberg, *supra* note 93, at 188.

[182] *See* Foberg, *supra* note 93, at 193 (quoting Brian Sandoval, Nevada Attorney General: "[M]ost are stunned to learn that the Yucca Mountain site is literally a porous volcano; that it sits on an earthquake fault; that its aquifer flows to the Amargosa Valley, home to the state's largest dairy and one of the nation's largest organic farms; that when it leaks — and it will — one of our state's most beautiful and productive agricultural resources will be contaminated by a below-ground nuclear septic field.").

[183] Paul Bedard, *Reid Celebrates Obama's Yucca Mountain Decision*, U.S. NEWS & WORLD REPORT, Feb. 26, 2009, http://www.usnews.com/articles/news/washington-whispers/2009/02/26/reid-celebrates-obamas-yucca-mountain-decision.html (discussing how the Obama budget request is a "critical first step" towards ending the Yucca Mountain project.); *but see* Steve Tetreault, *Panel's Decision Keeps Yucca Mountain Alive*, LAS VEGAS

However, with new reactors expected to come online between 2015 and 2020, the United States must find a way to safely store its nuclear waste, whether that be Yucca Mountain, a new massive repository site, or a new disposal technology such as boreholes.[184] While it is naïve to believe there will be universal agreement on how to handle nuclear waste — the commonsense approach would be to centralize waste where protection efforts can be maximized and the possible effects of nuclear waste can be mitigated, rather than the current situation where each individual reactor has its own waste management program.

The next possible mitigation to the waste problem is waste reduction. As discussed above, by investing time and energy into nuclear power, American ingenuity will discover methods to make energy production safer and more efficient. Specifically relevant to waste management is fuel reprocessing.[185] Instead of just storing waste in secure locations, the United States could reuse waste to make more energy.[186] Spent fuel contains significant quantities of uranium, specifically U-235 and U-238 along with plutonium.[187] Amazingly, "[t]heir fuel concentrations account for some 96 percent of the original uranium and over half of the original energy content."[188] Therefore, by reusing this "waste" the reactors can burn more fuel and end up with less net waste to be stored at a repository.

REVIEW-JOURNAL, June 29, 2010, http://www.lvrj.com/news/panel-s-decision-keeps-yucca-mountain-alive-97406634.html?ref=634 (discussing a July 2010 decision from a panel of administrative judges, which ruled that "the Obama administration does not have the power to withdraw the project without permission from Congress.").

[184] *See* HERBST & HOPLEY, *supra* note 95, at 183; *see also* R. Kretz, *A New Solution to the Nuclear Waste Problem in Canada: Near-Reactor Storage in Large-Diameter Boreholes,* 34 GEOSCIENCE CANADA 3–4, 151 (2007).

[185] *See supra* Part III.B. The United States currently bans nuclear reprocessing. *See* Hickey, *supra* note 35, at 424.

[186] Hickey, *supra* note 35, at 434; *see also* HERBST & HOPLEY, *supra* note 95, at 28–29. The French have been one of the most progressive countries in recycling nuclear fuel. France produces about 17% of its electricity from recycled nuclear fuel. *Nuclear Power in France*, WORLD NUCLEAR ASS'N (last modified Nov. 22, 2010), http://www.world-nuclear.org/info/inf40.html. Reprocessing has weapon proliferations implications that will be discussed in depth in a later section. *See infra* Part IV.C.

[187] HERBST & HOPLEY, *supra* note 95, at 109.

[188] *Id.*

B. Safety

1. Safety from Meltdown

In the movie *The China Syndrome* two reporters visit a fictitious nuclear power plant outside Los Angeles and accidentally witness a near meltdown.[189] The reactor goes through an emergency shutdown and, because of a faulty water level gauge, the control room staff reduces water levels and nearly exposes the core.[190] While *The China Syndrome* "quickly became a cult classic for antinuclear activists, [ ] most energy industry experts believe the film gave a heavily skewed interpretation of electric utility and nuclear power operations in the United States . . . ."[191] Unfortunately, despite the "expert" opinion that the movie was inaccurate, on March 28, 1979, only 12 days after the movie was released, the United States had its own, very real near meltdown at Three Mile Island (TMI).[192] The cause of the accident at TMI was the failure of a valve that drained water from the core and the failure of the staff to notice someone had turned off the emergency cooling system, which led the reactor to overheat.[193] "By the time the operators noticed the problem, the core was less than an hour from complete meltdown. That would have meant a breach of the concrete walls around a container building and the release of massive amounts of radiation into the environment."[194] Because the mistake was counteracted in time, only a small amount of radiation was released into the surrounding community.[195] While the TMI incident resulted only in a serious scare, some nuclear accidents have had devastating effects.

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189 THE CHINA SYNDROME (IPC Films 1979).
190 *Id.*
191 HERBST & HOPLEY, *supra* note 95, at 19–20.
192 THE CHINA SYNDROME, *supra* note 189; ALLISON, *supra* note 49, at 54. It should be noted that the accident that took place on Three Mile Island was significantly different from what the movie depicted. *Compare* THE CHINA SYNDROME, *supra* note 189, *with* ALLISON, *supra* note 49, at 54. However, for practical purposes, because the movie and the actual accident were so close in time, the two were burned together in the American psyche.
193 ALLISON, *supra* note 49, at 54.
194 *Id.*
195 *Id.* "[T]wo million people in the area [were exposed] to only one [millirem]. Nonetheless, during the crisis, hundreds of thousands of residents from surrounding areas fled for safer ground." *Id.*

On April 26, 1986, the world experienced its worst nuclear accident to date.[196] The Chernobyl nuclear power plant in Ukraine had an explosion at Reactor Unit 4.[197] The roof of the reactor building, weighing 1,000 tons, was blown off and the temperature inside rose to over 3,600 degrees.[198] More devastating to the people and environment was the 50 tons of radioactive material that was released into the air.[199] In all, over 6,000 people were directly killed by the calamity and thousands more annually continue to be victims of the incident through cancer and other related diseases.[200]

2. Safety from Attack

Nuclear terrorism is one of the most dangerous threats facing the United States.[201] Terrorists do not need a nuclear weapon for a nuclear attack on the United States. Just as on September 11, 2001, "the everyday instruments of modern life (like airplanes) [were] turned into weapons," terrorists could use the United States' nuclear plants themselves as weapons.[202]

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[196] *Id.*

[197] *Id.*

[198] ALLISON, *supra* note 49, at 54.

[199] *Id.* Allison recalls:

> For twelve days, while military helicopters flew overhead dropping sand, lead, and boron onto the burning reactor, valiant firefighters on the ground waged a suicidal battle to put out the flames, even as the plant spread radioactive debris across wide swaths of the Soviet Union. Air currents carried fallout across the Baltic States into Sweden, Norway, Finland, and other parts of eastern and central Europe.

Id.

[200] *See id.* at 54–55.

> An area the size of Kentucky, covering territory in Ukraine, Russia, and Belarus, is contaminated with enough cesium-137 to warrant regular cancer examinations. The eighteen square miles around the plant have been designated an exclusion zone from which everyone was evacuated and, to this day, no one has been allowed to return.

Id.

[201] *See* ALLISON, *supra* note 49, at 53.

[202] *Id.*

As discussed, TMI and Chernobyl were accidents, and accidents occur in the most mundane and routine industries as well as the most sophisticated industries.[203] Because the consequences of accidents within the nuclear industry can be so significant, power plants have multi-layered and independent safeguards. This strategy is sometimes referred to as the "belt and suspenders approach":[204]

> Redundant safety systems ensure that even extreme cases of multiple failures will not cause a meltdown of the core or any other catastrophic release of radiation. When these reactors and safety systems were designed, however, experts focused on 'normal' failures, not intentional sabotage or attack. Before 9/11, few considered the possibility that a jetliner could crash into a nuclear reactor.[205]

Nuclear power plants are constructed to withstand numerous natural disasters, including earthquakes and tornadoes; however, "none of the 103 operating United States nuclear reactors was designed to withstand the impact of a Boeing 767 jetliner."[206] Making matters worse is the fact that twenty-one of the 103 operating reactors are located within 5 miles of an airport and because a centralized waste repository does not exist, the nuclear waste pools present themselves as "softer targets than the thick containment domes."[207]

Less dramatic than an attack using a jetliner, some also believe that nuclear facilities are susceptible to a conventional attack. For instance, at the Los Alamos National Laboratory in New Mexico, at the highly secure Technical Area-18, a test of the laboratory's defenses proved disappointing.[208] Army Special Forces commandos carried out a mock

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[203] *See id.* at 55.

[204] *Id.*

[205] *Id.* "In a dispute about a proposed plutonium plan on the Savannah River, a group called Georgians against Nuclear Energy (GANE) argued that the risks of a 'malevolent act' had not been taken into account in designing the facility." The NRC responded to the criticism stating that the reactors only had to address reasonably foreseeable events. *Id.* However, after the 9/11 attacks, the NRC reversed course. *See id.*

[206] *Id.* at 53.

[207] *Id.* Some experts believe that "[s]imply draining the water from the pools can lead to combustion of the spent fuel. The Union of Concerned Scientists, using deliberately provocative language, calls the storage pools 'Kmarts without neon' for terrorists." *Id.*

[208] *See id.* at 83.

attack on the facility and were able to steal fissile material.[209] A similar attack could be carried out on a nuclear power plant, involving either the theft of nuclear material, or, the use of strategically placed explosives to release radioactive material in the air.

3. Mitigations and Misconceptions

Generating power through a nuclear reaction is certainly not without risk, and any claim that a risk-free reactor can be built was disproven by the incidents at Chernobyl and Three-Mile Island.[210]

When Nobel Prize winner Enrico Fermi first started experimenting with nuclear energy, he devised a system where a Safety Control Rod Axe man ("SCRAM") would cut a rope, separating the fuel rods and thus stopping the reaction.[211] "The acronym SCRAM is still used today; however there are no axe-wielding reactor personnel in control rooms."[212] Since the Three-Mile Island and Chernobyl incidents there have been many additional safety measures implemented.[213] Chernobyl used a natural uranium reactor that was graphite-moderated and cooled by water. This increased risk, because such a design "does not have a containment structure and . . . becomes unstable if there is a decrease in the water level."[214] In the United States, the dangerous technology used at Chernobyl

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[209] *Id.* Allison describes the events:

> As guards rushed to the scene, snipers shot them from the surrounding hills while their compatriots located multiple canisters of HEU inside the facility. When the canisters proved too heavy for an individual to carry, the attackers used a Home Depot garden cart to haul enough HEU for numerous nuclear weapons out of TA-18 and into the woods of Santa Fe. Department of Energy security planners refer to the now-notorious heist as the Garden Cart incident.

Id.; see also id. at 84 (describing a similar test raid by United States Navy Seals on the Rocky Flats Nuclear Laboratory in Denver, Colorado. Again, the commandos were able to gain access to the facility and steal "several bombs' worth of plutonium without getting caught.").

[210] *See generally* Tucker, *supra* note 77. "Risk free" is "not possible in any manmade creation. . . . All methods of power generation involve trade-offs, a balancing of risks against returns. We shouldn't evaluate nuclear power any differently." *Id.*

[211] HERBST & HOPLEY, *supra* note 95, at 131.

[212] *Id.*

[213] Hickey, *supra* note 35, at 433.

[214] *Id.* at 433 n.47.

has never been used. Today, nuclear reactors must meet rigorous standards for safety in both facility design and quality control.[215] "These design criteria address the containment of radioactive material, the cooling of the reactor, and the prevention of nuclear chain reactions.[216] Safety from an outside attack from Mother Nature is also taken into considering when designing these plants.[217] In addition, each key component is designed for the contingency that its failure would not prevent the system from functioning due to the redundant and independent backup systems.[218]

Moreover, these extremely sturdy designs would fend well against a terrorist attack.[219] Consider the much-feared scenario in which terrorists crash a jetliner into a reactor. "[A]lthough not specifically designed to resist the crash of a hijacked aircraft, the containment structure would provide extensive protection from such a crash."[220] To test this theory, in 1988 an F-4 fighter was flown into a simulated containment wall.[221] While the aircraft shattered into pieces, it only penetrated the containment wall by two inches.[222] This test suggests that even a bigger aircraft would not be able to threaten the containment housing.[223] Moreover, even if the aircraft "crashed into other parts of the facility, redundant, independent, and

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[215] Paul Gaukler, et al, *Nuclear Energy and Terrorism*, 16 NAT. RESOURCES & ENV'T 165, 165 (2002).
[216] *Id.* at 166.
[217] *Id.* at 165. "They also require extensive fire protection measures and the ability to withstand hurricanes, tornadoes, and earthquakes." *Id.*
[218] *See id.* at 165–66.
[219] *Id.* at 166.
[220] *Id.* Gaukler argues that a containment facility's thickness, reinforcement, and its very shape "enables it to resist extreme external pressures, even pressures similar to those that might be produced by the impact of a modern jet airliner." *Id.* Therefore, even if a terrorist pilot could manage to hit the containment facility, "a relatively small target compared to either the Pentagon or the World Trade Center," it would likely survive the impact. *Id.*
[221] *Id.*
[222] *Id.*
[223] *See id.; see also* HERBST & HOPLEY, *supra* note 95, at 160.

> Following the deadly World Trade Center and Pentagon attacks in September 2001, the NRC conducted an extensive analysis of the potential threat to nuclear facilities from aircraft attacks. While much of this analysis has been labeled as classified information, the NRC study reportedly confirmed that the likelihood of such a scenario damaging the reactor core and releasing radioactivity into the atmosphere is low.

Id.

physically separate safety systems would protect the nuclear fuel and allow the plant to shut down safely."[224]

As discussed above, because nuclear plants typically store their waste on site, the waste pools pose vulnerable terrorist targets. The greatest threat comes from terrorists finding a way to drain the pool and ignite the spent fuel. However, because these pools are designed to withstand massive natural disasters, draining the pool would be no easy task. [225] "Most pools are somewhat smaller in area than an Olympic swimming pool and typically are 55 feet to 60 feet deep."[226] Thus, exposing the fuel would require removing thousands of gallons of water.[227] If terrorists tried to destroy the pool with explosives, experts estimate it would take large amounts to just crack the concrete:[228]

> Even if the pool were successfully drained, it would be remarkably difficult to ignite the fuel rods. Very specific conditions — a tremendous amount of heat with little or no heat removal — are required to initiate a "fire" of the zirconium fuel cladding. A nearby explosion or fire would not be enough. NRC has conservatively estimated that, even if a pool were drained to uncover the fuel and no cooling was available, it would take hours (up to more than a day depending on the age of the spent fuel) for the heat produced by the radioactive decay of the spent fuel to raise the fuel cladding temperature to 900°C, the postulated ignition temperature of zirconium. Even then, it is unclear whether ignition would occur, for a zirconium nuclear fuel rod has never actually been ignited at 900°C.[229]

As far as physical security, despite the somewhat troubling example of the United States Special Forces successfully raiding the Los Alamos National Laboratory, NRC regulations require stringent physical security

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[224] Gaukler et al., *supra* note 215, at 166.
[225] *Id.* "The pools are designed so that water cannot be drained or pumped using plant systems below a level well above the spent fuel rods (approximately 10 feet to 20 feet)." *Id.*
[226] *Id.*
[227] *Id.*
[228] *Id.*
[229] *Id.* at 166–67 (internal citations omitted). In addition, a jetliner crashing onto the pool would not likely generate enough heat to ignite the fuel. *Id.* at 167.

provisions.[230] Facilities are required to be able to withstand a commando-style mock attack, and since 9/11, facilities have been required to carry out twice as many raid drills.[231] Moreover, since the Los Alamos simulated raid, owners have been required to enhance training and qualifications for security personnel.[232] "These orders includ[e] more frequent weapons practice, more realistic training under a varying number of conditions, and firing against moving as well as fixed targets."[233] Similar safeguards are in place for nuclear material in transit.[234]

There is no doubt that nuclear energy is a potentially dangerous business, and the consequences of a major failure at a reactor would be devastating. This is precisely why the industry has worked diligently to "improve reactor safety operations and the systems that operate these very complex machines" — to ensure that a failure will not happen again.[235] Moreover, regarding terrorist attacks, extensive steps have been taken to mitigate the possibility and effect of a potential attack.[236] To this end, many experts believe that sophisticated terrorists will not view nuclear plants as soft targets, and will instead realize that such an attack would likely fail.[237]

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[230] *See* 10 C.F.R. § 73.55.

[231] HERBST & HOPLEY, *supra* note 95, at 159. "In 2004 these exercises were expanded in order for the NRC to evaluate each plant site once every three years instead of every eight years, the standard used prior to the September 11 attacks." *Id.*

[232] *Id*; *see also* Gaukler et al., *supra* note 215, at 168. Gaukler describes the enhanced security procedures:

> The entire plant perimeter must be fenced with adjacent areas cleared to permit observation of both sides of the fenced barrier. The perimeter must be monitored both visually and electronically with electronic alarms sounding at two independent, continuously staffed stations. Entry points must be guarded and monitored and access must be strictly controlled. All plants must have armed response forces whose qualifications and tactical training are dictated by 10 C.R.F. Part 73, App. B. Each armed responder or watchman must be capable of maintaining continuous communication with each of the continuously staffed alarm stations.

Id.

[233] HERBST & HOPLEY, *supra* note 95, at 159. "In addition, the NRC also issued orders to ensure security personnel fitness for duty and that the number of hours worked does not compromise personnel's effectiveness in performing their duties." *Id.*

[234] *Id.* at 161-62.

[235] *Id.* at 163.

[236] Gaukler et al., *supra* note 215, at 169.

[237] *Id.*

C. Weapons

1. The Mushroom Cloud

A revolution in the nuclear industry that freed the United States from its oil addiction would certainly provide national security benefits. But what if increased nuclear energy production also increased the production of weapons-grade nuclear material, thus making it easier for the enemy to acquire a nuclear weapon? Indeed, the greatest factor limiting the ability of terrorist organizations and hostile states from obtaining nuclear weapons is the availability of fissile material.[238] "Once the nuclear material is obtained, actual design and construction of the weapon can proceed using publicly available information and access to conventional materials."[239] There are only two isotopes that are known to be suitable as weapon weapons-grade fissile material: uranium-235 and plutonium-239.[240] Uranium must be enriched in order to become weapons-grade, which is an arduous task.[241] Plutonium, on the other hand, is generated as a waste product when uranium-238 is used as a fuel source.[242] Moreover, purification of plutonium to weapons-grade form is much easier then enriching uranium.[243]

This type of proliferation of nuclear weapons is an inherent and undeniable risk caused by increased energy production.[244] For instance, in

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[238] Daniel C. Rislove, *Global Warming v. Non-Proliferation: The Time Has Come for Nations to Reassert Their Right to Peaceful Use of Nuclear Energy*, 24 WIS. INT'L L. J. 1069, 1086 (2007); *see also* Robert Chesney, *National Insecurity: Nuclear Material Availability and the Threat of Nuclear Terrorism*, 20 LOY. L.A. INT'L & COMP. L. J. 29, 36–38 (1997).

[239] Rislove, *supra* note 239, at 1086. Rislove describes this troubling phenomenon: "In 1964 the United States government conducted a test called the 'Nth Country Experiment.' A group of young physicists, none of whom had experience with nuclear physicists, were asked to design a nuclear weapon from publicly available information. Later analysis determined that the bomb they designed was fully functional." *Id.* at 1086 n.122 (internal citations omitted).

[240] *Id.* at 1086.

[241] *Id.*

[242] *Id* at 1086–87. Rislove adds: "It must be noted, however, that traditional commercial nuclear reactors produce substantial quantities of undesirable isotopes of plutonium that would make the material less useful in constructing a nuclear weapon." *Id.*

[243] *Id.*

[244] *See* Treaty on the Non-Proliferation of Nuclear Weapons art. IV, July 1, 1968, 21 U.S.T. 483; *see also* ALLISON, *supra* note 49, at 101. This is how North Korea acquired nuclear material to make its weapon. Because of the technical intensity of enriching uranium, North Korea used its Yongbyon reactor, which was made with assistance by the Soviet Union in 1979. *Id.*; *see also North Korea Claims to Have Weaponized Plutonium*, CNN (Jan. 17,

the 1950s, as part of United States' Atoms for Peace program — an effort to win hearts and minds during the Cold War — the United States exported 1,650 pounds of plutonium and 60,000 pounds of highly enriched uranium (HEU) to over 39 countries over a 30-year period.[245] Unfortunately, in some instances, destabilization led to security vulnerabilities that resulted in nuclear material falling into the wrong hands.[246] "Zaire's Triga II reactor fell into disarray. Funding for the reactor ceased in 1988, and it was shut down in 1992. Five years later, when rebels overthrew the dictator Mobutu Sese Seko, eight uranium bars . . . were spirited out of the country and into the black market."[247] Unfortunately, a similar story took place at the nuclear reactor in Kinshasa, Congo.[248] "During some of the more difficult times in Congo's recent history, the reactor in Kinshasa has sat unmonitored by local and international authorities. This reactor has been cited as a potential source for black market smugglers interested in the sale of dangerous materials."[249]

Therefore, many argue that if the United States turns to nuclear power to solve its energy woes, the implications for nuclear weapons proliferation would be problematic.[250] Specifically, opponents of nuclear power typically argue that other countries would follow the lead of the United States in promoting nuclear power, which would mean that ensuring that nuclear materials were not diverted to weapons programs would be almost impossible.[251] Indeed, the United States already confronts other countries "over alleged nuclear weapons aspirations from far more modest programs involving a handful of power plants" with minimal success.[252]

2009), http://www.cnn.com/2009/WORLD/asiapcf/01/17/korea.nuclear/ (last visited Nov. 10, 2010). By 1986 this reactor was producing spent reactor fuel which was ultimately turned into 40 kilograms of weapons-grade plutonium, enough for several nuclear weapons. *Id.*

[245] ALLISON, *supra* note 49, at 81; *see also* Burke, *supra* note 70, at 2.

[246] ALLISON, *supra* note 49, at 81.

[247] *Id.*

[248] Burke, *supra* note 70, at 2.

[249] *Id.* (citing Douglas Pasternak & Eleni E. Dimmler, *A Home-Grown Nuclear Threat*, U.S. NEWS & WORLD REP., Sept. 23, 2002, at 40).

[250] *See* Makhijani, *supra* note 117, at 66.

[251] *See id.*

[252] *See id.* Makhijani adds: "Similarly, it would be difficult to inspect, regulate and maintain such a vast number of plants properly. Even the United States regulatory system is currently under considerable strain. In fact, oversight and safety are deteriorating. There have been unexpected leaks and severe corrosion problems missed by inadequate regulation." *Id.* at 66–67.

2. Mitigations and Misconceptions

The simplest way to mitigate the proliferation implications of increased nuclear power is simply to not reprocess spent fuel, and thus cease the production of weapons-grade plutonium. Graham Allison, in his book, *Nuclear Terrorism: The Ultimate Preventable Catastrophe*, argues that in order to reduce this threat, the international community should take a "No New Nascent Nukes" approach.[253] Allison argues that the United States should try to prevent any new national capabilities to enrich uranium or reprocess plutonium. However, the United States would be hard-pressed to persuade other sovereign nations to forgo reprocessing if it started to use the technology itself. At the same time, if reprocessing were abandoned as the preferred method, the waste problem described earlier would become even more overwhelming. Thus, we must find a way to continue using nuclear energy safely, which still involves enriching uranium and reprocessing plutonium.

The primary concern with nuclear proliferation is the scenario in which a terrorist organization acquires nuclear material.[254] However, it is widely agreed that enriching uranium or reprocessing plutonium is outside the capabilities of even the most sophisticated terrorist organization.[255] Thus, Michael Levi, in his book *On Nuclear Terrorism*, argues that the answer is not preventing nuclear material from being made, but from preventing terrorists from acquiring it, through better security and surveillance.[256] Indeed, according to Levi, no nuclear capable nation "would ever want to allow terrorists access to a bomb or to the materials needed to make one. A more contentious debate exists over what Pakistan and North Korea might do with their arsenals, but many believe that they would not part with them

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[253] *See* ALLISON, *supra* note 49, at 156.

[254] *See* MICHAEL LEVI, ON NUCLEAR TERRORISM 15 (2007). However, this point does bring up a second concern with nuclear proliferation — unfriendly nations developing the technology. Indeed, there is strong evidence that North Korea has developed "the bomb" and Iran is on the road to becoming a nuclear power. *See* Justin McCurry & Tania Branigan, *North Korea Tests Nuclear Weapon 'as Powerful as Hiroshima Bomb'*, GUARDIAN, May 25, 2009, http://www.guardian.co.uk/world/2009/may/25/north-korea-hiroshima-nuclear-test; *see also Q&A: Iran and the Nuclear Issue*, BBC NEWS (Oct. 7, 2010), http://news.bbc.co.uk/2/hi/middle_east/4031603.stm. Thus, the difficulties that a terrorist network would face in developing a nuclear bomb would be diminished in the case of a sovereign state. *Id.*

[255] LEVI, *supra* note 255, at 15.

[256] *See id.*

either."[257] Therefore, through protection, control, and accounting of nuclear material, the possibility of terrorists gaining nuclear material from a peaceful power reactor could be minimized.[258]

Stealing plutonium would also be difficult. Because fresh fuel rods do not contain plutonium, terrorists would have to steal spent fuel rods and process them.[259] To do so, they would have to "shield themselves from a high degree of radiation and possess the technology and knowledge to separate the materials."[260] This would be an unlikely course of action given the small amount of weapons-grade material that can be extracted from a spent fuel assembly, which would therefore require theft of several. Furthermore, the process used to remove the weapons-grade material is demanding.[261]

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[257] *Id.*

[258] *Id.* at 15–20. Levi describes these safeguards in further detail:

> 1. *Materials protection* "should allow for the detection of any unauthorized penetration of barriers and portals, thereby triggering the use of force if necessary." 2. *Materials control* "should prevent unauthorized movement of materials and allow for the prompt detection of the theft or diversion of material." 3. *Materials accounting* "should ensure that all material is accounted for, enable the measurement of losses, and provide information for follow-up investigations of irregularities."

Id. at 19–20.

[259] Burke, *supra* note 70, at 13. It should be noted that terrorists could use the spent rods to make a dirty bomb. Lewis Smith, *Seizures of Radioactive Materials Fuel Dirty Bomb Fears*, THE SUNDAY TIMES, Oct. 6, 2006, http://www.timesonline.co.uk/tol/news/uk/crime/article663245.ece. However, as discussed above, the availability of spent fuel is limited, and it is difficult to handle. *See supra* section IV.B.3. Thus, because other nuclear material that could be used in a dirty bomb is more accessible and user-friendly, it is this Author's position that the likelihood of terrorists stealing spent fuel to make a dirty bomb is small. *See* Jane Harman & Susan Collins, *Al Qaeda Still Wants A Dirty Bomb*, WALL ST. J., July 22, 2010, http://online.wsj.com/article/SB10001424052748704201604575373270385490484.html (explaining that a dirty bomb is easy "to assemble from ingredients that are widely available in this country. Highly dispersible radiological materials like cesium-137 or cobalt-40 are used every day in medical procedures at hospitals and in universities. These components of modern medicine are underprotected.").

[260] Burke, *supra* note 70, at 13.

[261] LEVI, *supra* note 255, at 85–86. After extracting the material from the spent fuel, "the group will have to convert the extracted material either to powder or to metal. The first part of this process — essentially reprocessing, minus the complication of handling radioactive material — adds to the demands on a terrorist plot. Beyond that process, either oxide or metal must be produced." *Id.*

In addition, Levi notes that even if reprocessing allowed nuclear material to fall into the hands of terrorists, building a plutonium bomb would be much more difficult than a uranium bomb.[262] Specifically, "[n]ot only is plutonium metal harder to fashion into a powerful weapon than uranium is, but it is also more difficult to hide from radiation detectors because of its far higher rate of spontaneous fission."[263] Thus, because plutonium is considerably easier to detect, terrorists would be less likely to successfully use the material.[264]

Perhaps the most promising method to reduce the threat that reprocessing poses is innovation: inventing new ways for reactors to burn fuel without producing weapons-grade plutonium as a byproduct.[265] One such reprocessing method is called "uranium extraction plus," which keeps uranium and plutonium together in the fuel cycle, avoiding the possibility of pure plutonium being extracted.[266] Other designs purposely produce spent fuel rods with impurities, making it even more difficult to make weapons-grade material.[267] Specifically, "[b]y putting an isotope of americium, Am-241, in all new fuel rods, neutrons can be captured while the rod is in the reactor. This creates a curium isotope, Cm-242, which would eventually deteriorate into [plutonium]-238. Theoretically, if this process is timed appropriately, it would render spent fuel useless for weapons."[268]

This method has potential, for example, in North Korea, where in 1994, the United States agreed to help replace the Yongbyon reactor with a new light water reactor.[269] Unlike the type of reactor at Yongbyon, light-water reactors are much less capable of producing weapons-grade plutonium, and thus do not present the same proliferation concerns.[270] Although this deal never came to fruition, innovative nuclear technology could be an effective strategy to combat proliferation.

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[262] *Id.* at 73.
[263] *Id.* at 79.
[264] *Id.* at 81.
[265] Rislove, *supra* note 239, at 1090.
[266] *Id.*
[267] *Id.* at 1087; *see also* Burke, *supra* note 70, at 20.
[268] Burke, *supra* note 70, at 20.
[269] Agreed Framework Between the United States of America and the Democratic People's Republic of Korea (Oct. 21, 1994), *available at* www.kedo.org/pdfs/AgreedFramework.pdf.
[270] *See Energy Profile of North Korea*, THE ENCYCLOPEDIA OF EARTH, May 30, 2008, http://www.eoearth.org/article/Energy_profile_of_North_Korea

A final possible solution to the problems associated with reprocessing is the implementation of a type of fuel bank system. Under such a scheme, nations promise not to enrich or reprocess nuclear material or reprocess their fuel rods, and in exchange they are provided nuclear fuel at a considerable discount, and are also alleviated of their own waste problem.[271] "Concentrating fuel reprocessing facilities in a limited number of areas under multinational oversight would eliminate the redundancy of multiple processing centers and thereby increase the cost-effectiveness of nuclear energy."[272] In addition, "reprocessing itself will increase the total amount of energy extracted from uranium ores, which in turn will enhance the efficiency of nuclear power generation."[273] If a state refused to join such a consortium it could be a clear indication that it is intent on using self-generated fuel to make weapons, thus, increasing the practical enforceability of non-proliferation agreements.[274]

V. Changing the Decision Making Process

Shaping the nuclear debate is about more than just pointing out potential problems and reasons why those problems are exaggerated (misconceptions), or how we can reduce the potential harm caused by these problems (mitigations). Rather, this Article seeks to demonstrate that energy dependence is a critical threat to the United States' national security and that more than simply turning to a more internally sustainable energy source, this country needs to change the way it thinks about energy and how it formulates energy policy.

How a decision is made is often just as important as *what* decision is made. In addition to proposing the direction decision-makers should take to solve America's oil addiction, it is appropriate to consider what changes in the decision making process must also be addressed. Such changes necessarily implicate the fundamental processes by which policy decisions are made, both at the macro level (changing the way the nation thinks about

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[271] ALLISON, *supra* note 49, at 158.
[272] Rislove, *supra* note 239, at 1096.
[273] *Id.*
[274] *Id.* A drawback to a system such as this could be a chilling effect on membership. If states felt that they were being "muscled" into joining with the threat of being accused of having a nefarious nuclear agenda, they may refuse on the grounds of sovereignty.

energy dependence), and influencing the decisions of individuals at the micro level (the farmer deciding whether or not to grow ethanol).

Turning off the tap of foreign oil and instead relying on nuclear energy is not a novel proposal; policy makers in this country have been concerned about this issue since the Presidency of Richard Nixon.[275] The Nixon administration launched "Project Independence" in 1973, with the lofty goal of obtaining energy independence.[276] This goal was outlined in Nixon's 1974 State of the Union address: "Let this be our national goal: at the end of this decade, in the year 1980, the United States will not be dependent on any other country for the energy we need to provide our jobs, to heat our homes, and to keep our transportation moving."[277] The same threat was again recognized by President Ford, who in his 1975 State of the Union Address remarked:

> I have set the following national energy goals to assure that our future is as secure and as productive as our past: First, we must reduce oil imports by 1 million barrels per day by the end of this year and by 2 million barrels per day by the end of 1977. Second, we must end vulnerability to economic disruption by foreign suppliers by 1985. Third, we must develop our energy technology and resources so that the United States has the ability to supply a significant share of the energy needs of the free world by the end of this century. To attain these objectives, we need immediate action to cut imports.[278]

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[275] President Richard M. Nixon, Address to the Nation About National Energy Policy (Nov. 25, 1973), *available at* http://www.presidency.ucsb.edu/ws/index.php?pid=4051. One result of Project Independence, an initiative announced by President Nixon in reaction to the OPEC oil embargo, was the enactment of the Energy Policy and Conservation Act, on December 22, 1975, which created a billion barrel Strategic Petroleum Reserve (SPR). *See Strategic Petroleum Reserve Profile*, DEP'T OF ENERGY, http://www.fe.doe.gov/programs/reserves/spr/index.html (last visited Nov. 10, 2010). The SPR is located at four different sites in underground caverns near the coastline of the Gulf of Mexico and may hold up to 727 million barrels of petroleum. *Id.* "The Energy Policy Act of 2005 directs the Secretary of Energy to fill the Strategic Petroleum Reserve to its authorized one billion barrel capacity." *Id.*

[276] *Id.*

[277] President Richard M. Nixon, State of the Union Address (Jan. 30, 1974), *available at* http://www.presidency.ucsb.edu/ws/index.php?pid=4327.

[278] President Gerald Ford, State of the Union Address (Jan. 15, 1975), *available at* http://www.presidency.ucsb.edu/ws/index.php?pid=4938.

This goal was not a partisan one. President Carter took the goal of energy independence to new heights, stating early on in his tenure that "[o]ur excessive dependence on foreign oil is a clear and present danger to our nation's security."[279] In November 1999, eleven United States Senators, representing both parties, asked "the United States Department of Commerce [to conduct] an investigation into the nation's increasing oil imports. That study, released in November 1999, concluded 'that petroleum imports threaten to impair the national security.'"[280] President George W. Bush also echoed this concern, stating that a goal of his administration was to promote energy independence. He emphasized in his 2006 State of the Union address that, "[k]eeping America competitive requires affordable energy. And here we have a serious problem: America is addicted to oil, which is often imported from unstable parts of the world."[281] Finally, President Obama has talked extensively about energy and its effect on the United States' national security and economy.[282] Indeed, in most of his campaign speeches, then-Senator Obama made a point to talk about his goal of energy independence.[283] President Obama has actually taken some first steps to support nuclear energy, such as in February 2010, when he "announced more than $8 billion in federal loan guarantees [ ] for the construction of the first nuclear power plant in the United States in nearly three decades."[284]

Yet despite all the attention energy dependence has received since the 1970s, the United States is not any closer to obtaining the goal of the independence project today. In fact, the opposite is true — in 1973 the United States was importing 6 million barrels of oil per day,[285] today the United States imports just over 20 million barrels of oil per day.[286] The

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[279] President Jimmy Carter, State of the Union Address (Jan. 23, 1980), *available at* http://www.presidency.ucsb.edu/ws/index.php?pid=33079.
[280] Coon & Phillips, *supra* note 10, at 2.
[281] President George W. Bush, State of the Union Address (Jan. 31, 2006), *available* at http://www.presidency.ucsb.edu/ws/index.php?pid=65090; *see also* President George W. Bush, State of the Union Address (Jan. 28, 2003), *available at* http://www.presidency.ucsb.edu/ws/index.php?pid=29645.
[282] *See, e.g.*, Energy for America, *supra* note 65.
[283] *See id.*
[284] *Obama Renews Commitment to Nuclear Energy*, ASSOCIATED PRESS, Feb. 16, 2010, http://www.msnbc.msn.com/id/35421517/.
[285] *United States Energy History*, U.S. ENERGY INFORMATION ADMINISTRATION, http://www.eia.doe.gov/emeu/aer/eh/eh.html (last visited Dec. 16, 2010).
[286] *This Time, supra* note 14.

obvious question is this: why has the United States' decision-making process not only failed to address this problem over the last thirty years, despite every President and Congress consistently recognizing it, but also allowed the problem to get worse?

A. Priorities and the "Priority"

The first step in ensuring good decision making to address a problem is to make certain that the decision makers agree that there is a problem. When it comes to energy dependence, as discussed above, presidents have been in consistent agreement on this point since 1973. In addition, most experts in the private sector agree that American energy dependence is a national security concern.[287]

However, while recognizing that a threat exists is a necessary first step, it is far from the last. Where the hazard falls on the threat continuum is also critical to the decision making process. For example, it does no good if a government agrees that bird flu is a national security threat, and then fails to fund any resources to combat the threat because it is ranked ninety-ninth in importance out of 100 threats. If there are no resources, the decision making process stops cold.

As a result, proper prioritizing of the energy threat is a requisite to developing good policy in this area. While it is not clear exactly where energy dependence falls on the priority scale, it is currently not high enough, as evidenced by the lack of serious attempts by any administration to solve the problem. To illustrate Congress's questionable prioritizing, consider that it spent hundreds of hours and millions of dollars investigating steroid use in professional baseball, while largely ignoring the exigency of the current energy crisis.[288] President Obama should use his bully pulpit to keep this issue on the forefront of the national agenda, much like the way he did during the election.

The American people, like Congress and other decision makers, also appear to not truly appreciate the gravity of this emergency. Recently,

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[287] *See, e.g.*, PICKENS PLAN, http://www.pickensplan.com/ (last visited Nov. 10, 2010).
[288] *See* Erica Hill, *Congress and Baseball*, AC360.COM (Feb. 13, 2008, 7:43 PM), http://ac360.blogs.cnn.com/2008/02/13/erica-hill-congress-and-baseball/.

Americans have been outraged by the rise in gas prices.[289] Yet it is estimated that in the average American family, one quarter of purchased food goes from the store, to the refrigerator, to the garbage can.[290] This is significant because transportation plays a significant role in the price of food — wasting food is wasting oil. If the threat of energy dependence is to truly be given the attention it deserves, this country will need to approach it holistically. Because the United States' economy and the way of life of the American people is fully reliant on oil, the consequences of this problem are catastrophic and thus urgent.[291] Consider the fact that the United States imports 700 billion dollars[292] of oil every year, and the national GDP is 14 trillion dollars.[293] Thus, the United States is exporting a significant part of its wealth every year, just to power itself. For how many years can a country export so much wealth, no matter how powerful, before it finds itself "owned" by other countries? It is also interesting to note that foreign oil expenditures are significantly higher than the entire balance of the trade deficit ($60 billion), thus, eliminating foreign oil imports would simultaneously give America a $140 billion trade surplus.[294] Put another way, the recent bailout of several banks under the Troubled Assets Relief Program (TARP) that has drawn so much criticism was valued at $700 billion — about equal to the amount of money this country spends on oil in just one year.[295]

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[289] *See* Judy Keen & Paul Overberg, *Gas Prices Rattle Americans*, USA TODAY, May 9, 2008, http://www.usatoday.com/money/industries/energy/2008-05-08-gasprices_N.htm.

[290] Linda Resnik, *How Much Food Do You Waste?*, GOODCOOKING.COM, http://www.goodcooking.com/ckbookrv/winter_02/foodfaqs/foodwaste.htm (last visited Nov. 10, 2010); *see also Retail Food Prices Up at Beginning of 2008*, AMERICAN FARM BUREAU, http://www.fb.org/index.php?fuseaction=newsroom.newsfocus&year=2008&file=nr0327.html (last visited Nov. 10, 2010).

[291] *See supra* Part II.

[292] *See* PICKENS PLAN, *supra* note 287.

[293] *The World Factbook*, U.S. CENTRAL INTELLIGENCE AGENCY, https://www.cia.gov/library/publications/the-world-factbook/geos/us.html (last visited Nov. 10, 2010).

[294] *Foreign Trade*, U.S. CENSUS BUREAU, http://www.census.gov/foreign-trade/www/ (last visited Nov. 10, 2010).

[295] Matthew Ericson et. al., *Tracking the $700 Billion Bailout*, N.Y. TIMES, http://projects.nytimes.com/creditcrisis/recipients/table (last visited Nov. 10, 2010).

B. Seat at the Table

In 2007, Congress passed the Energy Independence and Security Act of 2007,[296] which, among other things, added the Secretary of Energy as a statutory member of the National Security Council ("NSC").[297] The NSC exists to "advise the President with respect to the integration of domestic, foreign, and military policies relating to the national security so as to enable the military services and the other departments and agencies of the Government to cooperate more effectively in matters involving the national security."[298] Regardless of whether this position on the NSC will actually give energy a more prominent role in the national security discussion at the NSC, this change does at least symbolically suggest that Congress considers energy issues of to be important enough that someone should represent these views at the highest levels in national decision making. This was a wise change; a good decision making process rests on the principle of listening to all the relevant players.[299]

The private sector must also have input in this area. T. Boone Pickens, the oil tycoon, launched a multi-million dollar campaign claiming that his ideas will save America from oil dependence.[300] While his idea primarily focuses on wind to generate energy, not nuclear power, it is important that the people who will really change the face of energy — private industry — have a say in how energy policy is made. One way the private sector can be brought in to the decision making process is the construction of a public-private committee that has teeth, which could make informed recommendations to decision makers without political motivation. If the government wanted to get really serious about the issue of energy dependence it could design the committee in the template of the Base Realignment Commission (BRAC), which was given real power to close wasteful and duplicative military installations.[301]

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[296] Energy Independence and Security Act of 2007, Pub. L. 110-140, 121 Stat. 1492 (codified at scattered sections of U.S.C.).
[297] *See id.* § 932 (codified at 50 U.S.C. § 402 (2006)).
[298] 50 U.S.C. § 402(a).
[299] *See* DORIS K. GOODWIN, TEAM OF RIVALS: THE POLITICAL GENIUS OF ABRAHAM LINCOLN xvii (2005).
[300] *See* PICKENS PLAN, *supra* note 287.
[301] *See Base Realignment and Closure (BRAC),* GLOBALSECURITY.ORG, http://www.globalsecurity.org/military/facility/brac.htm.

C. Reward the Righteous Not the Sycophants

In America there is a sentiment that the majority decision is the right decision. Yet this sentiment, throughout history, has often been proven untrue. Because virtually the entire world at one point thought that the world was flat did not make it so.[302] The Founding Fathers specifically established a system of government to prevent mob rule, and thus we have a system that allows wise but unpopular decisions to prevail. The Electoral College system was originally designed just for this purpose, to protect liberty against the changing whims of the populace.[303]

Today, decision makers rule, and are in turn ruled by the people they represent. The national decision making process favors finding quick fixes to short-term, popular issues only to ignore the proverbial 800 pound gorilla. This is true when the decision making process is deliberately designed, or when it is an organic, ad-hoc process that has evolved because of a hodge-podge mixture of pressures, ill-defined goals, and inattention to the urgency of the pending threat. It is the process that is exercised and the process that must be fixed. In advocating for a nuclear-led push towards energy independence, this Article urges America to embrace big ideas along with some risks. These ideas may cause short-term pains as the country weans itself from foreign oil, but these costs are outweighed by the benefits of building new efficient nuclear power plants, and using the resulting energy gap to develop new technology for transportation energy.

It is unlikely that the United States, or the world for that matter, will be able to just find more oil.[304] Hence, it is fairly clear to most serious

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[302] In America, the institution of slavery was supported by most Americans in the early 1800s, and not just in the Southern States. *See* Lynn D. Wardle, *The Quandary of Pro-Life Free Speech: A Lesson from the Abolitionists*, 62 ALB. L. REV. 853, 923–24 (1999). Indeed, "abolitionists were [ ] unpopular in both the North and South; they were considered . . . religious zealots whose message was allegedly unconstitutional and undeniably incendiary, and who were criticized for trying to impose their moral views upon others in a way that was extremely disruptive to the nation." *Id.*

[303] *See* Vin Suprynowicz, *Sacrificing Nevada's Voice in Favor of Mob Rule*, LAS VEGAS REVIEW-JOURNAL, Apr. 26, 2009, http://www.lvrj.com/opinion/43733762.html; *see also* Representative Ron Paul, *The Electoral College vs. Mob Rule*, LEWROCKWELL.COM, Nov. 2, 2004, http://www.lewrockwell.com/paul/paul214.html. As originally envisioned, the Founding Fathers "created the Electoral College to guard against majority tyranny in federal elections. The president was to be elected by the 50 states rather than the American people directly, to ensure that less populated states had a voice in national elections." *Id.*

[304] *See California Field*, *supra* note 20.

experts who study energy dependence crises that technology and science must be the savior.[305] Therefore, any deficiency in scientists' decision making processes is a problem. Unfortunately, there has been a major drawback in the area of new research that has stunted the growth of new science and technology. Specifically, the scientific community is plagued with a "culture that punishes less-than-ideal risk-related outcomes [and has] stifle[d] both initiative and innovation."[306] In a recent unscientific poll taken among the research and development staff at one of the world's largest products companies, when asked "[w]hat is your primary source of hesitation when it comes to taking work-related risks?",[307] the answer fifty-nine percent of the time was "[t]he Implications of Failure."[308] Hence, ingenuity — the very concept that can solve this problem — is being strangled in many research and development labs across America. History has shown that on numerous occasions "the experience from failures in scientific exploration is more precious than that from successes."[309]

China, the world's fastest growing economy,[310] has passed a law in order "to boost 'home-grown innovation'" that promotes the idea to scientists that they should take risks and that the government will "tolerate experiment failures."[311] This is precisely the type of change in decision making processes that needs to happen in the United States if Americans are to reap the maximum benefits from using technology to curve the energy dependence crises.

There is no doubt that political feasibility and the substance of the policies that are actually adopted are inextricably linked; if there is no political will to change how this country makes decisions concerning energy there will be no legal reality in the form of a policy. Accordingly, in order to make a difference, the country needs brave leaders who are willing to say

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[305] *See* Ker Than, *Quick Fixes Won't Solve Looming Oil Crisis, Scientists Say*, LIVESCIENCE (Apr. 26, 2008, 10:02 AM), http://www.livescience.com/environment/060428_oil_peak.html.
[306] Jim McCormick, *Seeking Initiative and Innovation? Reward Failure!*, TAKERISKS.COM, http://www.takerisks.com/pdf/Innovationv3.pdf.
[307] *Id.*
[308] *Id.*
[309] Guo Shipeng, *China Reassures Scientists Not to Fear Failure*, REUTERS, Mar. 13, 2008, http://www.reuters.com/article/idUSPEK28890320080313.
[310] *China Country Profile*, BBC NEWS, http://news.bbc.co.uk/2/hi/asia-pacific/country_profiles/1287798.stm (last visited Nov. 10, 2010).
[311] Shipeng, *supra* note 309 ("Worried about being left behind in global technological advances, China has launched a campaign to pour more resources into scientific research to boost 'home-grown innovation.'").

"the Emperor has no clothes" — not for the good of their next campaign but for the good of the country — leaders who do what is right, even when unpopular, and let history redeem them.

Conclusion

If the United States were a body, oil would be its blood. Nobody would agree to bring hostile or infected blood into their body, yet the United States imports 20 million barrels of infected "blood" into its borders every day.[312] The United States is being "blackmailed" by unstable and undemocratic nations through this addiction, which increases the probability of military conflicts around the world, which in turn decreases this country's overall security. Moreover, the oil addiction has driven oil companies to take bigger risks which directly caused one of the biggest disasters this country has ever seen — thousands of jobs lost, millions of cleanup dollars wasted, and the ecosystem scarred for years.

This situation is even more troubling when one realizes that clean, reliable, and abundant nuclear energy is available now. As demonstrated by this Article, while a nuclear renaissance is not without concerns, those concerns can be mitigated through technology and common sense. However, nuclear technology should not be the only avenue pursued to obtain energy freedom. Indeed, if the United States devotes itself to nuclear energy in the same way it has oil, it might end up in the same national security crisis with different facts. Therefore, just as the United States should be considering new ways to produce more and safer nuclear energy, so too should it be trying to discover the next energy breakthrough or expand on other contemporary sources. Surely a country that can send a man to the moon can become energy independent.

Lastly, Americans need to elect serious and courageous decision makers if they expect serious answers to this problem. Leaders need to stop asking softball questions and avoiding non-confrontational statements, and start making long-term decisions that are best for the country despite the short term pain they may bring.

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[312] *This Time, supra* note 14.