Maximizing Job Creation:

An Analysis of Alternatives for the Transformation of the Kansas City Plant

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Introduction

Investment is one of the most important processes for economic growth and development. Whether it is publicly or privately financed, there are always two key issues. First, is there a high enough expected rate of return to make the investment worthwhile? And second, how risky is it? That is, what are the chances that the investors will actually receive substantially less than that expected rate of return? Any sensible investment strategy pays attention to both these matters.

Furthermore, there are always alternative projects into which public or private investors can put their money. Therefore, it is a fundamental rule of wise investment strategy to compare risk and rates of return across a range of alternatives before committing to any particular use of funds. This is no less true of public investments than those made by the private sector. If anything it is more true, since the credit worthiness of governments and the tax revenues they collect from hardworking taxpayers are valuable public assets. Government officials entrusted with making decisions that maximize public benefit are obligated by that trust to invest these assets with great care.

With these considerations in mind, this report considers the relative effectiveness for the people of Kansas City of using publicly raised funds to facilitate the development

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of a new plant complex to replace the sixty-year old Kansas City Plant (KCP) owned by the U.S. Department of Energy (DOE). Under current plans, the new KCP complex is intended to carry on the mission of the old KCP in manufacturing, procuring, assembling and testing the vast majority of the non-nuclear components of nuclear weapons. Because it has been a central issue in the political debate concerning the KC plant, and because of the surrounding context of difficult economic times, we have used the prospects for job creation as the main measure of return on investment. Making no claims of comprehensiveness, we have focused primarily on the job creating prospects of three alternatives to continued production of nuclear weapons parts: renewable energy products, energy efficiency-related products, and key components of the national infrastructure. We present indicative evidence of the relative strengths of the markets for nuclear weapons and these three alternatives. We also quantitatively assess the effectiveness of three of these four options in generating additional jobs in the wider KC economy through the well known "ripple" or "multiplier" effect.

Our general findings indicate that renewable energy, energy efficiency, and infrastructure products are not only likely to have much bigger and more buoyant future markets than nuclear weapons, but also that they would be considerably more effective in generating jobs for the economy of Kansas City and its environs.

This report begins with a brief overview of the current KCP and the complex intended to replace it. We then assess the relative risk and return of investing in the four options under consideration by looking first at the likely future market for nuclear weapons, and second at the likely future markets for renewable energy, energy efficiency

and infrastructure. The next section evaluates three of these options in terms of their prospects as job generators. Finally, we summarize our analysis and findings.

It is always tempting to the cautious investor to invest in those economic activities that have seemed a safe bet in the past. But investment is an inherently forward-looking activity. One of the surest ways to lose is getting stuck in the past, rather than looking to the future. It is in the spirit of helping to avoid that fate that we present this report.

The Kansas City Plant: A Brief Overview

Located within the Bannister Federal Complex, the original facility of what is now the Kansas City Plant (KCP) was established during World War II (1943) by the Navy. The facility's mission was the assembly of Navy fighter plane engines.[1] During 1947, part of the building also served to store "tires, raw rubber, sugar, and lumber". The facility fell under control of the Department of Energy's (DOE's) predecessor, the U.S. Atomic Energy Commission in 1949 at which time its mission became the manufacture of nonfissionable components for nuclear weapons.[2]

After several changes in management, Honeywell Federal Manufacturing and Technologies (Honeywell) assumed management of the facility in 1999 on behalf of the National Nuclear Security Administration (NNSA).[3] Annual gross operating costs in FY2007 were $400 to $500 million, contributing $1.6 million to the Kansas City earnings tax coffers[4] and $1.7 million in earnings tax in FY2009.[5] Bruns reported that KCP procurements from small businesses in Missouri and Kansas totaled $15.7 million in FY2009[6] while the GSA reported that the KCP spent $22 million for small business procurements in Missouri and Kansas for FY2007,[7] a drop of twenty-nine percent.

In 1993, a consolidation of the U.S. nuclear weapons complex shifted all manufacturing and procurement activities for non-nuclear weapons components to the KCP.[8] In addition to procurement or production activities to support "the W88 submarine-launched ballistic missile warheads, the W78 and W87 intercontinental ballistic missile warheads, the W80 cruise missile warhead, and the B61 and B83 nuclear bombs", much of the KCP's current activities are to support and extend the life of the W76 warhead".[9] To that end, as of January 2008, the KCP employed 2,711 employees of which 2,426 worked at the Kansas City, Missouri plant.[10,11] Receiving $257.9 million in FY2007 payroll,[12] in 2008 these employees encompassed a range of disciplines and education levels: 406 were office/clerical workers, or officials and managers; 628 were skilled craft workers or technicians; there were 27 laborers; 483 were "operatives"; and 1,074 were professionals. This was (and is) a well educated workforce: 859 held a Bachelor's degree, 344 a Masters degree, 25 a Doctorate and two were identified as "MD, DDS, JD" (i.e., were trained as a medical doctor, dentist, or JD).[13] Employees, on average, worked at the plant for nineteen years (as of 2008).

At not quite three million square feet and a yearly cost of about $400 million to operate, the current KCP complex is considered to be too large, old and expensive to continue operating.[14] After the GSA and NNSA's review of multiple alternatives in various locations around the U.S. for modernization, downsizing, and reorganizing the KCP's operations, they selected a location for a new facility not far from the current one in Kansas City, Missouri.[15] After relocation, the KCP's footprint will decrease by more than fifty percent (from that at its current location in the Bannister Federal Complex) to approximately 1.5 million square feet on 177 acres.[16] Cost of the new campus,

"including design, construction, equipment, and payments on the twenty-year credit-tenant lease, is estimated at several billion dollars".[17] After relocation, federal government operating costs will reportedly decrease by $100 million,[18] yet the GAO states, "while leasing a facility through GSA under a 20-year scenario is less costly than purchasing, it can be more costly over the long term. Because KCP's analysis did not consider costs beyond 20 years, NNSA cannot be certain if other alternatives, such as purchasing the facility, might have offered lower costs over the longer term."[19] Despite the fact that employment is reported to be "more than 2,300" (according to the U.S. GSA)[20] at the Bannister Federal Complex KCP (or just under 2,500 according to Honeywell[21]), and downsizing implies a reduction in employees, employment at the new location is reported to be 2,500.[22]

It is widely cited in documents, reports, and articles that the KCP supplies 100,000 parts annually (through production or procurement), about eighty-five percent of the parts and components in the typical nuclear weapon. Currently the KCP outsources thirty to fifty-four percent of components; after relocation that outsourcing will increase to seventy percent. In a 2009 report the GAO raised some concern over proliferation risks from the increase in outsourcing.[23]

According to the DOE, principal output of the KCP since 1949 has included "arming systems, fusing and firing systems, radars, power supplies, rubber, plastic and foam parts, and outer casings".[24] O'Neill writes that the KCP also "supplies various electrical, electronic … components … and coded safety locks known as permissive action links (PALs)".[25] Despite procuring or

producing nonnuclear weapons parts, there has historically been a small amount of exposure to radiation, primarily from testing and calibration equipment.[26]

Materials, components and processes involved in nonnuclear weapons manufacturing at the KCP include "engineered materials such as …glass, [and] polymers …",[27] "welds and forgings, foams, plastics, adhesives, composites, ceramics, and coatings"; testing for cracks, flaws and chemical contaminations; testing thicknesses, densities, and dimensions of components; and the "identification of alloys; evaluation of heat treatment conditions; and image enhancement".[28] A NNSA report also notes that the KCP conducts surveillance inspection.[29] The names of some of the buildings used at the KCP for the construction of nonnuclear weapons provide additional indications of the types of components, processes and materials: "Polymer Building, High Power Laboratory, Mold Heating and Cooling Building, Plating Building and Spray Mask Facility".[30]

From publicly available information about materials, components, and production at the KCP and the possibility that some items are dual-use,[31] it is reasonable to expect there is some overlap between use of facilities at the KCP and, for example, the production of wind turbines or solar systems. The production of wind turbines can include die cast aluminum, steel castings or forgings, other composites, copper, glassfiber-reinforced plastic, and carbon filament reinforced plastic. Gearboxes require "high power solid state electronics".[32] Wind turbine assemblies are also subject to fatigue stress testing. And it is likely that forging is utilized for die casting aluminum and welding to

adhere together various parts of the system. Facility organization, employee skills and technical expertise for KCP operations that could overlap might include welding, forging, fatigue stress testing, electronics assembly and testing, the use of plastics and other chemicals involved in plastics and coatings, and mechanical assemblies.

There could also be some overlap between familiarity with and the handling of KCP materials and components and those required for the production of solar energy systems. For example, solar systems manufacturing is researching the viability of a variety of coatings, such as "advanced hardcoats, barriers, [and] antisoiling coatings"[33] as well as electronic components. Optical materials and testing equipment, and other specialized testing equipment would require an inventory of specialized electronics. In addition to other polymers, chemicals, electrical and electronic materials and components, there is also likely an additional overlap in technical similarity between those used or manufactured at the KCP and those used in wind energy or solar systems manufacturing.

The U.S. government describes the KCP as a "complex [that] has evolved into a high-tech research production facility that specializes in science-based manufacturing".[34] At the new location, there will be greater attention to using business management practices, utilization of a smaller more flexible facility, an increase in procurement and outsourcing, and a thirty percent reduction in staff over the next ten years. Staying in Kansas City and adopting these changes will reportedly save the U.S. government considerable money, at least during the first twenty years of operation. Said differently, there will be fewer dollars flowing

into the Kansas City local economy other than from the initial burst of dollars from the construction phase.

The Future Market for Nuclear Weapons

Nuclear weapons have long been a key component of U.S. national security strategy. Many thousands have been produced since the dawning of the nuclear age in the deserts of New Mexico. Trillions of dollars have been spent in the service of developing and building nuclear weapons and the equipment designed to deliver them to their intended targets. For obvious reasons, the same national security strategy that supported the nuclear military has always prevented exports, restricting the market of U.S. nuclear weapons producers to the American military. Even so, there has clearly been a substantial market demand for nuclear weapons for more than sixty years. But that is the past. What about the future?

From the beginning, there have been those who have opposed the building and expansion of nuclear weapons on a variety of grounds, from the inherent danger of fallible human beings interacting with such devastating weapons to the morality of using them as existential threats. Despite this opposition, the market for nuclear weapons has persisted. But in the last decade and a half, there has been a sea change in the nature, credentials, and influence of those arguing for substantial reductions in the size of nuclear arsenals and even for the complete abolition of nuclear weapons.

In 1996, the Canberra Commission presented a comprehensive plan for abolishing nuclear weapons to the United Nations. This proposal came from a group with very unusual credentials including General George Lee Butler, former commander-in-chief of the U.S. Strategic Command, the officer in charge of all American strategic nuclear weapons from

1991-1994; and Robert MacNamara, former U.S. Secretary of Defense and a key figure in developing the idea of security through "mutually assured destruction" that for decades drove much of the buildup of the American nuclear weapons stockpile. The lengthy report argues, "The proposition that large numbers of nuclear weapons can be retained in perpetuity and never used—accidentally or by decision—defies credibility. The only complete defense is the elimination of nuclear weapons and assurance that they will never be produced again."[35] The Commission goes farther, arguing that nuclear weapons have little military utility, and that "a central reality is that nuclear weapons diminish the security of all states."[36]

The year before the Canberra Commission was formed, U.S. Air Force General Charles A. Horner, head of the North American Aerospace Defense Command (NORAD) became the first active-duty officer to publicly call for the abolition of nuclear weapons, saying "I want to get rid of them all...."[37] Then on December 8, 1996, sixty retired generals and admirals from the all of the then-declared nuclear-armed nations (the U.S., Russia, Great Britain, France, and China) signed a joint statement at the United Nations endorsing the idea that nuclear weapons can and should be completely eliminated.[38]

The twenty-first century saw more of the same. On January 4, 2007, the Wall Street Journal published an editorial "A World Free of Nuclear Weapons", jointly authored by Henry Kissinger (former U.S. Secretary of State and Assistant to the President for National Security), George Schultz (former U.S. Secretary of State), William Perry (former U.S. Secretary of Defense), and Sam Nunn (former chairman of the Senate Armed Services Committee). The concluding paragraph of the editorial began, "We endorse setting the goal of a world free of nuclear weapons and working energetically on the actions required to

achieve that goal … .” December 2008 saw the launch of a new organization, Global Zero, focused on the goal of eliminating nuclear weapons within twenty-five years, supported by former U.S. President Jimmy Carter, former U.S. Defense Secretary Frank Carlucci, and a number of others with similar credentials.[39]

This idea has also been gaining currency among sitting national government leaders. On January 21, 2008, Gordon Brown, Prime Minister of Great Britain was quoted as saying, “we will be at the forefront of the international campaign to accelerate disarmament among possessor states and to ultimately achieve a world that is free from nuclear weapons”.[40] On September 24, 2009, presiding over a special Summit on Nuclear Nonproliferation and Nuclear Disarmament of the UN Security Council, U.S. President Barak Obama presented UN Resolution 1887 of 2009 for a vote. All of the nations of the Security Council (including France, China, Russia, the U.S. and Britain) voted in favor of the resolution about which President Obama said, “The historic resolution we just adopted enshrines our shared commitment to the goal of a world without nuclear weapons. And it brings Security Council agreement on a broad framework for action to reduce nuclear dangers as we work toward that goal”.[41]

On June 27, 2000, the Los Alamos National Laboratory—an institution that plays the key role of designing the nuclear weapons for which the KCP produces parts—issued a forward-looking report. Written by the Associate Laboratory Director for Nuclear Weapons, Stephen M. Younger, the report was called, “Nuclear Weapons in the Twenty-First Century”. In it, Younger wrote, “Advances in conventional weapons technology suggest that by 2020 precision long-range conventional weapons may be capable of performing some of the missions currently assigned to nuclear weapons…. The composition of our

nuclear arsenal may undergo significant modification…. [It] could employ more rugged and simpler designs that might be developed and maintained with high confidence… *with a smaller nuclear weapons complex* than we envision is required to maintain our current nuclear forces"[42] (emphasis added).

The National Nuclear Security Administration (NNSA)—the organization within the DOE responsible for maintaining the safety, security and reliability of U.S. nuclear weapons—is a key player in the KCP project. On January 1, 2009, NNSA issued a press release entitled, "Reducing the Nuclear Weapons Stockpile". Pointing out that "The current U.S. nuclear stockpile is the lowest it has been since the Eisenhower Administration", NNSA clearly stated that one of the consequences of changes in the nuclear weapons complex would be to "Employ 20-30% fewer workers directly supporting weapons missions consistent with a smaller, more efficient complex."[43] The NNSA website currently lists among the consequences of the "transformational changes" for the KCP in particular, "Over a decade or so, up to 30% fewer staff supporting nuclear weapons activities", along with a "15% increase of the component outsourcing percentage".[44]

To add to all this, the fact that the perceived threat to the nation's economic wellbeing posed by huge budget deficits and an enormous national debt has created tremendous pressure on both the White House and the Congress, Democrats and Republicans, to cut government spending. It is becoming increasingly clear in this political climate that military-related spending will not be exempt. On June 15, 2011, the powerful Republican-led House Appropriations Committee voted to cut hundreds of millions of dollars from Administration requests for nuclear weapons, including $100 million withheld from Los Alamos National Laboratory for a new plutonium facility.[45] According to the

Albuquerque Journal, this was central to a cost-reduction effort by the Republican chair of the Appropriations energy subcommittee.[46] Meanwhile, the Obama Administration has given recently confirmed Secretary of Defense Leon Panetta the assignment of recommending hundreds of billions of dollars worth of military spending cuts over the next decade.[47] While it is true that both the Administration and key Congressional Committees are still for the moment increasing nuclear weapons budgets, it is clear that cost-based pressures to reduce spending are already having an impact on funding. These pressures are very likely to increase dramatically in the near to mid-term future.

In summary, there is growing support for abolition of nuclear weapons—or at least major reductions in nuclear arsenals—on the part of high ranking military officers and government officials who previously played major roles in the growth of nuclear weapons stockpiles. Heads of governments are also increasingly voicing public support for this goal. And there is powerful political pressure on both Democratic and Republican leaders in the Congress and the Administration to cut government spending—pressures from which the military budget in general and the nuclear weapons budget in particular will not be immune. Given the confluence of all of these factors, the best forecast is that there will be a declining market for nuclear weapons in the U.S., if not immediately, then certainly over the next decade or two. Exactly how quickly and how much this market will shrink is difficult to predict, but it is even more difficult to believe that it will not.

The Future Markets for Renewable Energy, Energy Efficiency, and Infrastructure

There are many avenues of economic activity that stand as potentially productive job-creating alternative investments to an updated KC Plant focused on producing non-nuclear components of nuclear weapons. A comprehensive and thorough exploration of

these is well beyond the scope of this report. Instead we limit our attention to three broad alternative areas that are particularly promising as contributors to the present and future economic wellbeing of Kansas City, as well as to national goals of economic revitalization and even national security. These are renewable energy, energy efficiency, and critical infrastructure systems. All three of these alternatives require components that could be profitably manufactured and services that might be profitably provided by the KC workforce. The question is, what is likely to be the size and job-creating potential of these markets now and in the longer-term future?

There are many sources of renewable energy including the wind, the sun, the tides, waves, falling water, geothermal energy, and biomass. We focus here mainly on wind power, in part because it has enormous potential, in part because its use is expanding rapidly, and in part because it has been more extensively studied. This should not be taken to imply that other forms of renewable energy are necessarily inferior.

In 2007, the U.S. Energy Information Administration (EIA) estimated that U.S. electricity demand would grow to 5.8 billion megawatt-hours by 2030, a thirty-nine percent increase over the base year 2005.[48] To gain some appreciation for the economic potential of renewable energy we ask what the implications for job-generation would be if this increased demand were met by building conventional electricity-generating facilities powered by fossil fuels or by renewable energy. After thoroughly analyzing thirteen independent reports and studies on the economic and employment impacts of clean energy in the U.S. and Europe (and developing their own model), Kammen, Kapadia and Fripp of the University of California concluded in their 2004 report, "The renewable energy sector generates more jobs per megawatt of power installed, per unit of energy produced, and

per dollar of investment than the fossil fuel-based energy sector." The differences were not small. Comparing a scenario using renewable energy to meet twenty percent of U.S. electricity demand with a "fossil fuels only" scenario, they estimated that renewables would create between two and three times as many jobs by 2020—close to a quarter million.[49]

The model with which Kammen, Kapadia and Fripp estimated these rather sizable job gains did not even include the jobs that would be generated by exporting manufactured renewable energy systems. This means that their impressive figures could actually turn out to be substantial underestimates. By way of gauging the potential of this export market for job creation, a 2003 report by Heavner and Del Chiaro focused on California estimated that the international market for renewable energy could generate more than sixteen times as much employment for the state as would the in-state market alone.[50]

The 2004 Apollo Jobs Project investigated the impact of federal support for renewable energy as part of a more comprehensive ten-year federal program to encourage energy diversity and promote high performance buildings, among other investments. The renewable energy component alone was projected to create nearly half a million jobs.[51] Interestingly, many of the jobs that would be created by a vigorous renewable energy industry are in sectors of the economy that have experienced serious problems of job loss. Chief among these—and particularly relevant to the case of the KC Plant—is manufacturing, which has shrunk substantially over the last few decades. Renewable energy tends to create more jobs in manufacturing than in services or operations and

maintenance. The construction industry would also be boosted by movement toward creating a more renewables-oriented energy infrastructure.[52]

Wind power is the fastest growing source of electricity generation in the U.S.[53] According to the DOE report, 20% Wind Energy by 2030, "U.S. manufacturers have expanded their capacity to produce and assemble the essential components [of wind power systems]. Despite this growth, …U.S. manufacturers are struggling to keep pace with rising demand."[54] More than twenty states have enacted Renewable Portfolio Standards (RPSs), which require electricity suppliers in the states to obtain at least a given minimum percentage of their supply from renewable energy sources, ordinarily with these percentages rising over time. This has helped spur an ongoing expansion in the market for wind power (and thus for its manufactured components) and a dramatic drop in the price of wind-generated electricity—by some eighty percent between the 1980s and the late 1990s alone. DOE contends that this has created "an environment for stable growth" of the market for wind energy.[55]

The Jobs and Economic Development Impacts (JEDI) model was developed for the National Renewable Energy Laboratory (NREL) "to demonstrate the state and local economic development impacts associated with developing wind power plants in the United States". Using this model to analyze the economic impacts of its twenty percent wind power by 2030 scenario, DOE finds that the cumulative economic value generated by the construction phase alone will reach nearly $1 trillion, and create an average annual total of 258,755 jobs across the nation. More than 22,000 of these will be in manufacturing, with an additional 47,000 in the construction sector. Once all of the equipment manufactured for the twenty percent wind scenario is in place and generating

electricity (in 2030), ongoing maintenance and operation of these wind power facilities will still generate a total of 216,578 jobs.[56]

According to a study prepared for the United Nations Environmental Program (UNEP) in 2002, given the energy market share projected for wind power by 2020, it should be producing sales of $150 billion to $400 billion worldwide by then. The same study projected that global sales in the market for all forms of renewable energy will reach as much as $1.9 trillion by 2020. The market in the U.S. alone is expected to grow thirty-four percent by then.[57]

In April 2011, Secretary of Energy Steven Chu announced the DOE had offered a $2.1 billion conditional loan guarantee to support two units of a solar concentrating thermal electric generating plant in California, part of the Blythe Solar Power Project. The project is expected to create more than 1,000 jobs.[58] This is part of a much larger DOE program of loan guarantees intended to encourage clean energy projects. Current commitments under this program for solar manufacturing and solar power generation alone are in excess of $13.4 billion, with these projects expected to generate more than more than 4,300 permanent jobs, and over 13,200 jobs during construction.[59] The Department of Energy has also provided tens of million of dollars to projects aiming to develop supply chains for manufacturing solar energy products, such as photovoltaic cells.[60] (A 2010 study by Wei, Patadia, and Kammen at the University of California found that among the common renewable energy technologies, solar photo voltaics create the most jobs per unit of electric output.)[61] Independent of government assisted funding, major private sector companies such as General Electric and Google have also been investing in solar power.[62]

Reviewing fifteen recent studies on the potential job creating effects of renewable energy and energy efficiency among other things, Wei, Patadia and Kammen conclude that aggressive energy efficiency measures combined with renewable portfolio standards (at the level of thirty percent by 2030) would create over four million full-time equivalent job-years by 2030. Increased energy efficiency that would cut in half the annual rate of increase in electricity generation (so that electricity generation would continue to grow, but more slowly) would create two million job-years by itself. [63] Gains in energy efficiency great enough to keep energy demand flat would double the job gains to four million job-years.[64] Interestingly, they also found that the job creating potential of increased energy efficiency (measured in job-year/gigawatt-hour) is 2.7 times as great as that of nuclear power.[65]

Wei, Patadia and Kammen also find that "Energy efficiency investment offers a high payoff in induced jobs and is generally the least cost and often the most readily implementable approach." Furthermore, they cite a 2008 report by the American Solar Energy Society (ASES) saying, "job growth in the renewable energy and energy efficiency industries is biased toward technical, scientific, professional, and skilled workers"—which makes these industries particularly relevant as an alternative for the relatively skilled labor force at the KCP.[66]

Production in support of critical investment in the nation's infrastructure is yet another economically profitable alternative to production in support of the nuclear arsenal. A high quality infrastructure is virtually a prerequisite to healthy and dynamic national, state, and local economies. This critical set of systems supports the activities of both business and consumers. High quality infrastructure is one of the key differences

between developed and developing country economies. Yet, after careful analysis of fifteen major categories in their 2009 Report Card for America's Infrastructure, the American Society of Civil Engineers (ASCE) gave the U.S. infrastructure an overall grade of "D"—not quite failing, but close.[67] Only one category (solid waste systems) even ranked as high as a "C+". The nation's roads, dams, bridges, drinking water, aviation and energy infrastructure and the like are in serious need of upgrade and repair. This is not a matter of political ideology; it is a matter of physical reality.

To put this right, ASCE estimates that the nation needs to invest some $2.2 trillion in the nation's infrastructure within the next five years.[68] According to ASCE, projected investment to meet electric utility needs alone "could be as much as $1.5 trillion by 2030".[69] No matter how these investments are divided between government and the private sector, they will create an enormous market for related products. Extending and upgrading just the nation's electric grid, for example, will generate large markets for power towers, cables, wires, and all sorts of electronic and electromechanical control and switching devices. Many such products are natural alternatives for a workforce as skilled as that of the KCP.

According to simulations done in a May 2011 study by the Brattle Group, every $1 billion of U.S. investment in electricity transmission supports about 13,000 full-time equivalent job-years of employment.[70] If the rate of job creation were the same for all elements of the electric power system, even spread over a twenty-year period, the level of electric power investment that ASCE argues is necessary would generate an average of close to a million jobs (975,000) per year nationwide.

Investment in traditional infrastructure (such as bridges, dams, water treatment systems, and the like) is not the only type of infrastructure investment that would generate abundant good jobs and incomes and help keep American producers more competitive with their overseas rivals. In a January 2009 report from the Information Technology and Innovation Foundation, Atkinson, Castro and Ezell argue, "investment in certain parts of our national information technology (IT) infrastructure—America's digital infrastructure—will have a greater positive impact on jobs, productivity, and innovation". Key elements of IT infrastructure include broadband high speed Internet access, health related IT (such as interoperable electronic health records systems) and a "smart electricity grid" (which uses advanced sensors, meters, and two way communication to manage the grid in general and peak load in particular). They estimate that "spurring an additional investment of $30 billion in America's IT network infrastructure… will create approximately 949,000 U.S. jobs." In addition, they estimate that 525,000 of these jobs would be in small to medium size businesses (fewer than 500 employees).[71]

No one has a guaranteed accurate crystal ball for predicting the future, so there is no way of knowing in advance whose scenarios or which forecasts will turn out to be closest to what actually happens. But it is clear that the markets for products related to renewable energy, enhancing energy efficiency, and infrastructure investment are vibrant and growing. They are propelled by serious long-lasting environmental concerns and energy security considerations around the world, in addition to growing pressures at home to create jobs, reduce overblown trade deficits, and revitalize America's economic

base. Furthermore, regardless of U.S. policies, global forces are almost certain to assure a large, growing and profitable market for these products now and for many years to come.

Investing for Job Creation: An Analysis of Alternatives

As we have seen, pragmatic economic and political analysis indicates that over the next few decades the market for nuclear weapons-related products is likely to contract and decline, while the markets for renewable energy, energy efficiency and infrastructure related products are much more likely to expand and grow.

The "multiplier" is the analytical tool of choice by most economists for comparing output or job creation across investments. In this case, we are interested in the "employment multiplier" (sometimes called the "jobs multiplier"). The employment multiplier measures how many total jobs the project generates. Multipliers are useful for calculating employment effects of existing projects or enterprises (such as universities, hospitals, or military bases), or for predicting total employment gains from investments in new projects or ventures. Sometimes multipliers include the creation of short-term or temporary jobs involved in constructing the buildings and roads that are associated with the project or facility; often separate multipliers are used to calculate the gain in temporary construction jobs and more permanent post-construction jobs creation. A multiplier is not an abstract or hypothetical concept. Mathematical calculations from real employment data from existing or similar enterprises generate multipliers using input-output analysis.[72]

A job multiplier is used to calculate the total number of jobs generated in the economy from a business or enterprise. The total number of jobs consists of "direct

employment," "indirect employment," and "induced employment." Consider, for example, a hospital. Direct employment includes of all workers working within the hospital (e.g. nurses, lab technicians, cleaning staff, cafeteria workers, doctors, etc.) or employees of the hospital who work off campus. Indirect employment includes those in the local economy who produce goods or services used by the hospital and purchased or leased by the hospital. These include employees at companies that produce thermometers, gauze, patients' gowns, MRI machines, food served to patients or sold by the cafeteria, etc. Induced employment consists of jobs involved in providing goods or services to those workers directly and indirectly employed by the hospital. This includes in jobs working as dry cleaners, grocery store clerks, hair cutters, teachers, and so on. Combining direct, indirect and induced jobs provides the total number of jobs resulting from the business or venture. An *employment multiplier*, therefore, deals with the total number of jobs that are generated by an enterprise.

Multipliers are useful in comparing job-creating efforts across alternative industries. For comparability, we use the KCP's employment multiplier of 2.1 *as if* it would be adding new jobs.[73] In fact, the KCP jobs already exist. They would presumably be lost only if the KCP is shutdown and no alternative project is undertaken at all. Transferring employees from the old KCP location to the proposed new location does not infuse new (direct) jobs into the economy. There is one exception: construction jobs to build and ready the new plant. When construction employment multipliers are available, we include those in the analysis.

Each of the alternative industries in this analysis was described in the previous section. For simplicity in this section, we are calling investment in the electricity

transmission infrastructure "transmission"; constructing and laying down the grid for wind energy "wind infrastructure" (including the manufacture of wind turbines) and the operations of a wind plant "wind operations"; the development of IT-related enterprises, "health IT" and "broadband IT"; and the construction and operations of a solar energy-collection plant "solar."[74]

The multiplier tells us how many total jobs (direct + indirect + induced) will be created (or retained) in the economy for each person directly employed. As Figure 1 illustrates, we see that for each direct employment job at KCP, there will be 2.1 jobs retained in the local economy, including the direct jobs.[75] Investing in *transmission* has a considerably larger multiplier at 2.9.[76] Moving into s*olar* would generate still more jobs with a multiplier of 3.1 (as opposed to 2.1 for the KCP).[77] Constructing the necessary *wind infrastructure* can be expected to create 3.5 total jobs for every direct job created (while post-construction *wind operations* has a somewhat smaller multiplier at 2.8).[78] *Broadband IT* generates 3.6 jobs for each one hired in direct employment, compared to only 2.1 retained for each KCP employee.[79] Whether choosing *transmission, solar, wind infrastructure*, or *broadband IT*, each of these alternative enterprises would create many more jobs than does the KCP.

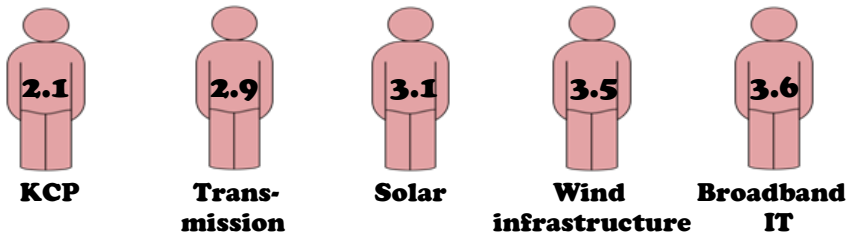

Figure 1. Multipliers for the KCP and alternatives

It is worth noting that total dollars spent on procurement by KCP within the Kansas City local economy fell between 2007 and 2009.[80] Either the amount paid by the KCP to procure the same quality and quantity of goods and services from local small businesses dropped between 2007 and 2009, or the NNSA transferred twenty-nine percent of small business procurement from the Kansas City region to other locales. Either way, fewer dollars went into small businesses in the local economy. With fewer dollars going into local small businesses, there would likely be a reduction in jobs in the local economy. Therefore, the KCP retained total jobs calculations could be overstated.

Next, we compare the total number of workers (direct and indirect-plus-induced) employed across the alternatives and with the KCP. For purposes of comparison, we assume that each of the proposed alternatives employs 2,500 in direct employment. We use 2,500 because this is the approximate size of direct employment anticipated for the KCP's new location. It is likely that direct employment at any or all of the alternatives could be significantly higher than 2,500, but a common benchmark of 2,500 simplifies comparison.

Multiplying the multiplier by the number of direct jobs (retained for KCP) or expected (for the alternatives) yields the number of total jobs, direct + indirect + induced. Since we assume that all alternatives will generate the same number of direct jobs (2,500), we focus on job gains by deducting the number of direct jobs from the number of total jobs calculated using the multiplier. We do this first for jobs relating to facility operations. We then compare the calculations of job gains for constructing the new facility for the KCP with additional jobs that would be gained by constructing a facility for an alternative type of production.

Using the KCP multiplier of 2.1 and direct employment of 2,500, approximately 5,250 total jobs were generated when the initial 2,500 employees were hired (2,500*2.1 = 5,250). Thus, in Table 1 for the KCP, there are 2,750 indirect plus induced jobs (5,250 – 2,500 = 2,750). Table 1 also includes subcategories of alternatives. As we can see, for the same number of direct jobs, there would be a gain of 4,850 indirect and induced jobs for *transmission.* Investment in *solar* leads to an additional 5,250 jobs for the local economy in support of the 2,500 direct hires. There are two IT subcategories: *health IT* and *broadband IT*.[81] *Health IT* generates 6,675 indirect and induced jobs from an initial 2,500 direct employment.[82] *Broadband IT* generates 6,500 from the same number of direct jobs.[83]

Table 1. Comparing job generation by the KCP and selected alternatives

Industry	Direct jobs (2,500 is assumed for alternatives)	Multiplier	Total jobs	Indirect and induced jobs*
KCP	2,500	2.1	5,250	2,750
Transmission	2,500	2.9	7,350	4,850
Solar				
facility operations	2,500	3.1	7,750	5,250
IT				
health [1]	2,500	3.7	9,175	6,675
broadband [1]	2,500	3.6	9,000	6,500
Wind [2]				
infrastructure	2,500	3.5	8,750	6,250
plant operations	2,500	2.8	7,000	4,500

*Gains in jobs are calculated by subtracting direct jobs from total jobs.

[1] There is an additional network effect with its own multiplier; the jobs from this effect are above and beyond jobs for *health IT* or *broadband IT* development itself.

[2] Job generation is based on a 24-year model to produce 20% more wind in the U.S.

Gains from *wind* can occur in two ways: one is for *wind infrastructure* development and manufacturing (towers, cables, turbines, etc.), and construction to transport and connect wind energy into the existing electricity grid; the second is by operating wind power generating plants built in/near Kansas City, *wind operations.* *Wind infrastructure* investment generates 6,250 jobs and *wind operations* creates 4,500 jobs above direct employment of 2,500.[84]

It is important is to observe how many more jobs would be created by the alternatives considered than are generated by the KCP. Figure 2 more graphically illustrates the net change in indirect and induces jobs from an original investment in 2,500 direct jobs.

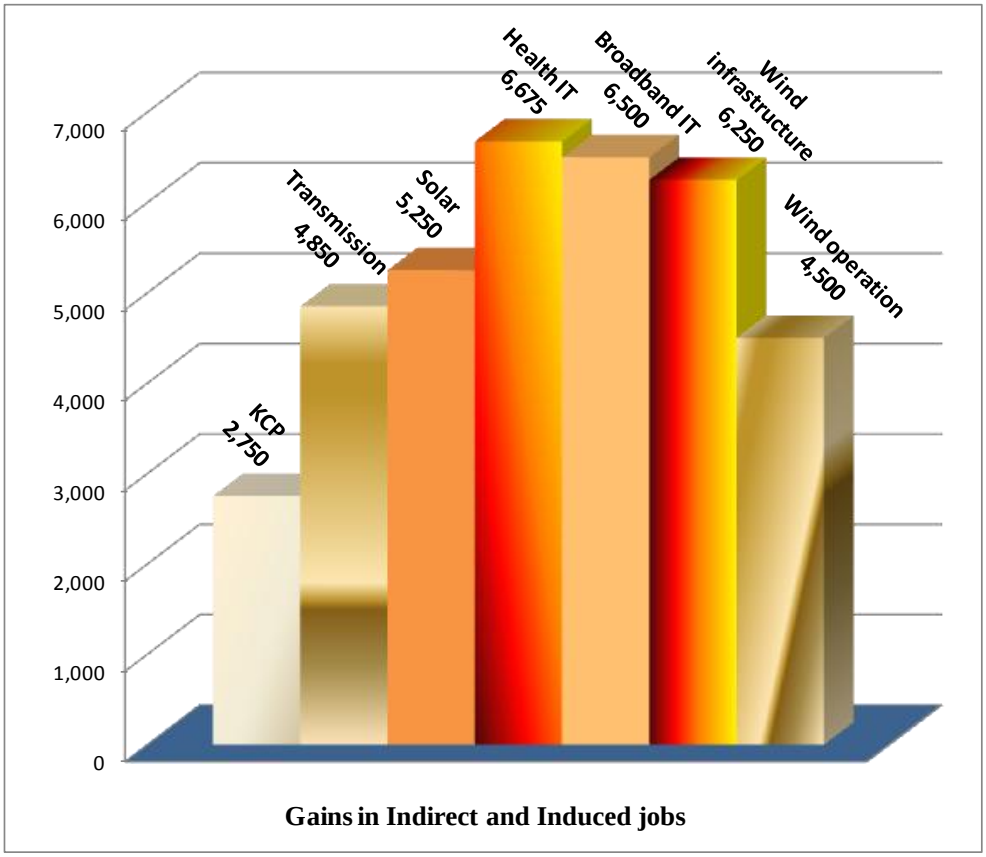

Figure 2. Addition to indirect and induced jobs, for an initial 2,500 direct jobs: KCP vs. alternatives

Not yet considered is the job contribution to the Kansas City economy from the construction phase to build the plant or facility for the KCP or its alternatives. Facility or plant construction employment too has a multiplier. This multiplier is distinct from that for operations of a facility or for construction associated with laying down or tying into a grid or infrastructure. Unfortunately, few data are available for contributions to local employment from construction to build facilities or plants. It is possible that an alternative to nuclear weapons production could utilize nearly the same facility (the new KCP), perhaps with retrofitting or some additional facility construction, but it is not possible to judge this without a technical and architectural assessment. There is no published multiplier for constructing the new KCP. Nonetheless it is important not to overlook the addition of construction jobs and indirect and induced jobs they create.

According to Bruns[85], the new KCP plant employs or will employ 1,500 construction personnel to build the new facility, over approximately a three year period. These are the direct construction jobs. There is no multiplier available to calculate the indirect and induced jobs resulting from the presence of these 1,500 additional workers in the KC economy. There is, however, a multiplier for construction of the plant for *solar* energy-collection operations.[86] Construction of this type of facility would take approximately three to four years as well. Using the relationship between direct jobs for KCP operations and direct construction jobs for the KCP, and the relationship between direct jobs for operations and direct construction jobs for *solar*, we can apply the *solar* multiplier to KCP construction and calculate a rough estimate of the number of construction jobs to build a *solar* facility employing as many workers as are employed at the KCP. Those calculations are as follows:

1) Number of construction jobs per one direct facility job

   KCP: 0.60 [1,500 construction jobs for 2,500 facility jobs: 1,500/2,500 = 0.60]
   Solar[87]: 1.97 [7,161 construction jobs for 3,640 facility jobs: 7,161/3,640 = 1.97]

2) Number of construction jobs to build a plant with 2,500 direct facility-operation employees:

   KCP: 1,500 (published)
   Solar: 4,925 (calculated) [2,500 * 1.97 = 4,925]

3) Multiplier (number of temporary direct, indirect, and induced jobs created by the construction of the facility)
   Solar (published): 2.9[88]

4) Application of the construction jobs multiplier (for *solar*) to the number of direct construction employees:
   KCP: 1,500 X 2.9 = <u>4,350 total jobs</u>
   Solar: 4,925 X 2.9 = <u>14,282 total jobs</u>

5) Gain in indirect and induced jobs (during construction only):
   KCP: 4,350 – 1,500 = <u>2,850 indirect and induced jobs</u> beyond the 1,500 direct construction jobs
   Solar: 14,282 – 4,925 = <u>9,357 indirect and induced jobs</u> beyond the 4,925 direct construction jobs

It is clear that ample investment opportunities exist for infusing more jobs into the Kansas City economy than those being generated by the KCP nuclear weapons activities. Using the well-established method of calculating total and indirect/induced jobs from an employment multiplier provides the opportunity to compare contributions to employment across a menu of investments for the same level of direct employment as at the KCP. *There are substantially more jobs to be gained in wind, solar, IT,* or *electric power transmission infrastructure* ventures than from investing in a new KCP nuclear weapons plant. The investment alternatives analyzed in this report are illustrative, not exhaustive. They reflect some pragmatic possibilities for the Kansas City economy given investment opportunities in today's business climate.

Conclusion

Even in the best of economic times, it is important that those entrusted by the public to represent their best interests pay careful attention to using public funds in ways that maximize public benefit. But that obligation is especially strong in economically challenging times like those we face today. With rising public needs, limited local revenues, and cutbacks in federal and state support, local government officials must be more careful than usual in how and where they invest public funds or the public's credit. And the public must be even more vigilant in making sure that projects undertaken in their name address their most pressing needs. In these times of persistently high unemployment, the short and long term impacts of public and private investments on job creation have become a particularly important focus of attention.

In this analysis, we have investigated the effects on job creation in the local Kansas City area of the new KCP as compared to a number of practical alternative economic investments. We find strong evidence that the demand for nuclear weapons—and therefore for the components of nuclear weapons processed by the new KCP—is likely to diminish sharply over the next decade or two. This is not a matter of ideology, but rather of dramatically changed judgments as to the value of and need for nuclear weapons in securing the nation on the part of a substantial number of highly placed military and government officials and agencies long and intimately involved with nuclear weaponry. This includes former U.S. secretaries of defense, secretaries of state, national security advisers to the president, and nuclear military commanders, along with sitting heads of state in the U.S. and in other nuclear-armed countries.

At the same time, we see strong evidence that the markets for renewable energy, as well as energy efficiency-enhancing and infrastructure-related products—all practical alternative investments given the location of KC and the character of the KC workforce—are growing rapidly and likely to continue expanding over the next several decades if not longer. For example, the Department of Energy estimates that the construction phase alone in the expansion of wind energy to fill 20% of U.S. electricity needs by 2030 is a $1 trillion market that will generate more than a quarter of a million jobs across the country. The conclusion that the market for these alternatives is strong and growing is again not a matter of ideological preference; it is a matter of best economic judgment given the nature of the challenges facing the U.S. and the wider world. And it is supported by the findings of many studies done by diverse analysts and a variety of major institutions.

Furthermore, using the standard economic tool of multiplier analysis, we show that the *least* effective job generator of these alternatives can be expected to generate nearly sixty-four percent more jobs in the wider economy than the new KCP for the same number of direct employees. The two greatest job-generating alternatives can be expected to create from *2.4 times* as many indirect and induced jobs than the KCP for the same number of direct employees (See Table 1). Admittedly, these numbers are approximations based on multipliers drawn from diverse sources. But they are accurate enough to make the basic point—investing in the declining market for nuclear weapons through the new KCP is by far a poorer generator of jobs than investing in the growing markets for any of the alternatives considered.

Endnotes

[1] Oak Ridge (Oak Ridge) Associated Universities; Dade Moeller & Associates; MJW Corporation, May 2005, *Site Profile for the Kansas City Plant*, ORAU TEAM Dose Reconstruction Project for NIOSH, Document No. ORAUT-TKBS-0031, Revision 00 PC-1, Effective date 01/06/2006, on behalf of the National Institute for Occupational Safety and Health, (NIOSH). http://www.cdc.gov/NIOSH/ocas/pdfs/tbd/kcplanta.pdf. Many sources conflate the construction of the facility in 1943 with establishment of the latter-day KCP operations. Citing 1949 as the date of the KCP's establishment is factually correct.

[2] Ibid., p. 8.

[3] Ibid.

[4] General Services Administration, January, 2008, *Commitments Made, Commitments Kept*. Kansas City Plant, National Security Asset: http://www.gsa.gov/graphics/pbs/Kanas_City_Plant_FactSheet2.pdf.

[5] Bruns, A. August, 2010, *A Nuclear Family Updates Its Home*, from Site Selection, The Magazine of Corporate Real Estate Strategy & Area Economic Development: http://www.siteselection.com/ssinsider/incentive/Nuclear-Family.cfm (accessed June 23, 2011).

[6] Ibid.

[7] Op.cit., General Services Administration, January, 2008.

[8] Op.cit., Oak Ridge, 2005.

[9] U. S. Government Accountability Office, October 7, 2009, *NUCLEAR WEAPONS: National Nuclear Security Administration Needs to Better Manage Risks Associated with Modernization of Its Kansas City Plant*, Report to the Subcommittee on Energy and Water Development, Committee on Appropriations, GAO-10-115, p. 7.

[10] Op.cit., General Services Administration, January, 2008. The remainder of employees worked for the KCP at different locations: 23 at Los Alamos; 232 in New Mexico; 19 in Arkansas; and 11 at "Other."

[11] Honeywell FM&T. (n.d.). *Kansas City Plant*, Locations - Careers - Kansas City Plant, http://www51.honeywell.com/aero/kcp/careers-sub/locations.html (accessed June 4, 2011). This Honeywell website states that "approximately 2,500" personnel work at the Kansas City, Missouri facility.

[12] Op.cit., Bruns, 2010. Bruns reports an FY2009 payroll of $341 million for 2,462 employees.

[13] Op.cit., General Services Administration, January, 2008. It is unclear if "operatives" was a typo in place of "operators." Either there were three, not two, with an "MD, DDS, JD" or at any given time there were at least two with that level of education and training.

[14] National Nuclear Security Administration, October, 2008, *Final Complex Transformation Supplemental Programmatic Environmental Impact Statement; Summary*, DOE/EIS-0236-S4, p. S-27; Op.cit., U.S. Government Accountability Office, October, 2009, p. 4.

[15] U.S. General Services Administration, (last reviewed May 25, 2011), *NNSA National Security Center Campus,* www.gsa.gov/portal/content/102613 (accessed June 4, 2011); The GSA reports consideration of eight locations. Op.cit., U.S. Government Accountability Office, October, 2009; Op.cit., Bruns, 2010; Op.cit., Federal Register, April 29, 2008, *Finding of No Significant Impact; Modernization of Facilities and Infrastructure for the Non-Nuclear Production Activities Conducted at the National Nuclear Security Administration's Kansas City Plant Environmental Assessment (DOE/EA-1592),*NNSA [PBS-N04], Vol. 73, No. 83.

[16] Op.cit., Bruns, 2010. Op.cit., U.S. Government Accountability Office, October, 2009;

[17] Op.cit., Bruns, 2010, p. 1; Op.cit., U.S. Government Accountability Office, October, 2009; Kansas City Business Journal, June 14, 2010, *GSA Finalizes lease for National Nuclear Security Administration campus,* http://www.bizjournals.com/kansascity/stories/2010/06/14/daily3.html (accessed July 29, 2011). As best understood, Kansas City (through private and public financing, i.e. bonds) will own the facility for twenty years until fully repaid for its investment. During that time it will lease the facility to CenterPoint Zimmer, which will then lease it to the GSA.

[18] Op.cit., National Nuclear Security Administration, October, 2008, p. S-27; Op.cit., Bruns, 2010. Although Bruns does not specify that these are yearly savings, it is implied.

[19] Op.cit., U.S. Government Accountability Office, October, 2009.

[20] U.S. General Services Administration, *Bannister Federal Complex,* (last reviewed May 20, 2011), http://gsa.gov/portal/content/101396 (accessed June 4, 2011).

[21] Op.cit., Honeywell, n.d.

[22] Op.cit., Bruns, 2010;

[23] Op.cit., U. S. Government Accountability Office, October, 2009. The percent currently outsourced varies, depending upon the source. Most cite thirty percent; the GAO, however, reports fifty-four percent. At the same time that outsourcing has been increasing, the KCP has been decreasing the number of external suppliers: in May 2008 there were 412, in September 2009 there were 320. Outsourced products come from domestic sources, Malaysia and Mexico. Only one supplier is certified to process, produce and store classified material or products.

[24] Op.cit., Oak Ridge, 2005, p. 8.

[25] O'Neill, K., 1998, *Building the Bomb*, Atomic Audit: The costs and consequences of U.S. nuclear weapons since 1940, Brookings Institution, Washington D.C., p. 49.

[26] Op.cit., Federal Register, 2008.

[27] Ibid., page 1, column 2.

[28] Op.cit., Oak Ridge, 2005, pp.9-10.

[29] Op.cit., National Nuclear Security Administration, 2008.

[30] Op.cit., Oak Ridge, 2005, p.8.

[31] Op.cit., General Accountability Office, October, 2009. The KCP outsources the production of dual-use items.

[32] Ancona, D., and McVeigh, J., August 29, 2001, *Wind Turbine - Materials and Manufacturing Fact Sheet*, Princeton Energy Resources International, LLC., prepared for the Office of Industrial Technologies, US Department of Energy. Pg. C-6. www.perihq.com/documents/WindTurbine-MaterialsandManufacturing_FactSheet.pdf (accessed June 24, 2011). This is not meant to be a comprehensive list of materials and components.

[33] U.S. Department of Energy, 2010, *Advanced Components and Systems Research and Development*, Energy Efficiency and Renewable Energy Solar Energy Technologies Program. This is not meant to be exhaustive of the many technical, research, testing, and production activities associated with creating solar panels. http://www1.eere.energy.gov/solar/component_systems_rnd.html (accessed June 22, 2011).

[34] Op.cit., U.S. General Services Administration, (last reviewed May 20, 2011), *Bannister*….

[35] Canberra Commission, Report on the Elimination of Nuclear Weapons, p.2. The full report is available at http://www.dfat.gov.au/cc/CCREPORT.PDF.

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[37] Diamond, J., "Air Force General Calls for End to Atomic Arms", Boston Globe (July 16, 1994), as cited in Forrow, Lachlan and Sidel, Victor W., "Medicine and Nuclear War", Journal of the American Medical Association (August 5, 1998), p.459.

[38] Dumas, Lloyd J., The Technology Trap: Where Human Error and Malevolence Meet Powerful Technologies (Santa Barbara: Praeger, 2010), p.351.

[39] "Statesman to Promote Global Nuclear Disarmament", Global Security Newswire (December 8, 2008:http://gsn.nti.org/gsn/nw_20081208_6843.php; accessed June 21, 2011); see also Grossman, Elaine, "To Nuclear Disarmers, It's Too Early to Worry about Violators", Global Security Newswire (December 16, 2008: http://gsn.nti.org/gsn/nw_20081216_9623.php; accessed June 21, 2011).

[40] "Abandon Nuclear Weapons, British PM Urges", Global Security Newswire (January 23, 2008: http://gsn.nti.org/gsn/GSN_20080123_C6FE1CD2.php; accessed June 21, 2011).

[41] Obama, Barak, "Remarks by the President at the United Nations Security Council Summit on Nuclear Non-Proliferation and Nuclear Disarmament" (New York: United Nations, September 24, 2009: http://www.whitehouse.gov/the_press_office/Remarks-By-The-President-At-the-UN-Security-Council-Summit-On-Nuclear-Non-Proliferation-And-Nuclear-Disarmament; accessed June 21, 2011).

[42] Younger, Stephen M., "Nuclear Weapons in the Twenty-First Century" (Los Alamos National Laboratory, June 27, 2000: LAUR-00-2850), pp.1 and 3.

[43] National Nuclear Security Administration, "Reducing the Nuclear Weapons Stockpile" (Release date: January 1, 2009). See the NNSA website (http://www.nnsa.energy.gov).

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[45] Los Alamos Study Group, Bulletin 118, "House Appropriation Committee Slashes $100 Million from Huge Proposed Plutonium Facility at Los Alamos". The Los Alamos Study Group is a non-governmental activist organization. See also "Panel Curbs Plutonium Lab Construction Funds", Global Security Newswire (June 22, 2011).

[46] "Panel Curbs Plutonium Lab Construction Funds", Global Security Newswire (June 22, 2011). The Committee did, however, endorse a $200 million rise in the overall budget for NNSA nuclear weapons activities for next fiscal year, about a three percent increase.

[47] MacAskill, Ewen, "Leon Panetta and David Petraeus Given New Roles in U.S. Security Reshuffle", The Guardian (April 27, 2010: guardian.co.uk). See also Barry, John and Tara McKelvey, "The Defense Rests; As Robert Gates Retires from the Pentagon, He Sounds a Grim Warning", Newsweek (June 27, 2011).

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Renewable and Appropriate Energy Laboratory (University of California, Berkeley: April 13, 2004), pp.2-3.

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[53] U.S. Energy Information Association, "Wind Data and Information" (http://www.eia.gov/cneaf/solar.renewables/page/wind/wind.html; accessed on June 25, 2011). Between 2008 and 2009, for example, wind power's share of electricity generation in the U.S. grew by nearly 34 percent. By 2009, it was 1.9 percent, leaving plenty of opportunity for expansion.

[54] U.S. Department of Energy, 20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply (DOE/GO-102008-2567: July 2008), p.5.

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US?", Energy Policy (vol.18: 2010), p.920.

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[63] Op. cit. Wei, Patadia and Kammen, pp.919-920. A job-year is one job held for one year. For example, 50 jobs held over a ten year period is 500 job-years; so is 25 jobs held for twenty years. Two half time jobs are one full time equivalent job.

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[65] Ibid., p.922.

[66] Ibid., p.928.

[67] American Society of Civil Engineers, 2009 Report Card for America's Infrastructure (March 25, 2009: http://www.infrastructurereportcard.org/sites/default/files/RC2009_full_report.pdf; accessed June 27, 2011).

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[69] Ibid., p.4.

[70] Pfeifenberger, Johannes P. and Delphine Hou, Employment and Economic Benefits of Transmission Infrastructure Investment in the U.S. and Canada (The Brattle Group: May 2011), p.ii.

[71] Atkinson, Robert D., Daniel Castro and Stephen J. Ezell, The Digital Road to Recovery: A Stimulus Plan to Create Jobs, Boost Productivity and Revitalize America (The Information Technology and Innovation Foundation: January 2009), pp.1, 2, and 12.

[72] See for example, the Bureau of Economic Analysis' *Regional Multipliers*, March 1997, available online: http://www.bea.gov/scb/pdf/regional/perinc/meth/rims2.pdf.

[73] This multiplier for the KCP is taken from Bishak, G. and Oden, M., 1989, *The INF Treaty and the United States' Experience: The Industrial, Economic and Employment Impacts.* World Employment Programme Research. Disarmament and Employment Programme, Working Paper No. 11 (WEP 2-41/WP.11), April 1989. Geneva: International Labour Organisation, p. 31. Decreases in employment can be just as useful for calculating a multiplier as are projections of increases in employment. The full paper is available at http://www.ilo.org/public/libdoc/ilo/1989/89B09_127_engl.pdf (accessed June 8, 2011).

[74] Although investment in services, technology development, and manufacturing to improve business and residential energy efficiency shows considerable promise as a

generator of jobs (as discussed in the preceding section), finding a clear and specific employment multiplier comparable to the others we present proved to be difficult. Employment multipliers are available, but they tend to be stated in terms of jobs per unit of energy, rather than total jobs relative to direct jobs.

[75] Op.cit., Bishak and Oden, 1989.

[76] The *transmission* multiplier of 2.9 is calculated from data published by the Working group for Investment in Reliable and Economic electric Systems (WIRES) and The Brattle Group, May 2011, in *Employment and Economic Benefits of Transmission Infrastructure Investment in the U.S. and Canada*, p. 33.

[77] The multipliers for *solar* (3.1 for *operations* and 2.9 for *construction*) are taken from Schwer, R.K. and M. Riddell, 2004, *The Potential Economic Impact of Constructing and Operating Solar Power Generation Facilities in Nevada*, Subcontractor Report prepared for National Renewable Energy Laborabory, NREL/SR-550-35037, February 2004, p. 8. http://www.nrel.gov/csp/pdfs/35037.pdf.

[78] The "*wind"* multipliers (3.5 and 2.8) are calculated from U.S. Department of Energy's, 20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply (DOE/GO-102008-2567: July 2008), Tables C-3 and C-4, pp. 205-206. It is worth noting that these wind multipliers are actually conservative (underestimates), since "In the JEDI model the direct effect includes what are usually called first-round indirect effects…" (p. 201, footnote 18).

[79] The multiplier of 3.7 for *broadband IT* is calculated from data published by Atkinson, R.D., D. Castro and S.J. Ezell, January 2009, in *The Digital Road to Recovery: A Stimulus Plan to Create Jobs, Boost Productivity and Revitalize America.* The Information Technology & Innovation Foundation, January, 2009, p. 5. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1334688.

[80] Op.cit., Bruns, 2010.

[81] Op.cit., Atkinson, Castro and Ezell, 2009. A tertiary industry in support of the information economy, *health IT* involves building hardware and developing software to integrate health data and information into an electronic digital network. *Broadband* involves building hardware and software to integrate the business sector into the digital information infrastructure (i.e., internet).

[82] This multiplier is calculated from published data in Ibid. p. 9.

[83] Not included in our analysis are the "network impacts" from developing a *health IT* or *broadband IT* industry. In addition to direct employment and indirect and induced jobs they generate, there are also spin-off jobs. These spin-off, or network, jobs are those arising in other related industries that benefit from the presence of advances in high-tech IT. According to Op.cit., Atkinson, Castro and Ezell, 2009, "…[the] digital infrastructure acts as a platform that serves as the foundation for a multitude of innovative products and

services" p. 2.

[84] These calculations use multipliers derived from published data in Op.cit., U.S. Department of Energy, July 2008, Tables C-3 and C-4, pp. 205-206. It is worth noting that these wind multipliers are actually conservative (underestimates), since "In the JEDI model the direct effect includes what are usually called first-round indirect effects…" (p. 201, footnote 18).

[85] Op. cit., Bruns, 2010.

[86] Op.cit., Schwer and Riddel, p. 9.

[87] Employment numbers are calculated using published data in Op.cit., Schwer and Riddel, p. 8.

[88] This multiplier is published on p. 8 in Op.cit., Schwer and Riddel.