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#### Interpretation: Production incentives are direct monetary support contingent on electricity generation - that’s different than investment incentives

Doris, NREL researcher, 12

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

3.3 Market Expansion

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

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

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

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

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

#### Energy production requires the generation of electricity

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

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

#### Violation – R&D is not a financial incentive

Doris et al – National Renewable Energy Laboratory (US DOE) – Dec 2009

Elizabeth Doris, Jaquelin Cochran, and Martin Vorum, Energy Efficiency Policy in the United States: Overview of Trends at Different Levels of Government http://www.nrel.gov/docs/fy10osti/46532.pdf

The industrial sector, which accounts for 31% of U.S. primary energy consumption (EIA 2008), spans a wide variety of subsectors, all of which have different energy needs. Thus policies to improve energy efficiency in this sector are designed to allow flexibility across a number of differing industry needs, including:

1. Incentives, both financial (e.g., loans and grants for industries to upgrade equipment) and non-financial (e.g., expedited permitting)

2. Technical assistance, including programs, such as energy audits, that help industries identify and implement energy-efficiency programs

3. Research and development.

The federal government offers all three policy types. It offers tax incentives for the manufacturing and home building subsectors, and loans that require energy savings and emission reductions from participating companies. These incentives are flexible enough to apply to a broad array of industry subsectors. In addition, the federal government offers several general industry programs that provide plant-specific technical assistance to highly energy-intensive industries.

State government programs focus on financial incentives, including tax credits, loans, and grants, to offset costs to industries for adopting efficient technologies. Many states also offer programs that can provide customized support to individual industries as part of broader energy efficiency programs. These programs allow funds to be spent on both incentives and technical assistance.

Local government programs related to energy efficiency are often designed with the goal of attracting industries, and thus jobs, to the locality. These programs primarily rely on non-financial incentives, such as expedited permitting for “green” industries.

#### Vote neg

#### Predictable limits – There are 100s of unproven technologies an aff could investigate – impossible to predict them because they aren’t in the energy production literature

#### Ground – Allows the aff to gain “science good” and spinoff advantages without defending efforts to boost status-quo energy production – avoids all our links – especially bad for the neg because the lit on undeveloped tech is skewed towards the optimists while the rational authors ignore it

### Politics

#### Comprehensive immigration reform is a top priority --- Obama will make an aggressive push to get it passed

Volsky, 12/30 (Igor, 12/30/2012, “Obama To Introduce Immigration Reform Bill In 2013,” <http://thinkprogress.org/justice/2012/12/30/1379841/obama-to-introduce-immigration-reform-bill-in-2013/>)

President Obama reiterated his call for comprehensive immigration reform during an interview on Meet The Press, claiming that the effort will be a top goal in his second term. “Fixing our broken immigration is a top priority. I will introduce legislation in the first year to get that done,” Obama said. Administration officials have hinted that Obama will “begin an all-out drive for comprehensive immigration reform, including seeking a path to citizenship” for 11 million undocumented immigrants, after Congress addresses the fiscal cliff. The Obama administration’s “social media blitz” will start in January and is expected “to tap the same organizations and unions that helped get a record number of Latino voters to reelect the president.” Cabinet secretaries and lawmakers from both parties are already holding initial meetings to iron out the details of the proposal and Obama will to push for a broad bill.

#### Obama’s capital and bipartisan cooperation are key to effective reform

DMN, 1/2 (Dallas Morning News, “Editorial: Actions must match Obama’s immigration pledge,” 1/2/2013, <http://www.dallasnews.com/opinion/editorials/20130102-editorial-actions-must-match-obamas-immigration-pledge.ece>)

President Barack Obama said all the right things Sunday about immigration reform. The president told NBC’s Meet the Press that he is serious about getting Congress to overhaul the laws governing immigrants. He even declared that he will introduce an immigration bill this year. This newspaper welcomes that announcement. Texans particularly understand the unique challenges that an outdated immigration system presents. Even though the flow of illegal immigrants into the U.S. has subsided in the last few years, the many holes in the system leave families, schools, businesses and law enforcement struggling. And those are just some of the constituents challenged by flawed immigration laws. The president’s words to NBC’s David Gregory are only that — words. What will really matter is whether he puts his muscle into the task this year. We suggest that Obama start by looking at the example of former President George W. Bush. Back in 2006 and 2007, the Republican and his administration constantly worked Capitol Hill to pass a comprehensive plan. They failed, largely because Senate Republicans balked. But the opposition didn’t stop the Bush White House from fully engaging Congress, including recalcitrant Republicans. Obama may have a similar problem with his own party. The dirty little secret in the 2006 and 2007 immigration battles was that some Democrats were content to let Senate Republicans kill the effort. Labor-friendly Democrats didn’t want a bill, either. And they may not want one this year. That reluctance is a major reason the president needs to invest in this fight. He must figure out how to bring enough Democrats along, while also reaching out to Republicans. In short, the nation doesn’t need a repeat of the process through which the 2010 health care legislation was passed. Very few Republicans bought into the president’s plan, leaving the Affordable Care Act open to partisan sniping throughout last year’s election. If the nation is going to create a saner immigration system, both parties need to support substantial parts of an answer. The new system must include a guest worker program for future immigrants and a way for illegal immigrants already living here to legalize their status over time. Some House Republicans will object to one or both of those reforms, so Speaker John Boehner must be persuasive about the need for a wholesale change. But the leadership that matters most will come from the White House. The president has staked out the right position. Now he needs to present a bill and fight this year for a comprehensive solution. Nothing but action will count.

#### Reform is key to U.S. competitiveness

Bush et al 09 – co-chairmen and director of a Council on Foreign Relations-sponsored Independent Task Force on U.S. Immigration Policy (7/21/09, Former Florida Gov. Jeb Bush and former White House Chief of Staff Thomas F. McLarty and Edward Alden, “Nation needs comprehensive, flexible immigration reform,” http://www.ajc.com/opinion/nation-needs-comprehensive-flexible-97393.html)

Our immigration system has been broken for too long, and the costs of that failure are growing. Getting immigration policy right is fundamental to our national interests — our economic vitality, our diplomacy and our national security. In the report of the bipartisan Council on Foreign Relations’ Independent Task Force on U.S. Immigration Policy, we lay out what is at stake for the United States. President Barack Obama has made it clear that reform is one of his top priorities, and that is an encouraging and welcome signal. Immigration has long been America’s secret weapon. The U.S. has attracted an inordinate share of talented and hardworking immigrants who are enticed here by the world’s best universities, the most innovative companies, a vibrant labor market and a welcoming culture. Many leaders in allied nations were educated in the U.S., a diplomatic asset that no other country can match. And the contributions of immigrants — 40 percent of the science and engineering Ph.D.s in the U.S. are foreign-born, for example — have helped maintain the scientific and technological leadership that is the foundation of our national security. But the U.S. has been making life much tougher for many immigrants. Long processing delays and arbitrary quota backlogs keep out many would-be immigrants, or leave them in an uncertain temporary status for years. Background and other security checks are taking far too long in many cases. Other countries are taking advantage of these mistakes, competing for immigrants by opening their universities to foreign students and providing a faster track to permanent residency and citizenship.

#### The plan is extremely unpopular

Hunter, 12 (Eve, 10/16/2012, “Livermore Fails to See the Light,” <http://nukesofhazardblog.com/tag/Congress>)

Those involved with the project claim the passing of the September 30 deadline can be chalked up to the difficulty of predicting scientific breakthroughs, as quoted in William Broad’s September 29th New York Times article. Broad sheds light on the scientists’ defense of the program, citing its utility as a potential energy source as well as contributions to the maintenance of the United States nuclear arsenal. If it is concluded that the NIF cannot contribute significantly to reducing American dependence on oil, advocates for the program argue that this facility can aid the Stockpile Stewardship Program meant to maintain reliability of nuclear weapons in the absence of testing. Enter noted scientist, Richard Garwin, to accuse the NIF of an unremarkable potential for contributions to Stockpile Stewardship. Garwin elaborates in a 2006 IEEE article: "The temperatures in the NIF chamber are much lower than they are in actual nuclear weapons, and the amounts of material being tested are much smaller." In response, the physicists at the laboratory speak of their ability to infer results and knowledge of atomic properties. Regardless, there is little to prove that this facility will produce useful information. As such, it has acquired the nickname “National Almost Ignition Facility”. Amidst the heated debate even among the preeminent scientists, there are growing Congressional concerns about the bottom line. The facility is costing about $290 million annually, and NIF’s failures could not come at a more inconvenient time. The highly divided Congress must come to a consensus on dealing with the federal deficit or face automatic budget cuts at the end of the year. A project not vital to the economy will be hard pressed to survive in this climate.

#### Competiveness key to economy and hegemony

Segal, 04 – Senior Fellow in China Studies at the Council on Foreign Relations

(Adam, Foreign Affairs, “Is America Losing Its Edge?” November / December 2004, http://www.foreignaffairs.org/20041101facomment83601/adam-segal/is-america-losing-its-edge.html)

The United States' global primacy depends in large part on its ability to develop new technologies and industries faster than anyone else. For the last five decades, U.S. scientific innovation and technological entrepreneurship have ensured the country's economic prosperity and military power. It was Americans who invented and commercialized the semiconductor, the personal computer, and the Internet; other countries merely followed the U.S. lead. Today, however, this technological edge-so long taken for granted-may be slipping, and the most serious challenge is coming from Asia. Through competitive tax policies, increased investment in research and development (R&D), and preferential policies for science and technology (S&T) personnel, Asian governments are improving the quality of their science and ensuring the exploitation of future innovations. The percentage of patents issued to and science journal articles published by scientists in China, Singapore, South Korea, and Taiwan is rising. Indian companies are quickly becoming the second-largest producers of application services in the world, developing, supplying, and managing database and other types of software for clients around the world. South Korea has rapidly eaten away at the U.S. advantage in the manufacture of computer chips and telecommunications software. And even China has made impressive gains in advanced technologies such as lasers, biotechnology, and advanced materials used in semiconductors, aerospace, and many other types of manufacturing. Although the United States' technical dominance remains solid, the globalization of research and development is exerting considerable pressures on the American system. Indeed, as the United States is learning, globalization cuts both ways: it is both a potent catalyst of U.S. technological innovation and a significant threat to it. The United States will never be able to prevent rivals from developing new technologies; it can remain dominant only by continuing to innovate faster than everyone else. But this won't be easy; to keep its privileged position in the world, the United States must get better at fostering technological entrepreneurship at home.

#### Hegemonic decline causes great power wars – 1930’s prove

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

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

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

### Weaponization DA

#### Magnetized target fusion violates norms against testing, causes pure fusion weapons development and massive proliferation – bigger impact because they blur the lines between conventional and nuclear weapons and are more useable

Makhijani and Zerrifi 98

(Arjun, Electrical and Nuclear Engineer, President of the Institute for Energy and Environmental Research, Hisham, Assistant Professor and Ivan Head South/North Research Chair, Liu Institute for Global Issues, “Thermonuclear Fusion Research Could Result in New Weapons and Greater Proliferation Dangers”, http://ieer.org/resource/reports/dangerous-thermonuclear-quest/)

July 15, 1998 WASHINGTON, D.C. Key portions of the US “stockpile stewardship” program for nuclear weapons may violate the Comprehensive Test Ban Treaty, which bans all nuclear explosions, according to a new report issued here today. The report warns of severe new proliferation dangers that would develop if current and planned US, French, and Russian laboratory nuclear testing programs, such as the National Ignition Facility at the Lawrence Livermore National Laboratory in California, result in the development of pure [fusion](http://ieer.org/wp/mcm_glossary/fusion/) weapons. The report, Dangerous Thermonuclear Quest: The Potential of Explosive Fusion Research for the Development of Pure Fusion Weapons, details current activities that are connected to the design of the thermonuclear components of weapons, commonly called “hydrogen bombs.” It was released today by the Institute for Energy and Environmental Research (IEER), a non-profit institute in Takoma Park Maryland. “Pure [fusion](http://ieer.org/wp/mcm_glossary/fusion/) weapons have long been a dream for nuclear weapons designers. Present-day thermonuclear weapons need [plutonium](http://ieer.org/wp/mcm_glossary/plutonium/) or highly enriched uranium to set off the hydrogen-bomb part,” said Dr. Arjun Makhijani, principal author of the report and president of IEER. “But pure fusion weapons would not need either of these fissile materials. They would produce little fallout. They could be made very small or very huge. And the research involves interesting scientific challenges.” However, pure fusion weapons would present far greater nuclear proliferation dangers since the acquisition of highly enriched uranium or [plutonium](http://ieer.org/wp/mcm_glossary/plutonium/) is currently the main obstacle to proliferation. By contrast, deuterium and [tritium](http://ieer.org/wp/mcm_glossary/tritium/), the forms of hydrogen used in fusion research and weapons, are less difficult to make. Verification would also be more difficult. Most importantly, fusion weapons would likely lower the threshold for nuclear weapons use, because of their smaller size and lack of fall-out, the report said. “Major advances in substituting the [fission](http://ieer.org/wp/mcm_glossary/fission/) trigger by non-nuclear components need to be made before the scientific feasibility of pure fusion weapons can be established,” said Hisham Zerriffi, a physicist and co-author of the report. “Until now, the hurdles have been too huge to overcome. But experiments are now being conducted and devices are now under construction that may achieve explosive thermonuclear ignition without fissile materials.” Two of the facilities discussed in the report are huge laser fusion machines — the National Ignition Facility (NIF) under construction at the Lawrence Livermore National Laboratory, in Livermore California, as well as a similar facility near Bordeaux in France, called Laser Mégajoule (LMJ). They are both designed to use powerful lasers to achieve thermonuclear explosions in the laboratory. The Comprehensive Test Ban Treaty (CTBT), which has been signed by over 150 countries including the United States and France, prohibits all nuclear explosions. The report states that the negotiating history shows that [fission](http://ieer.org/wp/mcm_glossary/fission/) explosion of even a few pounds of [TNT equivalent](http://ieer.org/wp/mcm_glossary/tnt-equivalent/) are banned under the CTBT. “We conclude that laboratory fusion explosions are also banned under the CTBT,” said Makhijani “That makes the National Ignition Facility and the Laser Mégajoule project illegal under that treaty. It is really provocative for the United States and France to be building these facilities at the same time they are lecturing countries like India and Pakistan to stop their nuclear weapons programs. IEER calls for a moratorium on explosive fusion projects and experiments designed to achieve thermonuclear ignition. Far more public debate on this crucial issue is needed.” The report points out that there is as yet no public negotiating record of the CTBT that explicitly deals with laboratory fusion explosions. It argues, however, that since these are clearly nuclear explosions, they are prohibited by the CTBT. The fact that some of these experiments would be for energy research does not change the reality that they would be nuclear explosions. Makhijani pointed out that once the scientific feasibility of pure fusion weapons is proven there would be inexorable pressures to actually develop them. “The time to stop is now, before the feasibility is established. Once feasibility is demonstrated, the pressures from the nuclear weapons laboratories as well as the military establishment to actually design and build weapons would be immense,” he said. The report discusses several different devices and experiments that relate to the potential development of pure fusion weapons. Besides the laser fusion machines NIF and LMJ, it describes joint US-Russian experiments at Los Alamos National Laboratory, near Santa Fe, New Mexico and a device called the wire-array z-pinch at the Sandia National Laboratory, in Albuquerque, New Mexico. “These machines are complementary,” Zerriffi pointed out. “Lasers cannot be miniaturized into deliverable weapons. But NIF could be more easily used to design the thermonuclear fuel targets than the other two devices. The Magnetized Target Fusion experiments at Los Alamos could be used to perfect the use of chemical explosives in fusion weapons, while the wire-array z-pinch can generate intense x-rays, similar to those that are produced by the fission portion of present-day thermonuclear warheads.”

#### That collapses the taboo and makes nuclear war inevitable – only a strong distinction between nuclear and conventional weapons prevents escalation

Gizewski 96

(Peter, Senior Associate, Peace and Conflict Studies Program, University of Toronto, “From winning weapon to destroyer of worlds: the nuclear taboo in international politics”, 51 Int'l J. 397 (1995-1996) pgs. 400-419)

\*\*Full text version is at the back of the file if they want to see it – the middle part is all boring history stuff\*\*

Absolute and all-encompassing, the prohibition sets all nuclear weapons apart as unique, regardless of size or power. Nuclear explosives - both large and small - are equally illegitimate, and the latter remain so despite the existence of seemingly 'legitimate' conventional explosives of greater destructive power. The distinction stems in part from widely held but rarely questioned perceptions of nuclear arms as 'different.' Nuclear weapons are distinct simply because they are perceived to be distinct.9 The distinction also has roots in legal reasoning and diplo- macy.'0 Traditions and conventions are crucial to the conduct of social relations. Once established, they render behaviour predictable, help to co-ordinate actor expectations, and offer a gauge of intentions. If they are not held to be inviolate, these functions become more difficult. Transgression at any level threatens to erode shared understandings and expectations - increasing uncertainty and the inevitable costs and requirements of coping with it. One violation makes subsequent, per- haps more serious, actions of the same type easier to contemplate and thus more likely. Thus, any breach of the nuclear threshold threatens more than one isolated act of destruction: it sets a precedent signalling potential chaos, which may well include the prospect of more destruction to come.

\*\*\*He Continues\*\*\*

Emerging international context Today, the non-use norm probably enjoys a degree of recogni- tion and support unmatched in its history. Not only has the end of the United States-Soviet rivalry dramatically reduced the rationale underpinning large nuclear arsenals, but the current international threat environment suggests little appreciable rise in opportunities for or incentives to use nuclear weapons. The long and continuing tradition of observance has doubt- less strengthened the taboo's influence. Although the 199o-1 Gulf War raised the issue of nuclear use, concerns over the moral opprobrium that would attend its employment, along with the potential of such action to encourage nuclear prblif- eration, kept the coalition military effort squarely focussed on the use of less politically damaging military alternatives - and underscored the taboo's widespread support in the process. Yet over the longer term, changing political, technological, and strategic circumstances may well increase the challenges to the taboo. Somewhat paradoxically, while the end of the Cold War has rendered the logic of nuclear deterrence increasingly irrelevant, it has also increased the prospects for the emergence of new nuclear threats. On the one hand, the development of a more co-operative relationship between the United States and Russia has reduced the extent to which mutual nuclear vulnerability serves as a deterrent to the use of nuclear arms by either state. Interna- tional conflict is no longer tightly coupled to the logic of East- West competition. Thus the use of nuclear weapons in future regional conflicts by either nuclear superpower is less likely to be inhibited by the fear of retaliation in kind so crucial to stable Cold War deterrence. On the other hand, the end of East-West rivalry has unleashed forces which increase the chances for mishandling and proliferating nuclear weapons, materials, and technology to a wide variety of national and subnational actors. Not only does this threat include more dedicated and sophisticated indige- nous efforts by some states (for example Iraq or North Korea) to attain nuclear capabilities, but also the prospect that elements of the vast nuclear complex of the former Soviet Union are mishandled by their inheritors;43 a situation whose dangers range from nuclear accident to unauthorized nuclear launch to the transfer of nuclear weapons, materials, and knowledge to states or other groups in regions marked by a history of tension and armed conflict. The result may eventually be a range of new nuclear possessors and threats far less amenable to tradi- tional deterrent logic. As the influence of nuclear deterrence erodes, the impor- tance of the nuclear taboo can only increase. Whether the norm is up to such challenges is not entirely clear. Declared nuclear weapons states will most likely continue to uphold the norm. Long socialization to the strictures of the norm itself, as well as possession of alternative military options capable of coping with emerging contingencies, will probably act to reduce incentives to breach the nuclear threshold. Recent years have witnessed a further de-emphasis of nuclear weapons in United States defence policy and a corresponding shift toward the develop- ment of improved conventional munitions, guidance systems, and non-lethal weaponry for regional contingencies. For a nation long wedded to nuclear arms as a cost-effective alterna- tive to conventional firepower, this is hardly an inconsequential development. Yet even this may not guarantee nuclear abstinence in the face of desperate military circumstances. It is perhaps useful to consider what might have occurred in the Gulf War if United States and Iraqi forces had become engaged in a long ground war and if Iraq had used chemical weapons against United States troops. Such a situation would not only breach a thresh- old governing the use of weapons of mass destruction but, depending on their effects, could have prompted correspond- ing United States escalation. As Thomas Schelling notes, given the fact that nuclear weapons are the 'unconventional weapon' the United States knows best, escalation might well have been nuclear.44 Similarly, would Israeli nuclear restraint have endured if Iraq had launched chemically armed SCUD missiles against Tel Aviv or Jerusalem? Future nuclear proliferators and possessors are less likely to have a range of military options at their disposal. And it is far from clear that they will feel the degree of allegiance to the nuclear norm that other states have displayed in the past. Judeo- Christian concepts of justice, moral standing in the interna-tional community, and alliance pressures - all of which reinforced past allegiance to the taboo - are much less likely to resonate in the minds of subnational and/or terrorist groups in possession of nuclear weapons. Similarly, the anti-nuclear instinct may be less acceptable to certain cultures. It is not entirely clear whether the non-use tra- dition has been inherited by such nations as Iran, Pakistan, and North Korea with the same force as some of their nuclear pre- decessors.45 While the Russian and Chinese experiences offer some grounds for optimism, the particular context in which their allegiances to the norm were formed, and the dramatic changes in the strategic environment which have occurred since then, suggests that broader foreign assimilation of the taboo cannot be taken for granted. Indeed, changed circumstances have already led to Moscow's retreat from the no-first-use policy that long governed its nuclear arsenal. Also worrisome is the danger that future technological innovations aimed at bolstering the nuclear threshold may eventually create and legitimize weapons technologies which rival or exceed the destructiveness of nuclear arms. The result could well be the future use of equally destructive non-nuclear weapons, or even a blurring of the distinction between nuclear and conventional arms to a point where the threshold is eroded and use of the former becomes acceptable.46 Already large fuel-air explosives offer a destructive capability which rivals that of small tactical nuclear weapons.

### K

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

Byrne & Toly 6

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

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

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

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

Beljac ‘8

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

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

### Leadership

#### Clean tech development in U.S. now --- moving up the global index

DeFreitas, 12 --- covered all manner of green technology for EarthTechling since 2009 (Susan, 3/10/2012, “WWF Index: U.S. A Leader In Cleantech,” http://www.earthtechling.com/2012/03/wwf-index-u-s-a-leader-in-cleantech/)

How’s the U.S. doing when it comes to nurturing clean technology start-ups? Not too shabby at all, according to Coming Clean: The Global Cleantech Innovation Index 2012, a new report from the World Wildlife Federation (WWF), which ranked the U.S. fifth in the world for cleantech start-up creation, after Denmark, Israel, Sweden, and Finland.

That means that while countries like Germany and Scotland are driving renewable energy generation full speed ahead with government policies, partnerships, and carbon reduction targets, the countries ranked highest in the WWF’s index are those doing the most to nurture the entrepreneurial approach, leading the world in fostering cleantech innovation.

Thirty-eight countries were evaluated on 15 indicators related to the creation and commercialization of cleantech start-ups, generating an index measuring each one’s potential (relative to its economic size), to produce entrepreneurial cleantech start-up companies and bring clean technology innovations to the market over the next 10 years.

While the U.S. came in fifth overall, in absolute terms (without factoring in economic size), the U.S. leads in many measures of cleantech innovation, as it currently boasts the greatest public cleantech R&D budget and the greatest number of cleantech start-ups and investors, as well as the most venture capital, private equity, and M&A deals in cleantech.

While North America and northern Europe lead with cleantech start-ups overall, the index also finds the Asia Pacific region performing well in terms of scaling up entrepreneurial cleantech companies to wider commercial success and revenue creation. And though it currently places 13th on the index, China was highlighted as leading in cleantech manufacturing, making a strong showing in early-stage growth, and indicating the potential to produce more early stage innovation in the future.

China is also rapidly gaining access to funding due to its success in raising money for cleantech-focused funds. (It has been home to the majority of cleantech IPOs since 2009, many of which listed on the recently established ChiNext board of the Shenzhen stock exchange.)

Another emerging cleantech start-up leader? India, which currently scores 12th on the index, but is performing well in fund-raising towards cleantech-focused funds and has shown plenty activity in later stage cleantech companies.

#### Even if fusion is feasible, its decades away from a fusion economy – can’t solve their impact

#### ITER solves fusion leadership – international coop is key

Chu – Secretary of Energy – 3/26/12, FYI: The AIP Bulletin of Science Policy News, <http://www.aip.org/fyi/2012/045.html>

Secretary Chu replied:

“Senator, you're asking a very important question that we asked ourselves. But first let me assure you that the program at NIF [National Ignition Facility] is not actually competing with ITER. And NIF is supported by the NNSA [National Nuclear Security Administration] budget. And we want to make sure that that new program goes forward.  Now, ITER is international science collaboration. It - in the view of the fusion community - represents the most advanced, best chance we have of trying to control plasmas in a way that it can potentially . . . bring about controlled fusion for power generation.  And it is an international cooperation. And we I think want this to go forward. We want to be seen as reliable international partners. But we're also very cognizant of the spending profiles.  And we are working with the fusion community in the United States as well as internationally to see if we can satisfy both the needs of the fusion community in the U.S. and this ITER commitment. But it's -- in these tight budget times, it's tough.”

#### US is investing in fusion research now – SNL and LLNL

Sebastian Anthony – Extreme Tech – 10/8/12, Clean, limitless fusion power could arrive sooner than expected, http://www.extremetech.com/extreme/137520-clean-limitless-fusion-power-could-arrive-sooner-than-expected

The first breakthrough comes from Sandia National Laboratories (the same engineers who brought us the fanless heatsink). At SNL, a research team has been working on a new way of creating fusion called magnetized liner inertial fusion (MagLIF). This approach is quite similar to the National Ignition Facility at the LLNL in California, where they fuse deuterium and tritium (hydrogen isotopes) by crushing and heating the fuel with 500 trillion watts of laser power. Instead of lasers, MagLIF uses a massive magnetic pulse (26 million amps), created by Sandia’s Z Machine (a huge X-ray generator), to crush a small cylinder containing the hydrogen fuel. Through various optimizations, the researchers discovered a MagLIF setup that almost breaks even (i.e. it almost produces more thermal energy than the electrical energy required to begin the fusion reaction). Probably more significant is news from the Joint European Torus (JET), a magnetic confinement fusion facility in the UK. JET is very similar to the ITER nuclear fusion reactor, an international project which is being built in the south of France. Whereas NIF and Sandia create an instantaneous fusion reaction using heat and pressure, ITER and JET confine the fusing plasma for a much longer duration using strong magnetic fields, and are thus more inclined towards the steady production of electricity. JET’s breakthrough was the installation of a new beryllium-lined wall and tungsten floor inside the tokamak — the doughnut-shaped inner vessel that confines 11-million-degrees-Celsius plasma (pictured above). Carbon is the conventional tokamak lining (and the lining that had been chosen for the first iteration of ITER) but now it seems the beryllium-tungsten combo significantly improves the quality of the plasma. Hopefully this information will allow ITER to skip the carbon tokamak and jump straight to beryllium-tungsten, shaving years and millions of dollars off the project. Moving forward, JET will actually try full-blown fusion with the optimum mix of deuterium and tritium (16 megawatts, for less than a second). At this point, JET is practically an ITER testbed, so its results from the next year or two will have a large impact on the construction of ITER’s tokamak, which should be completed by 2019. Before today, magnetic confinement fusion was generally considered to be more mature and efficient than inertial confinement fusion — but Sandia’s new approach might change that. ITER is one of the world’s largest ongoing engineering projects (it’s expected to cost around $20 billion), and yet critics are quick to point out that we still don’t know if it will actually work. ITER isn’t expected to fuse D-T fuel until 2027 (producing 500 megawatts for up to 1,000 seconds) — and an awful lot can happen in 15 years. Still, the main thing is that we’re actually working on fusion power — when we’re talking about limitless, clean power, it’s probably worth investing a few billion dollars, even if it doesn’t work out. Fusion reactors are some of the most beautiful constructions you’ll ever see, so be sure to check out our galleries of the National Ignition Facility and the Princeton Plasma Physics Lab.

### STEM

#### No impact to STEM decline – empirics

Galama, Ph.D. & M.Sc. in Physics from the University of Amsterdam, MBA from INSEAD, ‘8 (Titus, “U.S. Competitiveness in Science and Technology,” Prepared for the Office of the Secretary of Defense by the National Defense Research Institute of the RAND Corporation, <http://www.rand.org/pubs/monographs/2008/RAND_MG674.pdf>)

Despite the rhetoric and the intensive action on the Hill, some voices called for restraint. The reports and testimony making a case for or arguing against an S&T crisis are part of an ongoing policy debate. One line of counterargument is that such warnings are far from unprecedented and have never resulted in the crisis anticipated. The author of a Washington Watch article noted that “similar fears of a STEM crisis in the 1980s were ultimately unfounded” (Andres, 2006). Neal McCluskey, a policy analyst from the Cato Institute, noted that similar alarm bells were sounded decades earlier (and in his view, have had underlying political agendas): Using the threat of international economic competition to bolster federal control of education is nothing new. It happened in 1983, after the federally commissioned report A Nation at Risk admonished that ‘our once unchallenged preeminence in commerce, industry, science, and technological innovation is being overtaken by competitors throughout the world,’ as well as the early 1990s, when George Bush the elder called for national academic standards and tests in order to better compete with Japan. (McCluskey, 2006) Roger Pielke of the University of Colorado observed that such issues as poor student performance have an even longer history, with no negative outcomes. Arguments that “certain other countries produce a greater proportion of scientist and engineering students or that those students fare better on tests of achievement . . . have been made for almost 50 years,” he stated, “yet over that time frame the U.S. economy has done quite well” (Pielke, 2006).

#### Schools are systematically failing – no long term STEM potential

PCAST 10. (September 2010. President’s Council of Advisors on Science and Technology. Executive Office of the President. “Report to the President. Prepare and Inspire: K-12 Education in Science, Technology, Engineering, and Math (STEM) For America’s Future” PDF)

What lies behind mediocre test scores and the pervasive lack of interest in STEM is also troubling. Some of the problem, to be sure, is attributable to schools that are failing systemically; this aspect of the problem must be addressed with systemic solutions. Yet even schools that are generally successful often fall short in STEM fields. Schools often lack teachers who know how to teach science and mathematics effectively, and who know and love their subject well enough to inspire their students. Teachers lack adequate support, including appropriate professional development as well as interesting and intriguing curricula. School systems lack tools for assessing progress and rewarding success. The Nation lacks clear, shared standards for science and math that would help all actors in the system set and achieve goals. As a result, too many American students conclude early in their education that STEM subjects are boring, too difficult, or unwelcoming, leaving them ill-prepared to meet the challenges that will face their generation, their country, and the world.

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

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

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

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

#### US participation in ITER solves STEM / US science leadership

Frank Munger – 7/16/12, Thom Mason talks about U.S. ITER: 'When you're running a project, you've got to go full steam ahead', Knoxville News Sentinel, http://blogs.knoxnews.com/munger/2012/07/thom-mason-talks-about-us-iter.html

Oak Ridge National Laboratory Director Thom Mason spoke last week at the DOE Small Business Summit, and one of the topics he addressed was ORNL's role in leading U.S. efforts on the International Thermonuclear Experimental Reactor (ITER). Afterwards, on the sidelines of the conference, he talked a little about the funding issues facing the project and the planned course of actions. Mason noted that fusion won't really help the energy situation in the U.S. for the next 10, 20 or 30 years, but one of the reasons the U.S. is involved in ITER is not only the value of the research and the physics and engineering, but also to establish the capabilities in U.S. industry for designing and manufacturing these extraordinary cutting-edge components. Many of the components will be built in the U.S. and shipped to France, he said. He said some of the magnetic systems being constructed to contain the plasma fuel will be pushing the very edge of what's capable. These are the largest, mostly technically complex magnets ever built, he said. Vendors are being qualfied to perform this work and that's important now and for the future, Mason said. Some of the U.S. manufacturing endeavors have been successful, so successful that some of the other partner countries on ITER are seeking contracts with U.S. companies to do some of their work, such as the work on superconducting cable, Mason said. "The U.S. is a net winner," he said, noting that even though the United States is sending cash to France for the ITER contributions, there have been gains in the U.S. from contracting with other project teams.

#### The aff only addresses one of the two problems with STEM—proficiency is key

PCAST 10. (September 2010. President’s Council of Advisors on Science and Technology. Executive Office of the President. “Report to the President. Prepare and Inspire: K-12 Education in Science, Technology, Engineering, and Math (STEM) For America’s Future” PDF)

There are two obstacles to achieving the nation’s goals with respect to STEM education. First, too few U.S. students are proficient in STEM. Second, too few of those who are proficient pursue STEM fields. Of all ninth graders in the United States in 2001, for example, only about 4 percent are predicted to earn college degrees in STEM fields by 2011,41 a clear indicator that at various stages of the education system we are losing potential STEM talent. This loss begins well before high school. In both mathematics and science, about 70 percent of eighth graders score below the proficient level.42 Students who lack proficiency face a mounting barrier, as it becomes increasingly difficult to engage in STEM subjects without a solid foundation in basic skills, such as algebra. Even among the minority of students who are proficient in STEM in eighth grade, about 60 percent decide during high school that they are not interested in these subjects.43 Of those who remain interested in high school, only about 40 percent actually enter STEM majors in colleges. Of these students, 60 percent switch out of STEM44 while far fewer switch in. The problem is particularly acute among minority groups and women. Black, Latino, and Native American students who show interest in STEM as college freshmen are much less likely to graduate with STEM degrees than their white and Asian American counterparts.45 To address these challenges, we need a two-pronged approach: (1) we must prepare all students so they have a strong foundation in STEM no matter what careers they pursue, and (2) we must inspire students so that all are motivated to learn STEM subjects and many are excited about entering STEM fields. Preparation involves building shared skills and knowledge. Inspiration involves individual, meaningful experiences that speak to students’ particular interests and abilities. Preparation involves bringing all students up to the level of proficiency in STEM subjects. This requires a focus on high standards and meaningful assessments for STEM subjects, together with providing teachers and schools with tools to enable active, engaged learning by students. It also requires recruiting, preparing, and retaining teachers who have the knowledge and skills to effectively convey those standards. And it requires providing schools and teachers with tools and support to help students achieve these standards. Preparation includes giving the nation’s high-achieving STEM students challenges and opportunities to reach even higher. This requires recognizing and nurturing talent in all groups of students. Preparing students to succeed and excel in STEM, as well as in subjects and careers that draw upon STEM aptitudes and knowledge, will require a substantial effort that addresses the current inadequacies at all levels of the education system.

#### Nuclear primacy doesn’t de-escalate- low pain threshold

**Safranchuk, 2006,** Ivan, well-known nuclear analyst in Russia. He joined the World Security Institute in July 2001 and directs its branch office in Moscow. His research focuses on U.S.-Russian security relations and has written extensively on nuclear weapons and arms control issues. Dr. Sanfranchuk graduated from the Moscow State Institute for International Relations (MGIMO). “Beyond MAD,” <http://www.wsichina.org/cs4_6.pdf>, KHaze

Overwhelming superiority, on the other hand, does not guarantee zero retaliation. Nuclear superiority may minimize the chances of retaliation. Missile defense may even further diminish the possibility of a second strike. Yet, absolute nuclear primacy – when there will be a high probability of zero retaliation – is impossible with thousands of deployed warheads. Relative nuclear primacy, where one side can conceivably win a nuclear war, also means that retaliation would lead to “acceptable damage.” But this opens up the question of what exactly that level of acceptable damage, or the “pain threshold,” is for the United States. Currently, the prevailing view is that even a single nuclear explosion (presumably of hundreds of kilotons yield) in any of the large American cities represents a level of damage unacceptable to the United States. With such a low pain threshold, reliance on nuclear primacy looks highly dubious. Nuclear primacy then, whether achieved or not, accidental or intentional, may be a great strategic disappointment, as the existing low pain threshold will not provide the opportunity for strategic benefit. A search for nuclear primacy then becomes a waste of taxpayers’ money and security apparatus effort.

#### Testing non-uq – the US, Soviet Union, North Korea, Pakistan, and India have all tested – nothing happened

#### That’s just common sense, but here’s ev

Dana Priest – Wash Post - September 16, 2012, The B61 bomb: A case study in costs and needs, http://www.washingtonpost.com/world/national-security/the-b61-bomb-a-case-study-in-needs-and-costs/2012/09/16/494aff00-f831-11e1-8253-3f495ae70650\_print.html

In the years that followed, the United States conducted more than 1,000 nuclear tests as it perfected and expanded its nuclear arsenal during the arms race with the Soviet Union. Hundreds of tests also were conducted by other nuclear powers, including the Soviet Union, Britain, France and China. President George H.W. Bush called a halt to U.S. nuclear tests in 1992. His decision was reaffirmed in 1996 when President Bill Clinton signed the Comprehensive Test Ban Treaty. The Senate rejected the treaty in 1999 and has not voted on it again, but the ban has remained in place. Russia, Britain and France are among the 36 countries that have ratified the treaty.

### Fusion

#### Fusion power fails – costs too high and regulation too difficult

Robert L. Hirsch - former senior energy program adviser for SAIC – 10/16/12, Where to Look for Practical Fusion Power, http://dotearth.blogs.nytimes.com/2012/10/19/a-veteran-of-fusion-science-proposes-narrowing-the-field/

Many outstanding people turned to the pursuit of fusion power.  A number of fusion concepts emerged and were investigated.  Soon it became painfully clear that practical fusion power would not happen quickly. First, we had to develop the science of plasma physics. After decades of effort, a great deal has been learned and accomplished, but a practical fusion power concept has not been forthcoming. Note that I said ”practical fusion power.” Unlike fire, fusion power has to compete against a number of other options. The word “practical” means that a fusion power system must be desirable, based on the realities of the society into which it will be introduced. An unfortunate problem today is that many people in fusion research believe that producing a fusion-something that simply works is the goal, but that is definitely wrong! Fusion power and fire are distinctly different. Let’s consider some specific criteria for practical fusion power. In 1994, the U.S. Electric Power Research Institute – EPRI – convened a panel of utility technologists to develop “Criteria for Practical Fusion Power Systems.” The result was a four-page folder that outlined “Three principal types of criteria:” Economics, Public Acceptance, and Regulatory Simplicity. The criteria are almost self-explanatory, but let me quote from the Economics Criteria: “To compensate for the higher economic risks associated with new technologies, fusion plants must have lower lifecycle costs than competing technologies available at the time of commercialization.” Details for the criteria are given in the report, which I commend to anyone motivated to help develop fusion power. Against these criteria, let’s consider tokamak fusion, the centerpiece of which is ITER – the International Thermonuclear Experimental Reactor – under construction in France. As we know, it’s an enormously large machine, which is generally considered to be a prototype of a practical fusion power plant. Comparing the ITER and the core of a comparable commercial fission reactor shows an enormous difference in size – a factor of 5-10 — ITER being huge by comparison to a fission reactor core. It is known in engineering and technology development that the cost of a finished machine or product is roughly proportional to the mass of the device. Eyeballing ITER compared to a fission reactor core, it’s obvious that an ITER-like machine is many times more massive. Yes, you can argue details, like the hollow bore of a tokamak, but the size of the huge superconducting magnets and their heavy support structures provides no relief. Bottom line – On the face of it, an ITER-like power system will be much more expensive than a comparable fission reactor, so I believe that tokamak fusion loses big-time on cost, independent of details. Next, consider the fact that deuterium-tritium fusion inherently emits copious neutrons, which will induce significant radioactivity in adjacent tokamak structural and moderating materials. Accordingly, a tokamak power system will become highly radioactive as soon as it begins to operate and, over time, radiation damage will render those same materials structurally weak, requiring replacement. In the U.S., as elsewhere in the world, we have a Nuclear Regulatory Commission, which will almost certainly be given the task of ensuring that the public is safe from mishaps associated with tokamak power system failures. Expected regulation will require all kinds of safety features, which will add further costs to tokamak power. While the character of the plasma in a tokamak power reactor will not likely represent a large energy-release safety issue, the superconducting magnets would contain a huge amount of stored energy. If those magnets were to go normal – lose their superconducting properties – the energy release would be very large. It can be argued that the probability of that happening will be small, but it will nevertheless not be zero, so the regulators will require safety features that will protect the public in a situation where the magnets go normal, releasing very large amounts of energy. Accordingly, it is virtually certain that the regulators will demand a containment building for a commercial tokamak reactor that will likely resemble what is currently required for fission reactors, so as to protect the public from normal-going superconducting magnet energy release. Because an ITER-like tokamak reactor is inherently so large, such a building will be extremely expensive, further increasing the costs of something that is already too expensive. Next, there’s the induced radioactivity in the structure and moderator of a tokamak power reactor. Some tokamak proponents contend that structure might be made out of an exotic material that will have low induced radioactivity. Maybe, but last I looked, such materials were very expensive and not in common use in the electric power industry. So if one were to decide to use such materials, there would be another boost to cost, along with an added difficulty for industry to deal with. No matter what materials are chosen, there will still be neutron-induced materials damage and large amounts of induced radioactivity. There will thus be remote operations required and large amounts of radioactive waste that will have to be handled and sent off site for cooling and maybe burial. That will be expensive and the public is not likely to be happy with large volumes of fusion-based radioactivity materials being transported around the country. Remember the criteria of public acceptance. I could go on with other downsides and showstoppers associated with tokamak fusion power, but I won’t.  It is enough to say that tokamak fusion power has what I believe are insurmountable barriers to practicability and acceptability.

#### Fusion failure decks the research apparatus – turns STEM/leadership. Prefer our ev – it’s from a veteran fusion researcher

Robert L. Hirsch - former senior energy program adviser for SAIC – 10/16/12, Where to Look for Practical Fusion Power, http://dotearth.blogs.nytimes.com/2012/10/19/a-veteran-of-fusion-science-proposes-narrowing-the-field/

By the way, my arguments assume that tokamak physics and technology works well and is reasonably simple, meaning that not many more components will have to be added to the system to allow it to operate on a steady basis for very long periods of time between the long shutdowns needed to change out radiation-damaged, radioactive materials. What I’ve just described is not a happy story. At some point, probably in a matter of years, a group of pragmatic power industry engineers will be convened to seriously scrutinize tokamak fusion, and they are virtually certain to declare that it cannot become a practical power system. That will certainly be a calamity for the people involved and for the cause of fusion power. Let’s review what I’ve said. First, we have to recognize that practical fusion power must measure up to or be superior to the competition in the electric power industry. Second, it is virtually certain that tokamak fusion as represented by ITER will not be practical. So where are we likely to find practical fusion power? First, we must look for a concept or concepts that are inherently small in size, which means high plasma density. Second, we must look for something that can be based on a low or zero neutron fusion reaction. One example is the proton-boron reaction. We know some things about proton-boron fusion. First it requires much higher temperatures that deuterium-tritium. Second, it cannot be based on a Maxwellian plasma particle distribution, because theory tells us that the plasma radiation losses (Bremsstrahlung) from a very high temperature, Maxwellian, proton-boron plasma will kill the concept. That means that a proton-boron plasma must be non-Maxwellian, and it must be fashioned in such a way that normal inter-particle scattering reactions can be managed on an on-going basis. For this audience, the requirements for practical fusion power sound like they could be met by Inertial Electrostatic Confinement (IEC) fusion. As you well know, IEC is a family of possibilities from gridded systems to magnetically constrained systems and on and on. They can in principle be very high density and therefore small, and they could have plasma distribution control as an element. I can’t help but wonder if IEC just might be the key to practical fusion power. In conclusion, in the early days of the U.S. fusion research, the program was classified secret and called Project Sherwood. One explanation for that name was, if it works, it sure would be wonderful. I hope that you and others will be able to help make it happen. Thank you. PS. These thoughts were painful to formulate. As a past leader of the U.S. federal fusion program, I played a significant role in establishing tokamak research to the U.S., and I had high hopes for its success. Realities have emerged to dash those hopes.  When we learn unpleasant things, it is incumbent on us to speak up, even when it hurts.

#### No commercialization—definitely not fast

Brumfiel, Scientific American, 2012

[June 2012, Geoff, writer for Scientific American, MS in Science Writing from John’s Hopkins, double degrees in Physics and English from Grinnell College in Iowa, “Fusion’s Missing Pieces,” Scientific American, EBSCO]

ITER will prove whether fusion is achievable. It will not prove whether it is commercially viable. There is good reason to think it might not be. For starters, the radiation from fusion is very intense and will damage ordinary material such as steel. A power plant will have to incorporate some as yet undeveloped materials that can withstand years of bombardment from the plasma -- otherwise the reactor will be constantly down for servicing. Then there is the problem of tritium fuel, which must be made on-site, probably by using the reactor's own radiation. Arguably the greatest obstacle to building a reactor based on ITER is the machine's incredible complexity. All the specialized heating systems and custom-built parts are fine in an experiment, but a power plant will need to be simpler, says Steve Cowley, CEO of the U.K.'s Atomic Energy Authority. "You can't imagine producing power day in and day out on a machine that's all bells and whistles," he says. Another generation of expensive demonstration reactors must be built before fusion can come onto the grid. Given ITER's lumbering development, none of these will be up and running before the middle of the century.

#### Solvency is extremely difficult

Prager, U.S. DOE’s Princeton Plasma Physics Lab, 11

[Stewart, Director – U.S. Department of Energy’s Princeton Plasma Physics Laboratory and Professor of Astrophysical Sciences – Princeton University, "Perspective On: The future of Fusion", 5-12, http://www.pppl.gov/polPressReleases.cfm?doc\_id=772]

Fusion scientists, like you, have been working to produce fusion reactions for many decades. Why is it so hard to create fusion energy? In a nuclear fusion reaction two atomic nuclei fuse and release energy. In a fusion reactor the core will contain the plasma producing this energy. It's a difficult process because it requires making a hot gas that is 10 times hotter than the core of the sun -- 100 hundred million degrees -- and confining that for long periods of time in a controllable way. Plasmas exhibit complex behavior that is difficult to understand. The engineering challenge is also huge, because you have to surround this hundred-million-degree plasma with a material structure. We often say that fusion is maybe the most, or one of the most difficult science and engineering challenges ever undertaken.

#### Can’t be a conventional power source until at least 2050

SlashDot, 2012

[4/11/12, Interview with Dr. Martine Greenwal, Prof Ian Hutchinson, Assis Prof Anne White, Prof Dennis Whyte, Nathan Howard, “MIT Fusion Researchers Answer Your Questions,”

<http://hardware.slashdot.org/story/12/04/11/0435231/mit-fusion-researchers-answer-your-questions>]

MIT Researchers: This is obviously an impossible question to answer, but we can give some thoughts about when it might happen, and why. First, the current official plan is that ITER will demonstrate net fusion gain (Q = 10, that is, ten times more fusion power out than heating power put in) in about 2028 or 2029. (Construction will be done by about 2022 but there’s a six-year shakedown process of steadily increasing the power and learning how to run the machine before the full-power fusion shots.) At that point, designs can begin for a “DEMO”, which is the fusion community’s term for a demonstration power plant. That would come online around 2040 (and would putt watts on the grid, although probably at an economic loss at first), and would be followed by (profitable, economic) commercial plants around 2050.

#### Fusion doesn’t solve net energy costs that drive us into a hole before the plan can solve—cites their studies

Curren, Editor-in-Chief, Transition Voice, 2011

[7/11/11, Lindsay, Editor-in-Chief of Transition Voice, an online magazine on peak oil, “Of Buck Rogers, magic elixirs and fusion power,” http://energybulletin.net/stories/2011-07-11/buck-rogers-magic-elixirs-and-fusion-power]

This week, one of those scientists, Stewart C. Prager, the director of the Princeton Plasma Physics Laboratory, penned an Op-Ed in the New York Times that held out the elusive hope of nuclear fusion, and along with it made a plea for society to get behind such a promise with their will and a bevy of taxpayer dollars. Prager writes that What has been lacking in the United States is the political and economic will. We need serious public investment to develop materials that can withstand the harsh fusion environment, sustain hot plasma indefinitely and integrate all these features in an experimental facility to produce continuous fusion power. This won’t be cheap. A rough estimate is that it would take $30 billion and 20 years to go from the current state of research to the first working fusion reactor. Prager goes on to blithely equate this sum to "about a week of domestic energy consumption, or about 2 percent of the annual energy expenditure of $1.5 trillion." Is that all? Pulling rabbits out of hats What he doesn't explain, and perhaps even consider, is that the demonstration plant is itself an energy sink. Yet in his mind, apparently there's endless energy to ramp up not only the demo, but plants like it all over the country (once one is even able to successfully work, presumably around the year 2035) and then, then our energy problem will be solved! Technology to the rescue. Lot's of things look good on paper, but the trouble comes when vision meets reality. In that vein, Prager's title, "How Seawater Can Power the World," is disingenuous, too. Sure, you can get some hydrogen isotopes from seawater, but big deal. For what, more experiments? I spoke with the late Matt Simmons, a key figure in oil industry finance and a significant contributor to the peak oil conversation, before his unexpected death last year, and he too was passionate about the promise of seawater. Only for him it was more about proven tidal power, which is pretty low tech when you get right down to it. That would be a better way to spend $30 billion if you've got your heart set on that scale of a technical fix. Simplicity is elegance I don't want to be a wet blanket on the nuclear fusion dream, but, well, I have to be. The disconnect from physical reality that not only this physicist exhibits, but that most people show when they consider how to tackle dwindling energy supplies and increasing costs, is getting too big to ignore. Our illusions are the elephant in the room marring progress on doable energy solutions, job creation, and the movement of money in our economy right now. Wishful thinking, grand plans and the mirage of hope on every horizon is not a strategy to tackle domestic energy concerns. And, understandable long-time industry and academic interests notwithstanding, neither is the tired bromide, "All energy options need to be on the table." All energy options cost money. Some simply don't belong on the table. Research costs money, as does the ultimate development, distribution and integration of new energy providers into the infrastructure. And developing new energy ideas also takes more energy. Today, that will be the very fossil fuels that are getting costlier to find and produce. Instead of high-tech fantasies, what's needed are solutions available now that provide jobs, decrease demand for fossil fuels and gird against future energy shocks. Spend that $30 billion on solar in the US and you'd have panels for more than 10 million homes. Let's remember that it takes a lot of manpower to install solar on ten million homes. And all those paychecks buy a heckuva lot of stuff in local economies. This is a better use of that kind of money. Castles made of sand Whatever "solution" the magic of would-be nuclear fusion might provide, it won't provide raw materials. It won't provide the petroleum we chug through making our disposable water bottles and the straws we sip the water from. It won't make cars, or pave roads, or fuel the machinery to maintain the roads, much less feed the cows that become the burgers that fuel the men who work on the roads. That it may some day provide some portion of electricity after an immense number of plants are developed in centralized locations is just a fool's game. It's a money pit for the deluded, indebted and intellectually destitute

#### No impact to naval decline

**McGrath 2010**, Director of Consulting, Studies and Analysisat Delex Systems, Inc, citing Robert Gates, Bryan, “Debate: Do We Need 11 Carrier Groups: Yes”, Atlantic Council, <http://www.acus.org/new_atlanticist/debate-do-we-need-11-carrier-groups-yes>, KHaze

Next there’s this—and it is a longish clip from the speech: “It is important to remember that, as much as the U.S. battle fleet has shrunk since the end of the Cold War, the rest of the world’s navies have shrunk even more. So, in relative terms, the U.S. Navy is as strong as it has ever been. In assessing risks and requirements even in light of an expanding array of global missions and responsibilities – everything from shows of presence to humanitarian relief – some context is useful: • The U.S. operates 11 large carriers, all nuclear powered. In terms of size and striking power, no other country has even one comparable ship. • The U.S. Navy has 10 large-deck amphibious ships that can operate as sea bases for helicopters and vertical-takeoff jets. No other navy has more than three, and all of those navies belong to our allies or friends. Our Navy can carry twice as many aircraft at sea as all the rest of the world combined. • The U.S. has 57 nuclear-powered attack and cruise missile submarines – again, more than the rest of the world combined. • Seventy-nine Aegis-equipped combatants carry roughly 8,000 vertical-launch missile cells. In terms of total missile firepower, the U.S. arguably outmatches the next 20 largest navies. • All told, the displacement of the U.S. battle fleet – a proxy for overall fleet capabilities – exceeds, by one recent estimate, at least the next 13 navies combined, of which 11 are our allies or partners. • And, at 202,000 strong, the Marine Corps is the largest military force of its kind in the world and exceeds the size of most world armies.”

#### No internal link- Can’t stop Iran’s control of Hormuz- they can deter the US by interrupting oil supplies-

#### Takes out their internal link – CCS is about current sensors

#### Iran can’t lash out- economics and lack of hardline leaders checks

White 7 (Rebecca N., 12/4, pg. http://www.nationalinterest.org/Article.aspx?id=16266)

But, as Cordesman noted, Iran’s retaliatory options are limited by faults in its military and its fragile domestic economic base. Iran is in a poor position to strike back. Also tempering a potential response is the fact that President Ahmadinejad isn’t the only decision-maker in Iran, Eisenstadt pointed out. And his popularity is waning, Feldman said, due in part to the effects of economic sanctions. If we don’t have a firm grasp on what we’re up against or what we’re capable of, it’s difficult to develop a course of military action. Offering a word of warning, Cordesman looked to the past, to Operation Desert Fox in Iraq, as a lesson in faulty planning. But uncertainty is a given in any policy decision, according to Feldman. Risk analysis is about weighing probabilities. It’s never “crystal clear” how the other side will react.

#### Iran can’t hit ships – environmental conditions spoof missile seekers

William D. O’Neil - former Director of Naval Warfare, Department of Defense - Winter 2008/09, Costs and Difficulties of Blocking the Strait of Hormuz, International Security, Volume 33, Number 3, Project MUSE

How the clearance operations would be conducted would depend on the circumstances, and in particular, the degree of knowledge regarding the mine locations. If surveillance failed entirely, clearance would be impeded; however, even general information about mine locations would permit much faster clearance. the antiship missile threat Talmadge dwells on possible Iranian antiship missile threats, without dealing adequately with the end-to-end system issues on either side. To pose a meaningful missile threat, Iran must first maintain surveillance of the area. Targets must be located either by the surveillance system or by dedicated targeting sensors. The targeting information must be passed to a control facility where firing orders are computed and transmitted to the missile battery. The missile is launched and flies out to the target area, where it turns on its seeker at the programmed time. To guide the missile to its target, the seeker must acquire the correct target and resist natural and intended diversions. Delays of more than a few minutes or errors of more than a few hundred meters entail a high risk that the missile will miss its target. The only surveillance scheme likely to produce effective results involves the use of radars able to cover the target area. The location requirements of the surveillance radar are strict. To see ships well, the radar must view them against the horizon or against a background separated from the ship by a distance that is large relative to the range discrimination of the radar. If the radar points down into the sea clutter, its probability of detection will fall off sharply; this largely bars the ridgeline locations that Talmadge speculates about. In addition, the site must avoid nearby reflecting surfaces and provide a good ground plane. Near-shoreline towers are usually the best solution. The limited choice of good sites combines with the ease of detecting radar emissions to make the radars highly vulnerable. Talmadge seems to believe that destruction of all the missile launchers is necessary to cut off an antiship missile campaign. Once the radars are gone, however, the game is over—the missiles are no longer usable. Efforts might be made to hunt down and attack the mobile missile launchers, and this could well prove as exacting and frustrating as she envisions it to be, but success in this is not essential to protect shipping. Talmadge also seems to believe that the antiship missiles in flight must be shot down to be rendered ineffective, or at least that interception is the primary defense against them. Fortunately, there are much better responses. This is particularly true in the region surrounding the Strait of Hormuz, which is so unfavorable for the operation of antiship missile seekers that most missiles may be defeated by a combination of tactical and technical means to exploit and exacerbate natural difficulties—so-called soft-kill defenses. “Hard kill”—physical interception and destruction of the antiship missile— would play an important but secondary role in this case. Broadly speaking, three distinct categories of seekers are available for use by antiship missiles, each of which faces special problems in the region of the Strait of Hormuz. In an infrared seeker, a bolometer or (in more modern and complex versions) an imaging camera sensitive to heat radiation detects the target based on its difference in effective temperature from the sea background. Although ships are not sources of intense heat, they generally are sufficiently hotter or cooler than the background to permit contrast detection, at least for most of the day. The Strait of Hormuz, however, is an unfavorable location for this because the exceptionally high water vapor and dust content of the atmosphere rapidly absorb and attenuate infrared heat radiation, severely limiting the range at which the ship may be detected. Another approach is a passive electronic seeker, essentially a radio receiver with a directional antenna programmed to receive and recognize the signal of a radar or other electronic emitter associated with the target. These seekers can be useful against ships with a distinctive emitter, such as the radar of an Aegis cruiser, but not against merchant ships or mine countermeasures ships, whose radars and other emitters are too similar to those of other vessels in the vicinity to be distinguished by the seeker. The most common seeker is radar—a compact set in the missile’s nose programmed to detect and home on surface ships. (This may be combined with an infrared or passive electronic system to confirm target identification and refine homing accuracy.) Radar is generally preferred because it provides reliable detection at ranges great enough to permit acquisition of targets whose location is only approximately known. But in the region of the Strait of Hormuz, this can not be relied upon. First of all, it is dense with islands and man-made structures (chiefly oil platforms) that have very large radar cross sections and can return enough energy to confuse and overwhelm radar seekers. This region is also especially subject to strong surface evaporation ducts, which greatly complicate radar propagation and may confuse the seeker or make the target invisible to it.4 In such a region, the first line of defense against antiship missiles is to operate ships to take best advantage of the natural vulnerabilities of the missile seekers. In particular, tankers can be routed close to land and oil platforms whose radar returns will blank those of the ships. Talmadge suggests that traffic could be routed through the more southerly portions of the region to the west of the strait, and this would serve the purpose admirably, as well as putting it farther from the Iranian coast. Mariners would grumble about the navigational difficulties involved in threading their way through the obstacles, but the universal use of high-accuracy GPS navigational plotters makes this far more feasible than it would have been not long ago, even when visibility is limited.5 These steps in themselves would afford considerable protection against missile seekers. Employing passive or active electronic and infrared countermeasures would further confuse or blind the seekers and augment protection. U.S. Navy ships are reported to carry an array of such countermeasures, and further countermeasures could be deployed using dedicated platforms or shore sites. Finally, the surveillance and targeting radars that are so essential to the entire antiship enterprise would also be greatly affected by the natural difficulties of the region and would be vulnerable to countermeasures—particularly to powerful jammers. These jammers could be deployed either by specialized aircraft or in fixed sites on the heights overlooking the strait from the Arabian Peninsula side. Thus, even before surveillance radars were destroyed, they could be rendered largely ineffective. conclusion

#### Naval power resilient

Farley, 07 (Robert, assistant professor at the Patterson School of Diplomacy and International Commerce, University of Kentucky. 10-23-07. “The False Decline of the U.S. Navy” http://www.prospect.org/cs/articles?article=the\_false\_decline\_of\_the\_us\_navy)

The United States Navy currently operates eleven aircraft carriers. The oldest and least capable is faster, one third larger, and carries three times the aircraft of Admiral Kuznetsov, the largest carrier in the Russian Navy. Unlike China’s only aircraft carrier, the former Russian Varyag, American carriers have engines and are capable of self-propulsion. The only carrier in Indian service is fifty years old and a quarter the size of its American counterparts. No navy besides the United States' has more than one aircraft carrier capable of flying modern fixed wing aircraft. The United States enjoys similar dominance in surface combat vessels and submarines, operating twenty-two cruisers, fifty destroyers, fifty-five nuclear attack submarines, and ten amphibious assault ships (vessels roughly equivalent to most foreign aircraft carriers). In every category the U.S. Navy combines presumptive numerical superiority with a significant ship-to-ship advantage over any foreign navy. This situation is unlikely to change anytime soon. The French Navy and the Royal Navy will each expand to two aircraft carriers over the next decade. The most ambitious plans ascribed to the People’s Liberation Army Navy call for no more than three aircraft carriers by 2020, and even that strains credulity, given China’s inexperience with carrier operations and the construction of large military vessels. While a crash construction program might conceivably give the Chinese the ability to achieve local dominance (at great cost and for a short time), the United States Navy will continue to dominate the world’s oceans and littorals for at least the next fifty years.

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### AT Permutation

#### They create a mechanized society and depoliticize development of technology – that’s because they conflate social concerns with purely scientific questions – means they collapse any viable nuclear public sphere

Byrne & Toly 6

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

While moderns usually declare strong preferences for democratic governance, their preoccupation with technique and efficiency may preclude the achievement of such ambitions, or require changes in the meaning of democracy that are so extensive as to raise doubts about its coherence. A veneration of technical monuments typifies both conventional and sustainable energy strategies and reflects a shared belief in technological advance as commensurate with, and even a cause of, contemporary social progress. The modern proclivity to search for human destiny in the march of scientific discovery has led some to warn of a technological politics (Ellul, 1997a, 1997b, 1997c; Winner, 1977, 1986) in which social values are sublimated by the objective norms of technical success (e.g., the celebration of efficiency in all things). In this politics, technology and its use become the end of society and members have the responsibility, as rational beings, to learn from the technical milieu what should be valorized. An encroaching autonomy of technique (Ellul, 1964: 133 – 146) replaces critical thinking about modern life with an awed sense and acceptance of its inevitable reality. From dreams of endless energy provided by Green Fossil Fuels and Giant Power, to the utopian promises of Big Wind and Small-Is-Beautiful Solar, technical excellence powers modernist energy transitions. Refinement of technical accomplishments and/or technological revolutions are conceived to drive social transformation, despite the unending inequality that has accompanied two centuries of modern energy’s social project. As one observer has noted (Roszak, 1972: 479), the “great paradox of the technological mystique[is] its remarkable ability to grow strong by chronic failure. While the treachery of our technology may provide many occasions for disenchantment, the sum total of failures has the effect of increasing dependence on technical expertise.” Even the vanguard of a sustainable energy transition seems swayed by the magnetism of technical acumen, leading to the result that enthusiast and critic alike embrace a strain of technological politics. Necessarily, the elevation of technique in both strategies to authoritative status vests political power in experts most familiar with energy technologies and systems. Such a governance structure derives from the democratic-authoritarian bargain described by Mumford (1964). Governance “by the people” consists of authorizing qualified experts to assist political leaders in finding the efficient, modern solution. In the narratives of both conventional and sustainable energy, citizens are empowered to consume the products of the energy regime while largely divesting themselves of authority to govern its operations. Indeed, systems of the sort envisioned by advocates of conventional and sustainable strategies are not governable in a democratic manner. Mumford suggests (1964: 1) that the classical idea of democracy includes “a group of related ideas and practices... [including] communal self-government... unimpeded access to the common store of knowledge, protection against arbitrary external controls, and a sense of moral responsibility for behavior that affects the whole community.” Modern conventional and sustainable energy strategies invest in external controls, authorize abstract, depersonalized interactions of suppliers and demanders, and celebrate economic growth and technical excellence without end. Their social consequences are relegated in both paradigms to the status of problems-to-be-solved, rather than being recognized as the emblems of modernist politics. As a result, modernist democratic practice becomes imbued with an authoritarian quality, which “deliberately eliminates the whole human personality, ignores the historic process, [and] overplays the role of abstract intelligence, and makes control over physical nature, ultimately control over man himself, the chief purpose of existence” (Mumford, 1964: 5). Meaningful democratic governance is willingly sacrificed for an energy transition that is regarded as scientifically and technologically unassailable.

### STEM Link

#### They use competitiveness as a way to create an economic relationship between the national security state and the public – this relationship is not based upon deliberation or trust for citizen dialogue, but instead transforms the public into a mechanized society of passive consumers – that has a couple of impacts

#### Causes overshoot and extinction

Smith 11

(Gar, Editor Emeritus of Earth Island Journal, “NUCLEAR¶ ROULETTE¶ THE CASE AGAINST A¶ “NUCLEAR RENAISSANCE” Pgs. 46)

Even if all of the world’s current energy output could be produced by renewables, this level of¶ energy consumption would still inflict terrible harm on Earth’s damaged ecosystems. In order to¶ survive, we need to relearn how to use less. It is critical that we adopt a Conservation Imperative.¶ Faced with the inevitable disappearance of the stockpiles of cheap energy we have used to move and¶ transform matter, we need to identify society’s fundamental needs and invest our limited energy resources¶ in those key areas. A Post-Oil/Post Coal/Post-Nuclear world can no longer sustain the one-time extravagances¶ of luxury goods, designed-to-be-disposable products, and brain-numbing entertainment devices.¶ The long-distance transport of raw materials, food and manufactured goods will need to decline in favor¶ of local production geared to match local resources and needs. Warfare—the most capital-, resource- and¶ pollution-intensive human activity—must also be diminished. Neither the costly inventory of nuclear¶ arms nor the Pentagon’s imperial network of 700-plus foreign bases is sustainable. There will doubtless¶ still be wars but, in the Post-oil World, they will be either be waged with solar-powered tanks or fought¶ on horseback.¶ Modern economies insist on powering ahead like competing steamboats in an upstream race. We have¶ become addicted to over-consumption on a planet that was not designed for limitless exploitation. As¶ the late environmental leader David Brower noted: “In the years since the Industrial Revolution, we¶ humans have been partying pretty hard. We’ve ransacked most of the Earth for resources….We are living¶ off the natural capital of the planet—the principal, and not the interest. The soil, the seas, the forests, the¶ rivers, and the protective atmospheric cover—all are being depleted. It was a grand binge, but the hangover¶ is now upon us, and it will soon be throbbing.” 224¶ On the eve of India’s independence, Mahatma Gandhi was asked whether his new nation could expect¶ to attain Britain’s level of industrial development. Noting that “it took Britain half the resources of this¶ planet to achieve its prosperity,” Gandhi famously estimated that raising the rest of the world to British¶ levels of consumption would require “two more planets.” The United Nations Development Program¶ recently reconsidered Gandhi’s equation as it applies towards “a world edging towards the brink of¶ dangerous climate change.”¶ Working from the assumed “sustainable” ceiling of climate-warming gases (14.5 Gt CO2 per year),¶ UNEP confirmed that “if emissions were frozen at the current level of 29 Gt CO2, we would need two¶ planets.” Unfortunately, UNEP noted, some countries are producing more CO2 than others. Fifteen¶ percent of the world’s richest residents are using 90 percent of the planet’s sustainable budget of shared¶ resources. According to UNEP’s calculations, just sustaining the current lifestyle of Canada and the U.S.¶ would require the resources of 16 planets—eight planets each. 225

### 2nc FW/AT Pragmatism

#### The aff’s calls for pragmatism and specificity are a farce – their change in energy strategy represents a conscious pathways of social development that re-organizes human behavior, not an incremental change in existing policy – only radical analysis of the energy system takes the aff’s change seriously and avoids error replication

Byrne & Toly 6

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

When measured in social and political-economic terms, the current energy discourse appears impoverished. Many of its leading voices proclaim great things will issue from the adoption of their strategies (conventional or sustainable), yet inquiry into the social and political-economic interests that power promises of greatness by either camp is mostly absent. In reply, some participants may petition for a progressive middle ground, acknowledging that energy regimes are only part of larger institutional formations that organize political and economic power. It is true that the political economy of energy is only a component of systemic power in the modern order, but it hardly follows that pragmatism toward energy policy and politics is the reasonable social response. Advocates of energy strategies associate their contributions with distinct pathways of social development and define the choice of energy strategy as central to the types of future(s) that can unfold. Therefore, acceptance of appeals for pragmatist assessments of energy proposals, that hardly envision incremental consequences, would indulge a form of selfdeception rather than represent a serious discursive position. An extensive social analysis of energy regimes of the type that Mumford (1934; 1966; 1970), Nye (1999), and others have envisioned is overdue. The preceding examinations of the two strategies potentiate conclusions about both the governance ideology and the political economy of modernist energy transitions that, by design, leave modernism undisturbed (except, perhaps, for its environmental performance).

### AT Tek Good

#### We’re not saying that tech, science, or rationality are always bad, they’re just not able to tell us what we should do or value- SSP scientists’ blind faith in technology to produce positive outcomes ensures the worst totalitarian society

Kurasawa ‘4, (Fuyuki, Assistant Prof. of Sociology @ York University, The ties to bind: Techno-science, ethics and democracy, *Philosophy and Social Criticism* vol. 30, no. 2, pp. 159-186, http://www.yorku.ca/kurasawa/Fuyuki%20cv.htm)

This erosion of ethics and publicness creates a disturbing situation, according to which the sources of socio-political power and normativity increasingly stem from scientific and technological forces by default. The ethical vacuum and democratic lapse leave the social field open to being dominated by a sole instrumental imperative: what science and technology can do is what society ought to and will do. Reversing the situation common in other societies and in previous epochs, the good is progressively being determined by what is technically or scientifically possible. Hence, neither science nor technology inherently provides us with the means to deal with emerging issues and possibilities in a democratic, ethical fashion; to believe otherwise is to be technocratically naïve at best or, at worst, socially irresponsible. If left uncontested, the instrumental imperative will confirm the dystopias of scientific and technological determinism, of which Ellul’s ‘technological society’ and Postman’s ‘technopoly’ are the most widely recognized examples.4 To be sure, history teaches us that, if not for vigorous normative and democratic safeguards, little prevents the manipulation, control and mastery of nature from being extended to humankind as a whole, or to targeted (and subordinate or vulnerable) social groups. Techno-science may well bring about revolutions in our ways of living and thinking, but the crucial questions remain: in what direction, for what purposes, and according to what and whose values?

#### The K is a pre-req to your impact turns- only social change and public deliberation can ensure positive use of science and technology

Fuchs ’2, (Christian, Lecturer/Researcher @ Institute of Design and Technology Assessment @ Vienna University, On the Topicality of Selected Aspects of Herbert Marcuse’s Work, http://cartoon.iguw.tuwien.ac.at/christian/marcuse\_eng.html)

When Marcuse says, that domination is a technology (Marcuse 1964: 158), he does not mean it in a technological-determinist manner, but he wants to express that besides the execution of domination with the help of technology it can be said that the execution of power also can be seen as an aspect of technology as a broad concept in the sense of a social-technology (Sozialtechnologie). At another instance Marcuse says: “Technology as such cannot be isolated from the use to which it is put” (Marcuse 1964: xlviii). This also outlines his refusal of technological determinism. For Marcuse, technology as such does neither mean domination, nor liberation, nor neutrality. He sees liberation as a social process which needs a certain level of development of the productive forces, but which can only be established socially and during the course of social struggles. He says that the liberating aspects of technology are not part of technological progress as such, they presuppose social changes which also refer to the fundamental economic institutions and relationships (Marcuse 1957: 238). Marcuse’s concept of technology is a dialectical one: On the one side he supposes that technology is used in capitalism in such a way that people are forced into line and become powerless. A libertarian use of technology does not seem possible for him under such circumstances. But if post-capitalist relationships could be established, Marcuse argues, certain technologies could be used in order to reduce social necessary labor to a minimum and to give a maximum of freedom and self-determination to the individuals. In such a case technology would not mean gleichschaltung, manipulation and the end of individuality, but the possibility of wealth for all and of an “existence in free time on the basis of fulfilled vital needs” (Marcuse 1964: 231). Marcuse again and again points out that certain developments are a necessary foundation for the historical level of mankind where it is possible to make use of technology in order to establish a world of freedom – one without exploitation, misery and fear (Marcuse 1965a: 123), a technological and natural environment that is not dominated by violence, ugliness, limitedness and brutality (Marcuse 1972: 12). But it is also possible, Marcuse argues, that technological developments lead to standardisation of thinking and acting, technological rationality, one-dimensional and false consciousness and false needs. He stresses this ambivalence which concerns modern technologies and that fundamental social change does not necessarily take place. He e.g. says that he wants to stress that he does not (yet) judge technological developments, they could either be progressive and humanising or regressive and destructing (1966b: 172). Another time he writes that technology can put forward authoritaritiveness as well as freedom, lack as well as affluence, hard labor as well as its abolishment (Marcuse 1941: 286). Not technology and the machine are leverages of suppression for Marcuse, but the existence of masters who determine the amount, life time, power and importance of machines as well as the role they play in life.

### AT Utopianism Good

#### Techno-utopianism gets co-opted – even if visions of the future create space for public deliberation, they mask existing inequality and delay social movements by continually promising to resolve their concerns with technology

Byrne & Toly 6

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

Modernity’s formula for two centuries had been to increase energy in order to produce overwhelming economic growth. While diagnosing the inevitable failures of this logic, Mumford nevertheless warned that modernity’s supporters would seek to derail present-tense7 evaluations of the era’s social and ecological performance with forecasts of a bountiful future in which, finally, the perennial social conflicts over resources would end. Contrary to traditional notions of democratic governance, Mumford observed that the modern ideal actually issues from a pseudomorph that he named the “democratic- authoritarian bargain” (1964: 6) in which the modern energy regime and capitalist political economy join in a promise to produce “every material advantage, every intellectual and emotional stimulus [one] may desire, in quantities hardly available hitherto even for a restricted minority” on the condition that society demands only what the regime is capable and willing to offer. An authoritarian energy order thereby constructs an aspirational democracy while facilitating the abstraction of production and consumption from non-economic social values.

#### You should privilege everyday violence for two reasons- A) social bias underrepresents its effects B) its effects are exponential, not linear which means even if the only causes a small amount of structural violence, its terminal impacts are huge

Nixon ‘11

(Rob, Rachel Carson Professor of English, University of Wisconsin-Madison, Slow Violence and the Environmentalism of the Poor, pgs. 2-3)

Three primary concerns animate this book, chief among them my conviction that we urgently need to rethink-politically, imaginatively, and theoretically-what I call "slow violence." By slow violence I mean a violence that occurs gradually and out of sight, a violence of delayed destruction that is dispersed across time and space, an attritional violence that is typically not viewed as violence at all. Violence is customarily conceived as an event or action that is immediate in time, explosive and spectacular in space, and as erupting into instant sensational visibility. We need, I believe, to engage a different kind of violence, a violence that is neither spectacular nor instantaneous, but rather incremental and accretive, its calamitous repercussions playing out across a range of temporal scales. In so doing, we also need to engage the representational, narrative, and strategic challenges posed by the relative invisibility of slow violence. Climate change, the thawing cryosphere, toxic drift, biomagnification, deforestation, the radioactive aftermaths of wars, acidifying oceans, and a host of other slowly unfolding environmental catastrophes present formidable representational obstacles that can hinder our efforts to mobilize and act decisively. The long dyings-the staggered and staggeringly discounted casualties, both human and ecological that result from war's toxic aftermaths or climate change-are underrepresented in strategic planning as well as in human memory. Had Summers advocated invading Africa with weapons of mass destruction, his proposal would have fallen under conventional definitions of violence and been perceived as a military or even an imperial invasion. Advocating invading countries with mass forms of slow-motion toxicity, however, requires rethinking our accepted assumptions of violence to include slow violence. Such a rethinking requires that we complicate conventional assumptions about violence as a highly visible act that is newsworthy because it is event focused, time bound, and body bound. We need to account for how the temporal dispersion of slow violence affects the way we perceive and respond to a variety of social afflictions-from domestic abuse to posttraumatic stress and, in particular, environmental calamities. A major challenge is representational: how to devise arresting stories, images, and symbols adequate to the pervasive but elusive violence of delayed effects. Crucially, slow violence is often not just attritional but also exponential, operating as a major threat multiplier; it can fuel long-term, proliferating conflicts in situations where the conditions for sustaining life become increasingly but gradually degraded.

## Topicality

### A2: We Meet

#### R&D support is not a financial incentive – Financial incentives include loans, grants, production credits, etc. – that’s Doris

#### More ev

CCES 9 Center for Climate and Energy Solutions (also called c2es) “Buildings and Emissions: Making the Connection” No specific date dated, most recent citation from 2009 www.c2es.org/technology/overview/buildings

Policy Options to Promote Climate-Friendly Buildings

The mosaic of current policies affecting the building sector is complex and dynamic involving voluntary and mandatory programs implemented at all levels of government, from local to federal. Government efforts to reduce the overall environmental impact of buildings have resulted in numerous innovative policies at the state and local levels. Non-governmental organizations, utilities, and other private actors also play a role in shaping GHG emissions from buildings through third-party “green building” certification, energy efficiency programs, and other efforts.

Various taxonomies have been used to describe the policy instruments that govern buildings, typically distinguishing between regulations, financial incentives, information and education, management of government energy use, and subsidies for research and development (R&D). Each of these is broadly described below.

-Standards and codes

Regulatory policies include building and zoning codes, appliance energy efficiency standards, clean energy portfolio standards, and electricity interconnection standards for distributed generation equipment. Building codes can require a minimum level of energy efficiency for new buildings, thus mandating reductions at the construction stage, where there is the most opportunity to integrate efficiency measures. Zoning codes can provide incentives to developers to achieve higher performance. Because of regional differences in such factors as climatic conditions and building practices, and because building and zoning codes are implemented by states and localities, the codes vary considerably across the country. While substantial progress has been made over the past decade, opportunities to strengthen code requirements and compliance remain.

Appliance and equipment standards require minimum efficiencies to be met by all regulated products sold; they thereby eliminate the least efficient products from the market. Federal standards exist for many residential and commercial appliances, and several states have implemented standards for appliances not covered by federal standards (see Appliance Efficiency Standards).

-Financial incentives

Financial incentives can best induce energy-efficient behavior where relatively few barriers limit information and decision-making opportunities (e.g., in owner-occupied buildings). Financial incentives include tax credits, rebates, low-interest loans, energy-efficient mortgages, and innovative financing, all of which address the barrier of first costs. Many utilities also offer individual incentive programs, because reducing demand, especially peak demand, can enhance the utility’s system-wide performance.

-Information and education

While many businesses and homeowners express interest in making energy-efficiency improvements for their own buildings and homes, they often do not know which products or services to ask for, who supplies them in their areas, or whether the energy savings realized will live up to claims. Requiring providers to furnish good information to consumers on the performance of appliances, equipment and even entire buildings is a powerful tool for promoting energy efficiency by enabling intelligent consumer choices.

-Lead-by-example programs

A variety of mechanisms are available to ensure that government agencies lead by example in the effort to build and manage more energy-efficient buildings and reduce GHG emissions. For example, several cities and states, and federal agencies (including the General Services Administration), have mandated LEED or LEED-equivalent certification for public buildings, and the Energy Independence and Security Act of 2007 includes provisions for reduced energy use and energy efficiency improvements in federal buildings.

-Research and development (R&D)

In the long run, the opportunities for a low-greenhouse gas energy future depend critically on new and emerging technologies. Some technological improvements are incremental and have a high probability of commercial introduction over the next decade (such as low-cost compact fluorescents). Other technology advances will require considerable R&D before they can become commercially feasible (such as solid-state lighting). The fragmented and highly competitive market structure of the building sector and the small size of most building companies discourage private R&D, on both individual components and the interactive performance of components in whole buildings.

Building Technologies Center. The Oak Ridge National Laboratory’s Buildings Technology Center was established by the U.S. Department of Energy (DOE) and performs research into issues including heating and cooling equipment, thermal engineering, weatherization, building design and performance, envelope systems and materials, and power systems.

Emerging Technologies. This U.S. DOE-sponsored program develops technology that would reduce energy use in residential and commercial buildings by 60-70 percent. Technologies are in fields including solid-state lighting, space conditioning and refrigeration, building envelopes, and analysis tools and design strategies that would facilitate the development of energy efficient buildings through software and computer-based building analysis.

#### At best they are a non-financial incentive – it’s effects – links to our limits DA

GSWH 11 Global Solar Water Heating Market Transformation and Strengthening Initiative, This publication is the result of a joint effort from the following contributors: The European Solar ThermalIndustry Federation (ESTIF), the United Nations Environment Program (UNEP) through its Division ofTechnology, Industry and Economics (DTIE) and the Global Environment Fund (GEF). "Guidelines for policy and framework conditions" No Specific Date Cited, Most Recent Citations From 2011 www.solarthermalworld.org/files/policy\_framework.pdf?download

8 Non financial incentives for solar thermal

Non Financial Incentives include all public policies that support the creation of public good, even when providing an indirect financial advantage to the solar thermal market. For instance: an awareness raising campaign financed from public money or a programme to subsidise craftsmen training or R&D, etc. Obviously, all these instruments create an indirect financial advantage for companies involved in the market and this benefit is then passed on to the users.

8.1 Solar thermal obligations

• What is a Solar Thermal Obligation (STO)?

STO are legal provisions making mandatory the installation of solar thermal systems in buildings. The obligation mainly applies to new buildings and those undergoing major refurbishment. The owner must then install a solar thermal system meeting legal requirements. Most of the existing STOs are connected to national or regional energy laws and implemented through the municipal building codes. A growing number of European municipalities, regions and countries have adopted solar thermal obligations. Already today, more than 150 million people live in regions covered by a STO.

• Benefits

A major benefit of solar thermal ordinances is their effectiveness combined with low costs and limited administrative overheads for public authorities. As part of the building permit process, the inspection with regard to the renewable energy requirement is simple and thus does not strain public finances.

The introduction of a solar thermal ordinance prevents market fluctuation caused by inconsistent incentive programmes. It provides a stable planning environment for market actors and investors, encouraging local economic growth and creating new jobs in this sector.

• Unwanted effects and flanking measures

Solar obligations have a profound effect on the solar thermal market's structure. Therefore, to maximise their benefits, they require flanking measures.

In a market where solar thermal becomes mandatory, promoters and customers will tend to question the solar systems' operation and react more negatively than in a voluntary market.

Ends users and the construction sector will often go for the cheapest possible solution, while building owners will try to circumvent the obligation through exemptions. The real impact of any regulation strongly depends on its technical parameters and control procedures.

It is vital, therefore, that the regulations adopted ensure state-of-the-art quality assurance, products, planning, installation and maintenance of the system, guaranteeing the same high level of customer satisfaction as in the current voluntary market. Poor performance of "mandatory" systems would not only undermine public acceptance of the obligation, but also, possibly, of the solar thermal technology in general.

Israel, 30 years of experience with solar thermal ordinances

Thirty years ago, Israel was the first country to pass legislation on solar thermal installations. With the second oil crisis at the end of the 1970s, members of parliament examined ways to make their country less dependent on imported energy. The result was a law, which made solar water heaters mandatory in new buildings such as residential housing, hotels, guest houses and old people's homes up to 27 metres high. The legislation entered into force in 1980.

Nowadays over 80% of Israel's households get their domestic hot water from solar rooftop heaters. A typical domestic unit consists of a 150 litre insulated storage tank and a 2 m2 collector. These hot water heaters save the country the need to import about 4% of its energy needs, and replace about 9% of the electricity production.

The law has now become redundant. More than 90% of the solar systems are installed on a voluntary basis, i.e. they are installed in existing buildings, or the systems are larger than required by the obligation.

Source: PROSTO project

8.2 Quality, standards and certification policy

The need and methods to ensure quality in the market are so important for solar thermal, that a complete guide is dedicated to this topic in the framework of the GSWH project.

Why do we need standards?

The objective of standardisation and quality assurance is to guarantee product safety and quality, as well as lower prices. At every stage of market development, the capacity of solar thermal systems to deliver the expected level of performance is a key factor. In the early stage of the market, quality issues have had long lasting devastating effects. The existence of standards is the cornerstone of quality assurance.

The actors of standards and certification

Standardisation and quality for solar thermal should be the result of a joint effort from public authorities (market regulation), the industry, the technical community and, when they are adequately organised, the end users.

• Public authorities have a key role to play in imposing stringent quality requirements and in initiating, facilitating and controlling the standardisation process.

• The industry must provide product and technical expertise. It must understand the benefits

of ensuring standardised level of quality. Public authorities should guarantee that the standards are neutral and do not favour certain products or companies.

• I t is essential to be able to rely on independent testing facilities and certification bodies. If the private initiative is not adequate, then public authorities should actively support the creation of such structures.

• Consumer organisations can bring a useful contribution to the process. Quality installation for quality products

Solar thermal products usually need to be installed. This operation can be simple to the extent that it might not require the intervention of a specialist, e.g. some termosiphons systems, but on average it should be undertaken by a professional. To guarantee performance, the quality of the installation is as important as the quality of the system. Minimum requirements in terms of training and qualification of installers should be implemented in parallel with product requirements. Public authorities should regulate in the absence of initiatives from trade and industry.

Performance and quality for a sustainable market

Performance and quality measures do not constitute flanking or accompanying measures. Framework and regulations should be developed, and relevant bodies involved from the beginning, even if this has to be imposed to the market to some extent.

The market tends to be shortsighted; industry will naturally prefer to avoid costs and regulations. The benefits of high quality regulations and market surveillance will emerge eventually and guarantee a sustainable market. Public authorities should ensure that incentives and promotion endorse quality.

8.3 Research and development, demonstration projects (definition, importance, recommendations, examples)

Solar thermal is a simple and mature technology; however, research and development are necessary to guarantee that performance will continue to improve and costs to decrease. Research and development can also contribute to adapt the technical features of products to local needs, e.g. improve water tightness in tropical areas, resistance to frost in mountainous regions. Research and development cannot proceed only from public initiative but, through public universities and public research centres, public authorities have a leading role to play.

Building up centres of technical excellence

Applied research, engineering education, development, product innovation, standardisation, testing are closely linked and there are a lot of synergies between those fields. Most of the time, the same persons will be likely to teach, test and lead research projects. A sustainable market will always require relying on a high level engineering community. Public authorities should encourage the creation of multi disciplinary technical facilities for solar thermal engineering and encourage or even impose on the industry to participate in this effort.

Importance of demonstration projects

For both promotion and technical (experimental) reasons demonstrations projects are extremely useful. Projects implementing technologies that are not market ready, but which have an important potential, will allow testing and improving the solution, gather data, monitor functioning and finally demonstrate the feasibility to the general public and the industry in order to prepare the introduction on the market.

9 Financial incentives (direct, indirect, tax incentives, low interest loans): definition, importance, recommendations, examples

Financial Incentives include any public policy giving a financial advantage to those who install a solar thermal system or that use solar thermal energy.

#### Even if the aff is an incentive, it’s not an incentive for production - it supports investment in pre-production

Koplow 4 Doug Koplow is the founder of Earth Track in Cambridge, MA. He has worked on natural resource subsidy issues for 20 years, primarily in the energy sector "Subsidies to Energy Industries" Encyclopedia of Energy Vol 5 2004www.earthtrack.net/files/Energy%20Encyclopedia,%20wv.pdf

3. SUBSIDIES THROUGH THE FUEL CYCLE

Because no two fuel cycles are exactly the same, examining subsidies through the context of a generic fuel cycle is instructive in providing an overall framework from which to understand how common subsidization policies work. Subsidies are grouped into preproduction (e.g., R&D, resource location), production (e.g., extraction, conversion/generation, distribution, accident risks), consumption, postproduction (e.g., decommissioning, reclamation), and externalities (e.g., energy security, environmental, health and safety).

3.1 Preproduction

Preproduction activities include research into new technologies, improving existing technologies, and market assessments to identify the location and quality of energy resources.

3.1.1 Research and Development

R&D subsidies to energy are common worldwide, generally through government-funded research or tax breaks. Proponents of R&D subsidies argue that because a portion of the financial returns from successful innovations cannot be captured by the innovator, the private sector will spend less than is appropriate given the aggregate returns to society. Empirical data assembled by Margolis and Kammen supported this claim, suggesting average social returns on R&D of 50% versus private returns of only 20 to 30%.

However, the general concept masks several potential concerns regarding energy R&D. First, ideas near commercialization have much lower spillover than does basic research, making subsidies harder to justify. Second, politics is often an important factor in R&D choices, especially regarding how the research plans are structured and the support for follow-on funding for existing projects.

Allocation bias is also a concern. Historical data on energy R&D (Table III) demonstrate that R&D spending has heavily favored nuclear and fossil energy across many countries. Although efficiency, renewables, and conservation have captured a higher share of public funds during recent years, the overall support remains skewed to a degree that may well have influenced the relative competitiveness of energy technologies. Extensive public support for energy R&D may also reduce the incentive for firms to invest themselves. U.S. company spending on R&D for the petroleum refining and extraction sector was roughly one-third the multi-industry average during the 1956-1998 period based on survey data from the U.S. National Science Foundation. For the electric, gas, and sanitary services sector, the value was one-twentieth, albeit during the more limited 1995-1998 period.

3.1.2 Resource Location

Governments frequently conduct surveys to identify the location and composition of energy resources. Although these have addressed wind or geothermal resources on occasion, they most often involve oil and gas. Plant siting is another area where public funds are used, primarily to assess risks from natural disasters such as earthquakes for large hydroelectric or nuclear installations. Survey information can be important to evaluate energy security risks and to support mineral leasing auctions, especially when bidders do not operate competitively. However, costs should be offset from lease sale revenues when evaluating the public return on these sales. Similarly, the costs of siting studies should be recovered from the beneficiary industries.

3.2 Production

Energy production includes all stages from the point of resource location through distribution to the final consumers. Specific items examined here include resource extraction, resource conversion (including electricity), the various distribution links to bring the energy resource to the point of final use, and accident risks.

#### Only indirectly affects production

EIA, Energy Information Administration, Office of Energy Markets and End Use, U.S. DOE, ‘92

(“Federal Energy Subsidies: Direct and Indirect Interventions in Energy Markets,” <ftp://tonto.eia.doe.gov/service/emeu9202.pdf>)

Research and development. The budgetary cost of Government-funded research and development (R&D) is easy to measure. Determining the extent to which Government energy R&D is a subsidy is more problematic: often it takes the form of a direct payment to producers or consumers, but the payment is not tied to the production or consumption of energy in the present. If successful, Federal-applied R&D will affect future energy

### A2: Not Electricity

#### Their ev concludes there’s no useful distinction between “power” and “energy”

Touran 12 (Nick, Ph.D. in Nuclear Engineering – University of Michigan, "Power Basics (Terminology)", http://www.whatisnuclear.com/physics/power\_basics.html)

There is a specific amount of energy in each Uranium atom that can be released in a nuclear reactor. Thus, any kilogram of the same kind of Uranium has about the same amount of energy in it. In the nuclear industry, we use the term burnup to describe how much of this energy has been used up. It’s often discussed in units of Gigawatt-days (units of energy) per metric tonne (units of mass), or GWd/MT. The maximum theoretical burnup of Uranium is about 940 GWd/MT, with typical reactors reaching about 45 GWd/MT and fast reactors pushing 200GWd/MT. **[MSU EV ENDS]**

Nuclear power vs. nuclear energy?

When discussing electricity provided by nuclear reactors, the terms "nuclear power" and "nuclear energy" are used completely interchangeably. The preferred term is nuclear energy, as nuclear power brings to mind things like the USSR, the USA, and bombs.

### A2: “For” is Intentional

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

WORDS AND PHRASES 04

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

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

### A2: R&D Lowers Cost of Production

#### Subsidy “effects are not the same as financial incentives – EIA says so

EIA, Energy Information Administration, Office of Energy Markets and End Use, U.S. DOE, ‘92

(“Federal Energy Subsidies: Direct and Indirect Interventions in Energy Markets,” <ftp://tonto.eia.doe.gov/service/emeu9202.pdf>)

The issue of subsidy in energy policy analysis extends beyond consideration of actions involving some form of financial commitment by the Federal Government. Subsidy-like effects flow from the imposition of a range of regulations imposed by Government on energy markets. Regulations may directly subsidize a fuel by mandating a specified level of consumption, thereby creating a market which might not otherwise exist. The imposition of oxygenate requirements for gasoline in the winter of 1992, which stimulates demand for alcohol-based additives, is a recent example.

Regulations more often explicitly penalize rather than subsidize the targeted fuel. To the extent that regulations on coal emissions raise costs of coal use, the competitive opportunities for alternatives, including renewables, natural gas, and conservation, are enhanced. The additional costs that influence the consumption of coal versus other fuels do not require any exchange of money between the Government and buyers and sellers of energy. However, this in no way diminishes the policy’s potential impact on resource allocation and relative prices of energy products.

Much current debate on energy policy focuses on externalities associated with energy use. Many believe there is a large implicit subsidy to energy production and consumption insofar as pollution results in environmental costs not fully charged to those responsible. Failure to internalize “recognized” externalities in the context of current fuel use may result in conventional energy being underpriced compare to other energy sources. Advocates of increased use of renewable energy claim this form of “subsidy” to be central to the continued dominance of fossil fuels as a component of energy supply. In fact, the effort to deal with environmental concerns has become a central feature of Federal energy policy. Substantial costs which were formerly outside the market mechanism have, through the implementation of a series of taxes and regulations, been internalized to energy markets. This report examines these developments as components of the current energy debate regarding the significance of direct and indirect energy subsidies. In that context, a variety of environmental trust funds and components of the Clean Air Act are examined. The report does not address the question of how much and what kind of externalities remain to be addressed through further revision of policy. Such considerations are far beyond the scope of this effort.

There could be legitimate debate over whether some of the programs described in this report are primarily directed towards energy or towards some broader objective, or alternatively whether programs excluded from this report ought to have been included. Programs that provide incentives for broad classes of economic activity, such as investment in fixed capital or investment in basic research, have been excluded, because they affect neither the choice between energy and nonenergy investment, nor the choice among particular forms of energy. Some may consider the Strategic Petroleum Reserve (SPR) to be a subsidy to energy consumers, while others may consider it to be a program to protect the vital national interests of the United States. The SPR is not included in this report. Some of the more expansive definitions of energy subsidies have included defense expenditures related to contingencies in the Persian Gulf. U.S. defense expenditures are designed to provide security, and the level of oil prices is not functionally related to the level of defense activity. Therefore defense expenditures are not considered here. Some may consider Federal transportation programs to be forms of energy subsidy, while others may think the energy impact of transportation programs is incidental to their intended purpose. Transportation programs are not included. State and local programs (which are significant in a number of cases) have been excluded by definition, since this report is about Federal subsidies.

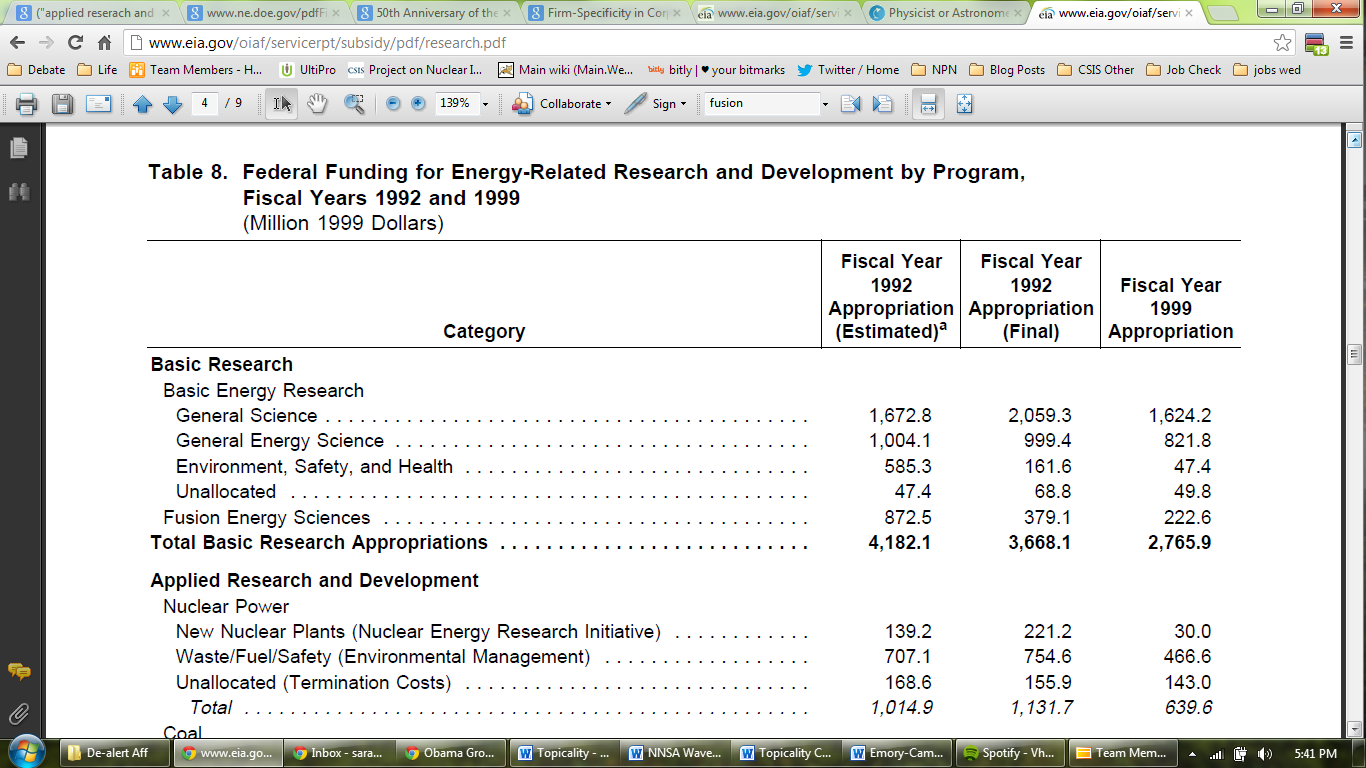
#### Limitless standard

Dyson et al, 3 - International Union for Conservation of Nature and Natural Resources (Megan, Flow: The Essentials of Environmental Flows, p. 67-68)

Understanding of the term ‘incentives’ varies and economists have produced numerous typologies. A brief characterization of incentives is therefore warranted. First, the term is understood by economists as incorporating both positive and negative aspects, for example a tax that leads a consumer to give up an activity that is an incentive, not a disincentive or negative incentive. Second, although incentives are also construed purely in economic terms, incentives refer to more than just financial rewards and penalties. They are the “positive and negative changes in outcomes that individuals perceive as likely to result from particular actions taken within a set of rules in a particular physical and social context.”80 Third, it is possible to distinguish between direct and indirect incentives, with direct incentives referring to financial or other inducements and indirect incentives referring to both variable and enabling incentives.81 Finally, incentives of any kind may be called ‘perverse’ where they work against their purported aims or have significant adverse side effects. ¶ Direct incentives lead people, groups and organisations to take particular action or inaction. In the case of environmental flows these are the same as the net gains and losses that different stakeholders experience. The key challenge is to ensure that the incentives are consistent with the achievement of environmental flows. This implies the need to compensate those that incur additional costs by providing them with the appropriate payment or other compensation. Thus, farmers asked to give up irrigation water to which they have an established property or use right are likely to require a payment for ceding this right. The question, of course, is how to obtain the financing necessary to cover the costs of developing such transactions and the transaction itself. ¶ Variable incentives are policy instruments that affect the relative costs and benefits of different economic activities. As such, they can be manipulated to affect the behaviour of the producer or consumer. For example, a government subsidy on farm inputs will increase the relative profitability of agricultural products, hence probably increasing the demand for irrigation water. Variable incentives therefore have the ability to greatly increase or reduce the demand for out-of-stream, as well as in-stream, uses of water. The number of these incentives within the realm of economic and fiscal policy is practically limitless.

### A2: Applied R&D

EIA – your author – 1999, 3. Federal Energy Research and Development, http://www.eia.gov/oiaf/servicerpt/subsidy/pdf/research.pdf



#### And, “basic” R&D isn’t T – YOUR AUTHOR AGREES

EIA – your author - July 10, 2000, 3. Federal Energy Research and Development, <http://www.eia.gov/oiaf/servicerpt/subsidy/research.html>

Table 8 allocates Federal energy R&D by energy type and function. Currently, nearly two-thirds of Federal energy R&D ($2.8 billion) is allocated to basic research. DOE's largest single basic research program is the General Science Program, funded at $1.6 billion in fiscal year 1999. Basic research is difficult to characterize as an energy subsidy, however, because it cannot be allocated between energy and non-energy benefits, or among forms of energy. Therefore, the balance of this chapter focuses on applied energy R&D.

#### Also means the aff can’t solve – there are no current producers of fusion to get the funding

EIA – your author - July 10, 2000, 3. Federal Energy Research and Development, <http://www.eia.gov/oiaf/servicerpt/subsidy/research.html>

Research and Development Defined

Federal energy-related R&D can be described as falling into three classes: basic research, research that seeks to develop new energy technologies, and research that seeks to improve existing technologies. Basic Research. The potential beneficiaries of basic research could be considered to be the population of the United States or the world as a whole. Basic research includes research projects designed to pursue the advancement of scientific knowledge and the understanding of phenomena rather than specific applications. Research To Develop New Technologies. The efforts in this context involve attempts to discover new scientific knowledge that can have commercial application. Although the end objective of the research is known, the research task is difficult and uncertain. Research To Improve Existing Technologies. These efforts emphasize the use of scientific knowledge to design and test new processes that may have substantial technical and cost uncertainties. The immediate beneficiaries are generally well defined: current producers and consumers of particular fuels or operators, and customers of the technology being improved. Energy Research and Development as a Subsidy It is easier to measure energy R&D spending than to it characterize from a subsidy perspective. R&D spending is intended to create useful knowledge that benefits society. Thus, all Federal R&D spending could, in a general way, be considered a subsidy to knowledge; however, the extent to which specific R&D programs actually affect energy markets is more difficult to ascertain. The results of research are inherently uncertain. Many programs will advance knowledge across a range of energy and non-energy applications, rather than in the context of a particular fuel or form of consumption. Further, the knowledge obtained may be negative, in the sense that the research may only reveal technical or economic dead ends to be avoided in the future. (42) Thus, only a portion of Federal energy R&D is likely to achieve results (in the form of changes in energy costs or consumption) that can be attributed specifically to a particular R&D program. Moreover, to the extent that there are attributable results, they are likely to be measurable only years after the funded research effort is initiated. Federal R&D is intended to support research that the private sector would not undertake. It is not supposed to substitute for private-sector R&D. However, the creation of a Government-funded R&D program could, under some circumstances, displace private-sector R&D. In that case, the Federal program would not produce any net new knowledge but simply reduce private costs. It is impossible, however, to know with certainty what private-sector firms would have done in the (hypothetical) absence of a Federal program. In general, the less "basic" the R&D program and the more focused on near-term commercialization, the greater the risk that the program will be a substitute for private-sector R&D. There are no means to determine conclusively whether or not particular Federal energy R&D projects are substitutes or complements for private-sector activities. Moreover, because research is risky, with failure an inherent part of the process, the effectiveness of Federal R&D cannot easily be assessed. This report makes no judgments on either of these issues. Rather, it surveys the current composition of Federal R&D spending and provides a degree of historical perspective on the changing composition of Federal energy R&D efforts. There is another issue that is specific to U.S. energy R&D programs: much U.S. energy R&D is aimed not at producing fuels per se but at developing fuel-consuming capital equipment (particularly power generation technologies). Such projects may be more properly viewed as a subsidy to capital equipment manufacturers than to fuel producers or consumers. Although, in principle, all successful power generation R&D benefits electricity consumers, the effects on fuel producers are more ambiguous. Because they are energy-saving technologies, the new technologies will only benefit producers if they help to expand the market for their fuel. Thus, if one seeks to understand the effects, rather than the intent, of R&D spending, the success of the programs must be evaluated, noting that expenditures will necessarily occur long before technology adoption, and considering the competitive consequences of any new technologies introduced. Finally, much of the expenditure that is formally defined as "energy research and development" in the U.S. Government's budget accounts is not directly expended on energy research or development. Some of the funds are expended for environmental restoration and waste management for energy (particularly nuclear) research facilities, or on R&D on environmental restoration and waste management, or on overhead or difficult-to-allocate functions. Such spending may not have a material impact on current or future energy markets. Energy Research and Development Trends Table 8 allocates Federal energy R&D by energy type and function. Currently, nearly two-thirds of Federal energy R&D ($2.8 billion) is allocated to basic research. DOE's largest single basic research program is the General Science Program, funded at $1.6 billion in fiscal year 1999. Basic research is difficult to characterize as an energy subsidy, however, because it cannot be allocated between energy and non-energy benefits, or among forms of energy. Therefore, the balance of this chapter focuses on applied energy R&D. Table 8. Federal Funding for Energy-Related Research and Development by Program, Fiscal Years 1992 and 1999 (Million 1999 Dollars) Table 8 lists both "estimated" and "actual" research and development appropriations for fiscal year 1992. The estimated appropriations are drawn from the Department of Energy's fiscal year 1993 budget proposal, prepared in early 1992, which showed appropriations by budget account for the previous fiscal year. (43) The estimated appropriations were used in EIA's 1992 subsidy report. The actual appropriations are drawn from the Office of the Chief Financial Officer's Appropriation History Tables, prepared in early 1997, which show final appropriations by budget account. The differences between the two columns have multiple causes. The Department transfers (with the approval of Congress) unspent monies from one account to another. This may take place well after the end of a fiscal year if the Department has multi-year spending authority for a particular account. The largest difference between the two columns is due to a large reprogramming of funds for fusion research. There have also been several changes of classification. For example, the account "Biological and Environmental Research" has been transferred from "Environment, Safety, and Health" to "General Science." In addition, minor errors in the original 1992 report have been corrected in the final appropriations column. For example, some of the expenditures on wind in the "Wind, Photovoltaic, and Other Solar" category were interchanged with biomass expenditures in the 1992 report. Applied R&D is aimed primarily at improving existing technology. Appropriations for applied energy R&D were about $1.5 billion in fiscal year 1999. Of that amount, more than half is allocated to nuclear activities. Within the range of nuclear projects, most of the money is spent on environmental management rather than R&D per se. For coal, the bulk of spending supports development of clean coal technologies. Solar, photovoltaic, and wind energy absorb the major share of renewable energy research funds ($134 million out of a total of $327 million). Expenditures shown as "unallocated" in Table 8 are administrative and miscellaneous programs associated with R&D. For example, unallocated expenditures for nuclear R&D ($143 million) in fiscal year 1999 include program termination costs and program direction. For renewable energy programs, they include program direction and funding for the National Renewable Energy Laboratory ($22 million in fiscal year 1999). The unallocated appropriation for basic energy research ($49.8 million in fiscal year 1999) funds personnel in a variety of research centers and provides support services and other related expenses.

# 1NR

## DA

#### Pure fusion weapons are useable and make the nuclear taboo impossible – they blur the line between conventional and nuclear weapons, can’t be tracked, and are more difficult to verify

Davidson 98

(Keay, “New Pure Fusion Nuclear Weapons Already Raising Major Issues”, San Francisco Examiner, 7-22-98, http://www.rense.com/political/nearfusion3.htm)

The Makhijani-Zerriffi study "is an important contribution to a growing body of scientific and political evidence that the nuclear weapons establishment in this country is indeed pursuing the development of new generations of nuclear weapons," says Cabasso, who works at the Western States Legal Foundation in Oakland.   Cabasso says the U.S. Department of Energy's "Stockpile Stewardship Program," which includes NIF, is a cover for the continued investigation of new designs for nuclear weapons. The Energy Department maintains that Stockpile Stewardship is needed to monitor the reliability of the existing U.S. nuclear arsenal.   Cabasso rejects Hogan's claim that the great size of NIF makes it irrelevant for weapons development. Size "isn't the point," Cabasso says. "Once fusion is achieved, then the process of miniaturizing it using other technologies becomes much more practical and there are other technologies being explored which might be very suitable (for this task), which that (Makhijani-Zerriffi) report discusses."   Pure-fusion weapons, Cabasso says, would be "particularly insidious because they may blur the distinctions between nuclear and conventional weapons, which may make them harder to (control)with treaties and make them likelier to be used."   Critics cite another objection to the development of pure-fusion bombs: A nation could more easily hide the manufacture of such bombs than of ordinary nuclear weapons. That's because the pure-fusion bombs would not require the use of uranium or plutonium, whose radioactivity can be detected by U.N. weapons inspectors. The present way to "prevent the spread or proliferation of nuclear weapons is by detecting the materials needed to make nuclear weapons, (namely) plutonium and highly enriched uranium," Cabasso says. "Since you don't need those for pure-fusion weapons, then that means of detecting the existence of the weapons disappears."

#### Violation of taboo leads to use – transforms IR behavior and gives into leaders temptation to use weapons

Tannenwald 5

(Nina, “Stigmatizing the Bomb: Origins of the Nuclear Taboo,” International Security, Vol 29, No 4. (Spring 2005) Nina Tannenwald is Director of the International Relations Program and Joukowsky Family Research Assis- tant Professor at the Watson Institute for International Studies at Brown University. <http://muse.jhu.edu/journals/international_security/v029/29.4tannenwald.pdf>)

The nuclear taboo refers to a de facto prohibition against the first use of nuclear weapons. The taboo is not the behavior (of nonuse) itself but rather the normative belief about the behavior. By “norm,” I mean a standard of right or wrong, a prescription or proscription for behavior “for a given identity.”13 A taboo is a particularly forceful kind of normative prohibition that is concerned with the protection of individuals and societies from behavior that is defined or perceived to be dangerous. It typically refers to something that is not done, not said, or not touched.14 What makes the prohibition against using nuclear weapons a taboo rather than simply a norm? There are two elements to a taboo: its objective characteristics and its intersubjective, phenomenological aspect, that is, the meaning it has for people. Objectively, the nuclear taboo exhibits many, although not all, of the characteristics associated with taboos: it is a prohibition, it refers to danger, and it involves expectations of awful or uncertain consequences or sanctions if violated. Further, it is also a “bright line” norm: once the threshold between use and nonuse is crossed, one is immediately in a new world with all the unimaginable consequences that could follow.15 Finally, the nuclear taboo counteracts the deep attraction that nuclear weapons present to national leaders as the “ultimate weapon” and reminds them of the danger that lurks behind such weapons.16

### 2NC Link XT

#### Magnetic fusion leads to pure fusion weapons and mini-nuke development – their “no weaponization” cards are just industry propaganda to avoid a panic

Nuke Watch 1

(“Alterations, Modifications, Refurbishments, and Possible New Designs For the US Nuclear Weapons Stockpile” <http://www.nukewatch.org/facts/nwd/weaponsfactsheet.html>)

Magnetized Target Fusion (MTF):  LANL and the Air Force are attempting to super compress deuterium-tritium into a high-density plasma which burns as nuclear fusion, all in a cylinder the size of a beer can.  While MTF research is being advertised for future energy production, empirical demonstration would likely have immediate and profound weapons applications.  If MTF was ever successful, pure fusion weapons could be possible.  The implication is that fission triggers (plutonium pits) would no longer be necessary for initiating fusion in thermonuclear weapons.  This, in turn, could lead to “mini-nuke” development.  LANL has projected that several billion dollars of research will be spent on MTF.[[46]](http://www.nukewatch.org/facts/nwd/weaponsfactsheet.html" \l "46)

### AT No Prolif – Glaser

#### We control terminal impact uniqueness – global prolif is slow and non-prolif norms are strong

Persbo 12

(Andreas Executive Director of the Verification Research, Training and Information Centre (VERTIC) – February, A reflection on the current state of nuclear non-proliferation and safeguards, http://www.sipri.org/research/disarmament/eu-consortium/publications/publications/non-proliferation-paper-8 )

Some would, and do, argue that the NPT bargain is unsustainable over the long term, and that the cracks in the non-proliferation regime are beginning to widen. But notwithstanding the above-mentioned crises, the NPT has shown itself to be a remarkably robust pact over the years. Today, the NPT has near universal membership and the norm against the possession of nuclear weapons is exceptionally strong. Why that is, and how that norm has been maintained, is explored in the next section of this paper.

\*\*\*CTBT Impact

\*\*\*Mini-nukes Impact

\*\*\*Assymetric Prolif Impact

## Leadership

#### ITER solves fusion leadership – international coop is key

Chu – Secretary of Energy – 3/26/12, FYI: The AIP Bulletin of Science Policy News, <http://www.aip.org/fyi/2012/045.html>

Secretary Chu replied:

“Senator, you're asking a very important question that we asked ourselves. But first let me assure you that the program at NIF [National Ignition Facility] is not actually competing with ITER. And NIF is supported by the NNSA [National Nuclear Security Administration] budget. And we want to make sure that that new program goes forward.  Now, ITER is international science collaboration. It - in the view of the fusion community - represents the most advanced, best chance we have of trying to control plasmas in a way that it can potentially . . . bring about controlled fusion for power generation.  And it is an international cooperation. And we I think want this to go forward. We want to be seen as reliable international partners. But we're also very cognizant of the spending profiles.  And we are working with the fusion community in the United States as well as internationally to see if we can satisfy both the needs of the fusion community in the U.S. and this ITER commitment. But it's -- in these tight budget times, it's tough.”

#### US is investing in fusion research now – SNL and LLNL

Sebastian Anthony – Extreme Tech – 10/8/12, Clean, limitless fusion power could arrive sooner than expected, http://www.extremetech.com/extreme/137520-clean-limitless-fusion-power-could-arrive-sooner-than-expected

The first breakthrough comes from Sandia National Laboratories (the same engineers who brought us the fanless heatsink). At SNL, a research team has been working on a new way of creating fusion called magnetized liner inertial fusion (MagLIF). This approach is quite similar to the National Ignition Facility at the LLNL in California, where they fuse deuterium and tritium (hydrogen isotopes) by crushing and heating the fuel with 500 trillion watts of laser power. Instead of lasers, MagLIF uses a massive magnetic pulse (26 million amps), created by Sandia’s Z Machine (a huge X-ray generator), to crush a small cylinder containing the hydrogen fuel. Through various optimizations, the researchers discovered a MagLIF setup that almost breaks even (i.e. it almost produces more thermal energy than the electrical energy required to begin the fusion reaction). Probably more significant is news from the Joint European Torus (JET), a magnetic confinement fusion facility in the UK. JET is very similar to the ITER nuclear fusion reactor, an international project which is being built in the south of France. Whereas NIF and Sandia create an instantaneous fusion reaction using heat and pressure, ITER and JET confine the fusing plasma for a much longer duration using strong magnetic fields, and are thus more inclined towards the steady production of electricity. JET’s breakthrough was the installation of a new beryllium-lined wall and tungsten floor inside the tokamak — the doughnut-shaped inner vessel that confines 11-million-degrees-Celsius plasma (pictured above). Carbon is the conventional tokamak lining (and the lining that had been chosen for the first iteration of ITER) but now it seems the beryllium-tungsten combo significantly improves the quality of the plasma. Hopefully this information will allow ITER to skip the carbon tokamak and jump straight to beryllium-tungsten, shaving years and millions of dollars off the project. Moving forward, JET will actually try full-blown fusion with the optimum mix of deuterium and tritium (16 megawatts, for less than a second). At this point, JET is practically an ITER testbed, so its results from the next year or two will have a large impact on the construction of ITER’s tokamak, which should be completed by 2019. Before today, magnetic confinement fusion was generally considered to be more mature and efficient than inertial confinement fusion — but Sandia’s new approach might change that. ITER is one of the world’s largest ongoing engineering projects (it’s expected to cost around $20 billion), and yet critics are quick to point out that we still don’t know if it will actually work. ITER isn’t expected to fuse D-T fuel until 2027 (producing 500 megawatts for up to 1,000 seconds) — and an awful lot can happen in 15 years. Still, the main thing is that we’re actually working on fusion power — when we’re talking about limitless, clean power, it’s probably worth investing a few billion dollars, even if it doesn’t work out. Fusion reactors are some of the most beautiful constructions you’ll ever see, so be sure to check out our galleries of the National Ignition Facility and the Princeton Plasma Physics Lab.

## Fusion

### Fusion

#### Fusion power fails – costs too high and regulation too difficult

Robert L. Hirsch - former senior energy program adviser for SAIC – 10/16/12, Where to Look for Practical Fusion Power, http://dotearth.blogs.nytimes.com/2012/10/19/a-veteran-of-fusion-science-proposes-narrowing-the-field/

Many outstanding people turned to the pursuit of fusion power.  A number of fusion concepts emerged and were investigated.  Soon it became painfully clear that practical fusion power would not happen quickly. First, we had to develop the science of plasma physics. After decades of effort, a great deal has been learned and accomplished, but a practical fusion power concept has not been forthcoming. Note that I said ”practical fusion power.” Unlike fire, fusion power has to compete against a number of other options. The word “practical” means that a fusion power system must be desirable, based on the realities of the society into which it will be introduced. An unfortunate problem today is that many people in fusion research believe that producing a fusion-something that simply works is the goal, but that is definitely wrong! Fusion power and fire are distinctly different. Let’s consider some specific criteria for practical fusion power. In 1994, the U.S. Electric Power Research Institute – EPRI – convened a panel of utility technologists to develop “Criteria for Practical Fusion Power Systems.” The result was a four-page folder that outlined “Three principal types of criteria:” Economics, Public Acceptance, and Regulatory Simplicity. The criteria are almost self-explanatory, but let me quote from the Economics Criteria: “To compensate for the higher economic risks associated with new technologies, fusion plants must have lower lifecycle costs than competing technologies available at the time of commercialization.” Details for the criteria are given in the report, which I commend to anyone motivated to help develop fusion power. Against these criteria, let’s consider tokamak fusion, the centerpiece of which is ITER – the International Thermonuclear Experimental Reactor – under construction in France. As we know, it’s an enormously large machine, which is generally considered to be a prototype of a practical fusion power plant. Comparing the ITER and the core of a comparable commercial fission reactor shows an enormous difference in size – a factor of 5-10 — ITER being huge by comparison to a fission reactor core. It is known in engineering and technology development that the cost of a finished machine or product is roughly proportional to the mass of the device. Eyeballing ITER compared to a fission reactor core, it’s obvious that an ITER-like machine is many times more massive. Yes, you can argue details, like the hollow bore of a tokamak, but the size of the huge superconducting magnets and their heavy support structures provides no relief. Bottom line – On the face of it, an ITER-like power system will be much more expensive than a comparable fission reactor, so I believe that tokamak fusion loses big-time on cost, independent of details. Next, consider the fact that deuterium-tritium fusion inherently emits copious neutrons, which will induce significant radioactivity in adjacent tokamak structural and moderating materials. Accordingly, a tokamak power system will become highly radioactive as soon as it begins to operate and, over time, radiation damage will render those same materials structurally weak, requiring replacement. In the U.S., as elsewhere in the world, we have a Nuclear Regulatory Commission, which will almost certainly be given the task of ensuring that the public is safe from mishaps associated with tokamak power system failures. Expected regulation will require all kinds of safety features, which will add further costs to tokamak power. While the character of the plasma in a tokamak power reactor will not likely represent a large energy-release safety issue, the superconducting magnets would contain a huge amount of stored energy. If those magnets were to go normal – lose their superconducting properties – the energy release would be very large. It can be argued that the probability of that happening will be small, but it will nevertheless not be zero, so the regulators will require safety features that will protect the public in a situation where the magnets go normal, releasing very large amounts of energy. Accordingly, it is virtually certain that the regulators will demand a containment building for a commercial tokamak reactor that will likely resemble what is currently required for fission reactors, so as to protect the public from normal-going superconducting magnet energy release. Because an ITER-like tokamak reactor is inherently so large, such a building will be extremely expensive, further increasing the costs of something that is already too expensive. Next, there’s the induced radioactivity in the structure and moderator of a tokamak power reactor. Some tokamak proponents contend that structure might be made out of an exotic material that will have low induced radioactivity. Maybe, but last I looked, such materials were very expensive and not in common use in the electric power industry. So if one were to decide to use such materials, there would be another boost to cost, along with an added difficulty for industry to deal with. No matter what materials are chosen, there will still be neutron-induced materials damage and large amounts of induced radioactivity. There will thus be remote operations required and large amounts of radioactive waste that will have to be handled and sent off site for cooling and maybe burial. That will be expensive and the public is not likely to be happy with large volumes of fusion-based radioactivity materials being transported around the country. Remember the criteria of public acceptance. I could go on with other downsides and showstoppers associated with tokamak fusion power, but I won’t.  It is enough to say that tokamak fusion power has what I believe are insurmountable barriers to practicability and acceptability.

#### Fusion failure decks the research apparatus – turns STEM/leadership. Prefer our ev – it’s from a veteran fusion researcher

Robert L. Hirsch - former senior energy program adviser for SAIC – 10/16/12, Where to Look for Practical Fusion Power, http://dotearth.blogs.nytimes.com/2012/10/19/a-veteran-of-fusion-science-proposes-narrowing-the-field/

By the way, my arguments assume that tokamak physics and technology works well and is reasonably simple, meaning that not many more components will have to be added to the system to allow it to operate on a steady basis for very long periods of time between the long shutdowns needed to change out radiation-damaged, radioactive materials. What I’ve just described is not a happy story. At some point, probably in a matter of years, a group of pragmatic power industry engineers will be convened to seriously scrutinize tokamak fusion, and they are virtually certain to declare that it cannot become a practical power system. That will certainly be a calamity for the people involved and for the cause of fusion power. Let’s review what I’ve said. First, we have to recognize that practical fusion power must measure up to or be superior to the competition in the electric power industry. Second, it is virtually certain that tokamak fusion as represented by ITER will not be practical. So where are we likely to find practical fusion power? First, we must look for a concept or concepts that are inherently small in size, which means high plasma density. Second, we must look for something that can be based on a low or zero neutron fusion reaction. One example is the proton-boron reaction. We know some things about proton-boron fusion. First it requires much higher temperatures that deuterium-tritium. Second, it cannot be based on a Maxwellian plasma particle distribution, because theory tells us that the plasma radiation losses (Bremsstrahlung) from a very high temperature, Maxwellian, proton-boron plasma will kill the concept. That means that a proton-boron plasma must be non-Maxwellian, and it must be fashioned in such a way that normal inter-particle scattering reactions can be managed on an on-going basis. For this audience, the requirements for practical fusion power sound like they could be met by Inertial Electrostatic Confinement (IEC) fusion. As you well know, IEC is a family of possibilities from gridded systems to magnetically constrained systems and on and on. They can in principle be very high density and therefore small, and they could have plasma distribution control as an element. I can’t help but wonder if IEC just might be the key to practical fusion power. In conclusion, in the early days of the U.S. fusion research, the program was classified secret and called Project Sherwood. One explanation for that name was, if it works, it sure would be wonderful. I hope that you and others will be able to help make it happen. Thank you. PS. These thoughts were painful to formulate. As a past leader of the U.S. federal fusion program, I played a significant role in establishing tokamak research to the U.S., and I had high hopes for its success. Realities have emerged to dash those hopes.  When we learn unpleasant things, it is incumbent on us to speak up, even when it hurts.

#### No commercialization—definitely not fast

Brumfiel, Scientific American, 2012

[June 2012, Geoff, writer for Scientific American, MS in Science Writing from John’s Hopkins, double degrees in Physics and English from Grinnell College in Iowa, “Fusion’s Missing Pieces,” Scientific American, EBSCO]

ITER will prove whether fusion is achievable. It will not prove whether it is commercially viable. There is good reason to think it might not be. For starters, the radiation from fusion is very intense and will damage ordinary material such as steel. A power plant will have to incorporate some as yet undeveloped materials that can withstand years of bombardment from the plasma -- otherwise the reactor will be constantly down for servicing. Then there is the problem of tritium fuel, which must be made on-site, probably by using the reactor's own radiation. Arguably the greatest obstacle to building a reactor based on ITER is the machine's incredible complexity. All the specialized heating systems and custom-built parts are fine in an experiment, but a power plant will need to be simpler, says Steve Cowley, CEO of the U.K.'s Atomic Energy Authority. "You can't imagine producing power day in and day out on a machine that's all bells and whistles," he says. Another generation of expensive demonstration reactors must be built before fusion can come onto the grid. Given ITER's lumbering development, none of these will be up and running before the middle of the century.

#### Solvency is extremely difficult

Prager, U.S. DOE’s Princeton Plasma Physics Lab, 11

[Stewart, Director – U.S. Department of Energy’s Princeton Plasma Physics Laboratory and Professor of Astrophysical Sciences – Princeton University, "Perspective On: The future of Fusion", 5-12, http://www.pppl.gov/polPressReleases.cfm?doc\_id=772]

Fusion scientists, like you, have been working to produce fusion reactions for many decades. Why is it so hard to create fusion energy? In a nuclear fusion reaction two atomic nuclei fuse and release energy. In a fusion reactor the core will contain the plasma producing this energy. It's a difficult process because it requires making a hot gas that is 10 times hotter than the core of the sun -- 100 hundred million degrees -- and confining that for long periods of time in a controllable way. Plasmas exhibit complex behavior that is difficult to understand. The engineering challenge is also huge, because you have to surround this hundred-million-degree plasma with a material structure. We often say that fusion is maybe the most, or one of the most difficult science and engineering challenges ever undertaken.

### Middle East

#### No military adoption/spin-off without manufacturing capabilities that work

#### Iran can’t lash out- economics and lack of hardline leaders checks

White 7 (Rebecca N., 12/4, pg. http://www.nationalinterest.org/Article.aspx?id=16266)

But, as Cordesman noted, Iran’s retaliatory options are limited by faults in its military and its fragile domestic economic base. Iran is in a poor position to strike back. Also tempering a potential response is the fact that President Ahmadinejad isn’t the only decision-maker in Iran, Eisenstadt pointed out. And his popularity is waning, Feldman said, due in part to the effects of economic sanctions. If we don’t have a firm grasp on what we’re up against or what we’re capable of, it’s difficult to develop a course of military action. Offering a word of warning, Cordesman looked to the past, to Operation Desert Fox in Iraq, as a lesson in faulty planning. But uncertainty is a given in any policy decision, according to Feldman. Risk analysis is about weighing probabilities. It’s never “crystal clear” how the other side will react.

#### Iran can’t hit ships – environmental conditions spoof missile seekers

William D. O’Neil - former Director of Naval Warfare, Department of Defense - Winter 2008/09, Costs and Difficulties of Blocking the Strait of Hormuz, International Security, Volume 33, Number 3, Project MUSE

How the clearance operations would be conducted would depend on the circumstances, and in particular, the degree of knowledge regarding the mine locations. If surveillance failed entirely, clearance would be impeded; however, even general information about mine locations would permit much faster clearance. the antiship missile threat Talmadge dwells on possible Iranian antiship missile threats, without dealing adequately with the end-to-end system issues on either side. To pose a meaningful missile threat, Iran must first maintain surveillance of the area. Targets must be located either by the surveillance system or by dedicated targeting sensors. The targeting information must be passed to a control facility where firing orders are computed and transmitted to the missile battery. The missile is launched and flies out to the target area, where it turns on its seeker at the programmed time. To guide the missile to its target, the seeker must acquire the correct target and resist natural and intended diversions. Delays of more than a few minutes or errors of more than a few hundred meters entail a high risk that the missile will miss its target. The only surveillance scheme likely to produce effective results involves the use of radars able to cover the target area. The location requirements of the surveillance radar are strict. To see ships well, the radar must view them against the horizon or against a background separated from the ship by a distance that is large relative to the range discrimination of the radar. If the radar points down into the sea clutter, its probability of detection will fall off sharply; this largely bars the ridgeline locations that Talmadge speculates about. In addition, the site must avoid nearby reflecting surfaces and provide a good ground plane. Near-shoreline towers are usually the best solution. The limited choice of good sites combines with the ease of detecting radar emissions to make the radars highly vulnerable. Talmadge seems to believe that destruction of all the missile launchers is necessary to cut off an antiship missile campaign. Once the radars are gone, however, the game is over—the missiles are no longer usable. Efforts might be made to hunt down and attack the mobile missile launchers, and this could well prove as exacting and frustrating as she envisions it to be, but success in this is not essential to protect shipping. Talmadge also seems to believe that the antiship missiles in flight must be shot down to be rendered ineffective, or at least that interception is the primary defense against them. Fortunately, there are much better responses. This is particularly true in the region surrounding the Strait of Hormuz, which is so unfavorable for the operation of antiship missile seekers that most missiles may be defeated by a combination of tactical and technical means to exploit and exacerbate natural difficulties—so-called soft-kill defenses. “Hard kill”—physical interception and destruction of the antiship missile— would play an important but secondary role in this case. Broadly speaking, three distinct categories of seekers are available for use by antiship missiles, each of which faces special problems in the region of the Strait of Hormuz. In an infrared seeker, a bolometer or (in more modern and complex versions) an imaging camera sensitive to heat radiation detects the target based on its difference in effective temperature from the sea background. Although ships are not sources of intense heat, they generally are sufficiently hotter or cooler than the background to permit contrast detection, at least for most of the day. The Strait of Hormuz, however, is an unfavorable location for this because the exceptionally high water vapor and dust content of the atmosphere rapidly absorb and attenuate infrared heat radiation, severely limiting the range at which the ship may be detected. Another approach is a passive electronic seeker, essentially a radio receiver with a directional antenna programmed to receive and recognize the signal of a radar or other electronic emitter associated with the target. These seekers can be useful against ships with a distinctive emitter, such as the radar of an Aegis cruiser, but not against merchant ships or mine countermeasures ships, whose radars and other emitters are too similar to those of other vessels in the vicinity to be distinguished by the seeker. The most common seeker is radar—a compact set in the missile’s nose programmed to detect and home on surface ships. (This may be combined with an infrared or passive electronic system to confirm target identification and refine homing accuracy.) Radar is generally preferred because it provides reliable detection at ranges great enough to permit acquisition of targets whose location is only approximately known. But in the region of the Strait of Hormuz, this can not be relied upon. First of all, it is dense with islands and man-made structures (chiefly oil platforms) that have very large radar cross sections and can return enough energy to confuse and overwhelm radar seekers. This region is also especially subject to strong surface evaporation ducts, which greatly complicate radar propagation and may confuse the seeker or make the target invisible to it.4 In such a region, the first line of defense against antiship missiles is to operate ships to take best advantage of the natural vulnerabilities of the missile seekers. In particular, tankers can be routed close to land and oil platforms whose radar returns will blank those of the ships. Talmadge suggests that traffic could be routed through the more southerly portions of the region to the west of the strait, and this would serve the purpose admirably, as well as putting it farther from the Iranian coast. Mariners would grumble about the navigational difficulties involved in threading their way through the obstacles, but the universal use of high-accuracy GPS navigational plotters makes this far more feasible than it would have been not long ago, even when visibility is limited.5 These steps in themselves would afford considerable protection against missile seekers. Employing passive or active electronic and infrared countermeasures would further confuse or blind the seekers and augment protection. U.S. Navy ships are reported to carry an array of such countermeasures, and further countermeasures could be deployed using dedicated platforms or shore sites. Finally, the surveillance and targeting radars that are so essential to the entire antiship enterprise would also be greatly affected by the natural difficulties of the region and would be vulnerable to countermeasures—particularly to powerful jammers. These jammers could be deployed either by specialized aircraft or in fixed sites on the heights overlooking the strait from the Arabian Peninsula side. Thus, even before surveillance radars were destroyed, they could be rendered largely ineffective. conclusion