PREPARING FOR 21st CENTURY RISKS

REVITALIZING AMERICAN MANUFACTURING TO PROTECT, RESPOND AND RECOVER

Governor Tom Ridge • Colonel Robert B. Stephan (USAF Retired)

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ABOUT THE AUTHORS

THE HONORABLE TOM RIDGE, President and CEO, Ridge Global

Following the tragic events of September 11th, 2001, Tom Ridge became the first Assistant to the President for Homeland Security and, on January 24, 2003, became the first Secretary of the U.S. Department of Homeland Security. During his DHS tenure, Secretary Ridge worked with more than 180,000-plus employees from a combined 22 agencies to create a Department that facilitated the flow of people and goods, instituted layered security at air, land and seaports, developed a unified national response and recovery plan, protected critical infrastructure, integrated new technology and improved information sharing worldwide. Tom Ridge served as Secretary of this historic and critical endeavor until February 1, 2005.

Before the events of September 11th, Tom Ridge was twice elected Governor of Pennsylvania, serving from 1995 to 2001. He was one of the first Vietnam combat veterans to be elected to the U.S. House of Representatives, where he served for six terms.

Tom Ridge is currently President and CEO of Ridge Global, an international security and risk management advisory firm, headquartered in Washington, DC. He serves as chairman of the National Organization on Disability and co-chair of the Flight 93 National Memorial, and speaks regularly throughout the world on issues such as security, business and leadership.

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Robert B. Stephan is an Executive Vice President with CRA, Inc., an Alexandria, Virginia-based homeland security and defense contracting firm. Prior to his current position, Mr. Stephan served as the Assistant Secretary of Homeland Security for Infrastructure Protection, U.S. Department of Homeland Security from 2005 to 2008. In this capacity, he was responsible for the Department's efforts to catalog the nation's critical infrastructures and key resources, develop the National Infrastructure Protection Plan and coordinate risk-based strategies and protective measures to secure U.S. infrastructure from terrorist attack, as well as enable their timely restoration in the aftermath of natural disasters and other emergencies.

With the initial activation of the Department of Homeland Security in 2003, Mr. Stephan served as Special Assistant to the Secretary and Director of the Secretary's Headquarters Operational Integration Staff. Previously, Mr. Stephan served as the first Senior Director for Critical Infrastructure Protection in the Executive Office of the President.

Colonel Stephan also held a variety of key operational and command positions in the joint special operations community during a 24-year Air Force career. He is a distinguished graduate of the USAF Academy, an Olmsted Scholar, and has earned Master's Degrees in International Relations from the University of Belgrano, Buenos Aires, Argentina, and The Johns Hopkins University.

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EXECUTIVE SUMMARY

The 21st century risk environment is creating an alarming trend in which the hyper-consequential, "500-year" event is occurring with greater frequency. Hurricanes, tornadoes, flooding, wildfires, earthquakes and tsunamis, as well as acts of terrorism and other man-made disasters, stand as constant reminders of the potential for significant and prolonged disruptions in our daily lives.

Despite more than 10 years of progress since the tragic events of September 11, 2001, and seven years of similar progress in the aftermath of Hurricane Katrina, America's critical infrastructure—our electric grid, transportation systems, nuclear power plants, water infrastructure and treatment plants, and petroleum pipelines—as well as key population centers, remain inherently vulnerable.

While we cannot predict when weather-related, man-made, or other events will occur, as a nation we can certainly take steps to prepare for them in advance. Critical to this preparation is a robust, diverse, and resilient domestic manufacturing sector.

The deterioration and offshoring of America's industrial base is becoming more apparent with each passing day, leaving new national security and preparedness concerns in its path. In short, we are becoming too reliant on global suppliers (many of whom may not have our best interests at heart in a time of crisis), along with a highly complex and vulnerable global supply chain needed to bolster our weak points or come to our rescue in the midst of an emergency.

To help understand this serious issue, the Alliance for American Manufacturing (AAM) asked two respected experts on homeland security and preparedness—Governor Tom Ridge and Robert B. Stephan—to examine the direct nexus between a strong domestic manufacturing sector and America's ability to prevent, mitigate, recover from, and rebuild quickly in the wake of catastrophic events.

In their analysis, Governor Ridge and Colonel Stephan take an in-depth look at recent disasters, such as Hurricane Katrina and the Japan Earthquake and Fukishima Nuclear Reactor Disaster of 2011. They also provide a snapshot of several manufacturing sectors, including steel, water, and the electric grid, which are critical to disaster preparedness and recovery efforts. Their analysis brings into clear focus an unsettling vulnerability that must be addressed before it is too late.

Revitalizing America's domestic manufacturing capacity must become a clear and urgent national priority at all levels of government and among industry leaders. The future vitality of our national and economic security goes hand-in-hand with that of our domestic manufacturing base.

The report makes a number of key recommendations designed to revitalize American manufacturing and ensure that we are not left flatfooted and vulnerable at a time when quick response and rapid rebuilding are necessary.

Among their specific recommendations are:

- **Develop a plan** to make the restoration of a strong American manufacturing sector a key component of both national and economic security strategies.
- **Reinvest in America's infrastructure**, using U.S.-made materials.
- **Incentivize the revitalization of American manufacturing**, including the use of domestic-content preferences that maximize the power of federal procurement funds.
- **Enforce trade laws** to ensure a level playing field for U.S manufacturers and their workers facing unfair competition.
- **Invest in the American workforce** to ensure we have the trained workers needed to rebuild our infrastructure and work in a larger, more modern manufacturing sector.

Revitalizing America's domestic manufacturing capacity must become a clear and urgent national priority at all levels of government and among industry leaders. The future vitality of our national and economic security goes hand-in-hand with that of our domestic manufacturing base.

I. INTRODUCTION

As evidenced by events including extensive wildfires affecting large areas of the Southeast and Southwest United States, massive flooding along the Mississippi and Missouri Rivers, the Japanese tsunami and Fukushima nuclear disaster, and numerous disrupted domestic terrorist plots, the present global risk environment is highly unpredictable and unforgiving. This environment includes a wide array of manmade and naturally occurring threats and hazards including: domestic and international terrorism, floods, hurricanes, earthquakes, environmental mishaps, technological failures, pandemic influenza, and malicious cyber intrusions and disruptions.

Despite more than ten years of progress since the tragic events of September 11, 2001, and seven years of similar progress in the aftermath of Hurricane Katrina, our critical infrastructure and key population centers remain inherently exposed to these threats in many important ways. Vulnerabilities to the electric grid, transportation systems, nuclear power plants, commercial facilities, water infrastructure and treatment plants, communications systems, petroleum refineries and pipelines manifest themselves both within and across sectors as a function of complex physical, cyber and human considerations. These vulnerabilities are also increasingly a function of "just-in-time" operations tied to a highly interconnected global economy and international supply chains. The complex scope of dependencies and interdependencies across our critical infrastructure sectors makes our national economy very fragile in the context of catastrophic disasters. In fact, the consequences resulting from an incident impacting one or more key infrastructure nodes or systems in just the right way are potentially staggering.

Given the extent of these challenges, much concern remains regarding national preparedness for all-hazards disasters, strategic vulnerability mitigation and our ability to quickly and efficiently recover from a catastrophic attack or natural disaster affecting our critical infrastructure and key population centers.

…there is a direct nexus between a strong domestic manufacturing sector and America's ability to prevent, mitigate, recover from and rebuild quickly in the wake of catastrophic events.

To address these multi-dimensional challenges, the White House National Security Strategy issued in 2010 calls for a comprehensive approach appropriately balancing resilience with risk-based prevention, protection and preparedness activities specifically designed to reduce the most serious threats to the American people and the infrastructure that serves them. A core aspect of this approach includes having the means to limit hyper-cascading economic and psychological damage in the aftermath of catastrophic events by restoring, rebuilding and recovering critical infrastructure and communities as quickly and efficiently as possible. A well-managed recovery effort helps communities, critical industries and businesses quickly rebound, and can provide an emotional lift to public morale. Orchestrating a timely and efficient national recovery effort, however, is no small task and requires comprehensive preparation and capacity development well in advance of a paralyzing incident.

Critical to this preparation and capacity development is a robust, diverse and resilient domestic manufacturing sector. In fact, there is a direct nexus between a strong domestic manufacturing sector and America's ability to prevent, mitigate, recover from and rebuild quickly in the wake of catastrophic events. Educating decision-makers and the general public and developing a forward-looking policy agenda on this issue is critical to American security and resilience.

Unfortunately, many key components and technologies that support our critical infrastructures in the context of catastrophic disaster prevention, preparedness and recovery are no longer manufactured in the United States. Moreover, many of these products typically have long manufacturing and shipment lead times, and are made in countries that may be unstable, or undependable based on geopolitical factors. These factors make their availability to us in time of national crisis highly uncertain. Additionally, increasing amounts of American dollars are being spent on foreign materials used in domestic infrastructure projects. Not only is planning more complex and delivery timelines typically much longer for such projects, but the quality and safety ratings of foreign materials are often in question.

The United States, once seen as the leader in global manufacturing, has fallen behind other countries that are experiencing unprecedented growth, oftentimes through artificial government advantages and trade policy inequities. The attendant outsourcing of manufacturing processes and products takes away American jobs, hurts the economy and unjustly promotes our international competitors. Moreover, this dependence on other countries for critical manufacturing capacity leaves the United States less safe and less secure in the context of truly catastrophic disasters.

In addition to framing these threats and vulnerabilities in more detail, this report provides specific recommendations supporting a strong domestic manufacturing sector, which is vital to managing catastrophic risks to our critical infrastructure and population centers—whether manmade or naturally occurring—and enabling more robust, timely and efficient national level recovery in the context of those scenarios we are unable to avoid or mitigate in advance.

II. DEFINING THE 21st CENTURY RISK ENVIRONMENT IN THE CONTEXT OF A HIGHLY INTERDEPENDENT GLOBAL ECONOMY

The 21st century risk environment presents a challenging paradox in the context of traditional views of national and economic security. On the one hand, the United States is very productive and is one of the most prosperous countries on earth. This prosperity, in many regards, is the result of the post-industrial information technology and transportation revolutions that swept the globe beginning in the 1960s and '70s and entered into hyperdrive with the advent of the Internet and satellite-enabled communications and navigation. This ever-accelerating leap into the future has dramatically changed traditional notions of time and distance and created an increasingly interconnected and interdependent, just-in-time global economy and consumer base. When the system works as designed, the result is: instantaneous global communications, unimpeded access to resources, heretofore unimaginable efficiency in the delivery of goods and services, an elevated global standard of living and cheaper consumer prices for key commodities in most places worldwide. The positive aspects of these twin revolutions, in turn, are felt daily across America—in our homes, businesses, communities and everyday lives.

On the other hand, the system does not always work as intended or designed, and, as such, may expose us to unprecedented risk in certain circumstances. This is due to the fact that today's global service economy is dependent on a vast array of highly interconnected and interdependent critical infrastructure nodes and systems that cut across sectors domestically and transcend national borders and traditional economic boundaries. These infrastructure nodes and systems, although typically highly resilient in the face of minor disruptions and anticipated events, may be very fragile in the context of disasters and disturbances that exceed the norm.

In this new paradigm, increased interdependencies mean that impacts felt in one part of the system may very quickly produce cascading impacts system-wide. This fact is particularly true regarding high-consequence natural and technological disasters that provide little-to-no advance warning such as the East Coast power blackout in August, 2003, or cross the "failure of imagination" threshold as did Hurricane Katrina in August, 2005, and the Pacific tsunami that struck Japan and cracked the Fukushima Daiichi nuclear reactor last year. It is also true of manmade disasters or disruptions brought about by a wide array of human actors with a malicious, high-consequence agenda—rogue nation-states, international and domestic terrorist extremists, cyber criminals and others. As a result, the United States and its global partners now confront threats and challenges to our national and economic security that we have never faced before. In essence, the heightened global prosperity that is the hallmark of the Information Age has come at potentially dangerous price: greater systemic exposure in real time to a wide and increasing array of potentially devastating threats and hazards and cascading vulnerabilities inherent in the system.[1] To put it simply, the concept of a catastrophic "localized" disaster no longer holds true.

A. The Specifics of All-hazards Threats and Vulnerabilities in Today's Global Risk Environment.

The threats we face in today's global risk environment are vastly different from those of the Cold War era in many important ways. The bipolar superpower confrontation has given way to a globally distributed threat environment characterized by a wide variety of potentially dangerous actors and security challenges. These include nation states operating outside of international norms, less-than-stable nuclear powers, international and "home grown" terrorists and malicious cyber actors. Major catastrophic natural disasters and technological failures marked by increased frequency and intensity and featuring excessively high consequences—such as the Great East Japan Tsunami, Fukushima Daiichi nuclear reactor disaster, Hurricane Katrina and the record-breaking earthquake in Haiti—also have

significant national security implications, as do a potential global H1N1 pandemic, and global climate change. Future threats along these lines may be even more complex and consequential as depicted below.

FUTURE THREATS AND VULNERABILITIES

By 2025…

- 75% of U.S. residents are expected to live on the country's coasts, impacting the infrastructure around wetlands, healthcare, housing and transportation and insurance costs associated with tropical storms and hurricanes.
- Many people will return to central cities for living, working, and recreation, creating "24/7" cities across the U.S.—whose infrastructure can never "rest."
- The global population is expected to be 7.9 billion, mostly in developing countries. A growth rate that well exceeds the ability of many countries to upgrade and expand capacity of existing infrastructure.
- Climate change will impact cities in coastal locations, resource-dependent regions and economies that are closely linked with climate-sensitive infrastructure.

Source: http://www.toffler.com/docs/Five-Critical-Infrastructure-Threats.pdf

Of utmost concern within this new mix of global threats is the growing number of nation-state and non-state actors empowered to do unprecedented harm by virtue of equally unprecedented access to highly advanced technologies, information and information systems, and weapons materials—including, potentially, those necessary to configure a weapon of mass destruction. As stated in the 2010 Quadrennial Homeland Security Review (QHSR) Report, "Among the forces that threaten the U.S. and its interests are those that blend the lethality and high-tech capabilities of modern weaponry with the power and opportunity of asymmetric tactics such as terrorism and cyber warfare."[2] From rogue nuclear states to violent and persistent terrorist extremists to increasingly sophisticated cyber attackers, today's world is an increasingly dangerous and unpredictable place.

Within the context of these new types of threats, the QHSR Report asserts that the highly interconnected and interdependent nature of people, economies and borderless infrastructure that characterizes today's world can transform seemingly isolated or remote incidents into nationally or even globally significant events.[3] The Northeast Power Blackout of 2003 and its cascading human and economic impacts on both sides of the U.S.-Canada border illustrate this point. More recently, the eruption of a long-dormant volcano in Iceland in 2010 had oversized effects on global business and transportation. This event closed more than 20 airports across Europe, impacted U.S. military logistics supporting theater combat operations, delayed delivery of "just-in-time" electronic components supporting domestic U.S. auto production, and stranded tens of thousands of business and leisure travelers on six continents. Similarly, a global pandemic could rapidly impact transportation and lifeline infrastructures and services around the world for an extended period. Taken in combination, these types of events provide clear warning signs of the inevitable intentional and unintentional challenges that lie ahead.

Another specific asymmetric threat that grows more problematic with each passing day is the actualization of targeted cyber attacks on our critical public-private information systems (including highly sensitive defense networks), critical infrastructure, businesses and technologically-based way of life. Cyber attacks manifest themselves in three important ways—data theft, data manipulation, and penetration of the automated systems which enable the control of an increasing number of our critical infrastructure systems. The QHSR Report asserts that "Widespread international cyber attacks—from some of the most sophisticated denial-of-service efforts to persistent and rising attacks on U.S. government cyber systems—reflect the increasing importance of securing the information systems that are the very lifeblood of so much of our critical energy financial, health, commerce and transportation infrastructure."[4] Particularly alarming is the fact that the interdependent nature of these and other critical infrastructure sectors and their increasing dependence on a vulnerable information backbone for control purposes magnifies the speed, magnitude and reach of technical and malicious disruptions and their near-simultaneous cascading impacts. This threat will continue to grow as

Another related vulnerability is the pattern of geographic and/or functional "clustering" of many of our critical infrastructures as part and parcel of a globalized economy and service environment which champion efficiency and just-in-time delivery over robustness and redundancy

more aspects of our critical infrastructure sectors and our day-to-day lives are connected in accelerated fashion to this international information backbone.

This proliferation of threats in the post-Cold war world is accompanied by a similar proliferation of significant systemic vulnerabilities both domestically and internationally. These vulnerabilities are associated with the relative ease of malicious access to and the susceptibility to disruption of our increasingly linked and interdependent global infrastructures: banking and finance, energy, commercial facilities, transportation, communications, information technology, public health, etc. Regarding the terrorist threat—as aptly demonstrated by the 9/11 attacks—considerations of ease of access, system interconnectivity, operational reach and iconic attraction—taken in concert with the catastrophic human, economic and psychological consequences associated with a successful attack at the right place at the right time—mark our critical infrastructures as potentially high-payoff terrorist targets.

Another related vulnerability is the pattern of geographic and/or functional "clustering" of many of our critical infrastructures as part and parcel of a globalized economy and service environment which champion efficiency and just-in-time delivery over robustness and redundancy. These infrastructure concentrations have developed as such over time through a combination of market influences, economy of scale considerations and government policy and regulation.[5] On the commercial side, as stated in *Defense Horizons*, "In many cases, economic factors—notably, the capital costs of building facilities on the scale needed to operate and compete in a globalized marketplace—continue to create pressures toward having fewer, larger and more geographically concentrated infrastructures."[6]

Whether a product of market realities or government fiat, this trend is akin to having our most important eggs in increasingly fewer baskets. Although such clustering is a key to maintaining economic competitiveness, in fact, it also may be a recipe for disaster and disproportionate effects in the context of terrorist nodal analysis and "more-bang-for-the-buck" targeting. This approach may also leave core infrastructure clusters servicing important regions of the country at the mercy of natural disasters or technological failures capable of delivering a knockout blow under the right circumstances. Finally, such an approach leaves little room for the reserve capacity that is integral to effective incident response and recovery, particularly in the case of widespread catastrophes.

A number of examples illustrate this "clustering" trend within the U.S., including the following:

- Nearly one-third of waterborne container shipments pass through the port of Los Angeles-Long Beach
- Over 36 percent of freight rail cars pass through the Chicago area
- Almost 25 percent of pharmaceuticals are manufactured in Puerto Rico, primarily in the San Juan metropolitan area
- Over 38 percent of chlorine production is located in central Louisiana
- Almost 43 percent of the total U.S. oil refining capacity is located along the Texas and Louisiana coasts
- More than 31 percent of naval shipbuilding and repair operations are in or near Norfolk, Virginia[7]

Additionally, Hurricane Katrina demonstrated the extreme vulnerability of a core concentration of critical energy and chemical production and distribution facilities along the Gulf Coast of Louisiana and Mississippi. Similarly, according to the California Seismic Safety Commission, a major tsunami could close the twin ports of Los Angeles and Long Beach for approximately two months and cause $60 billion in commercial disruption.[8]

Related to this clustering trend is the tendency for a growing number of infrastructure owners and operators to outsource core support requirements to a relatively small number of key product and service providers, particularly in the area of supply chain management. Others have turned to a handful of primary systems integrators and application providers to support core process and system requirements. As discussed in *Defense Horizons*, "the result is that many organizations that think of themselves as relatively autonomous are

…across America a large number of our highways, bridges, tunnels, dams, water and wastewater systems are worn out, weather-beaten, on the verge of failure and in desperate need of immediate attention.

in fact highly reliant on a small number of contractors and suppliers…and on information systems developed and supported by a few large vendors…"[9] All this certainly makes perfect sense from a business efficiencies perspective, but also serves to exacerbate the "all-eggs-in-one-basket" dilemma and ease the targeting challenges of malicious actors, particularly in the cyber arena.

There are also many important vulnerabilities associated with the structural fragility of our infrastructure nodes and systems, many of which are at or near the end of their projected operational life spans and in need of a thorough overhaul. In this sense, the structural collapse of the I-35 Mississippi River Bridge in Minneapolis in 2007 was a key wake-up call. Prior to its collapse, engineers with the Minnesota Department of Transportation did not believe that the bridge was in danger of imminent failure, despite affording it a "structurally deficient" rating since 1990.[10] Similarly, across America a large number of our highways, bridges, tunnels, dams, water and wastewater systems are worn out, weather-beaten, on the verge of failure and in desperate need of immediate attention. The most recent (2009) American Society of Civil Engineer (ASCE) Report Card gives an overall grade of "D" or "Poor" to our nation's infrastructure, stating that investment needs amount to more than $2.2 trillion over the next five years to address the most critical needs.[11] To be clear—this is the amount of funding required simply to "break even," not the amount required to keep pace with a growing population and an accelerating demand for urban infrastructure services within the same time frame. Summing up the situation, the ASCE Report Card puts it very bluntly: "In a country as vast as the U.S., with such great geographical, historical and political diversity, one challenge seems sadly universal: the infrastructure we rely on to live and thrive is coming unraveled."[12] (see Table 1)

Table 1. 2009 Report Card for America's Infrastructure, American Society of Civil Engineers

Infrastructure	Grade
Aviation	D
Bridges	C
Dams	D
Drinking Water	D-
Energy	D+
Hazardous Waste	D
Inland Waterways	D-
Levees	D-
Public Parks and Recreation	C-
Rail	C-
Roads	D-
Schools	D
Solid Waste	C+
Transit	D
Waste Water	D-
America's Infrastructure GPA	D
Estimated 5 Year Investment Need	$2.2 Trillion

A = Exceptional B = Good C = Mediocre
D = Poor F = Failing

Notes: Each category was evaluated on the basis of capacity, condition, funding, future need, operation and maintenance, public safety and resilience. Source: "2009 Report Card for America's Infrastructure". *American Society of Civil Engineers*, 2010. http://www.infrastructurereportcard.org/.

Compounding this dilemma is the reality that time, weather, environmental effects, Mother Nature, and usage far beyond that envisioned in original engineering designs continue to work against our critical infrastructures on a daily basis. Unfortunately, a grossly inadequate lack of capital re-investment and the fact that no one has really "owned" this long-term maintenance problem in a holistic sense over the years have greatly exacerbated this situation. Additionally, in too many cases, the resources pushed into the "piecemeal" capital overhaul of our infrastructures in the past have not been allocated wisely. Simply put, it has proven much easier to design and deploy huge infrastructure projects such as the Eisenhower

Interstate System than to provide for their sustained care and feeding over the long haul.[13] As homeland security expert Stephen Flynn aptly sums it up: "… we're just running it down like a battery instead of thinking about it as an investment that we must pass down to our children and our grandchildren."[14]

Continuing along the current trajectory, this dilemma is likely to worsen dramatically with already strained infrastructure systems becoming increasingly fragile over time. Several examples serve as cases in point:

- Freight rail tonnage is expected to increase by roughly 50 percent by 2020, requiring an investment of $12-13 billion to address capacity issues
- Passenger rail utilization is expected to double in the next 20 years, and triple in the next fifty
- 50 percent of the locks along our nation's inland waterways are obsolete today; that figure will increase to 80 percent by 2020 with replacement costs projected at more than $125 billion
- Air travel is expected to increase by at least 4 percent annually through 2015
- Existing transmission capability on the national power grid does not meet today's demand, let alone the demand of the future.[15] Between 1980 and 2000, vehicle miles traveled on U.S. highways increased by 80 percent, while lane miles of public highways increased by only 2 percent

Even these few examples paint a bleak picture of a problem with far-reaching implications for the future if we fail to take comprehensive action in the near term to begin to fix it. Although the overall costs associated with the required solutions are no doubt immense, the cost of continued inaction will be far more disastrous for our future.

Taken in concert, the totality of this global convergence of potentially dangerous threats, "single-point" vulnerabilities and strategic infrastructure fragility is a reality for which we are very ill-prepared and for which we have few workable strategic solutions today.

On the other hand, maneuvering within this "perfect storm" environment, malicious actors continue to explore ways in which to exploit the growing vulnerabilities that permeate our key population centers, supporting infrastructures and national economic and defense centers of gravity. In so doing, they will most likely continue to pursue asymmetric, high-yield strategies against us—strategies that avoid pitting them against our traditional strengths as a nation. As the 2010 Quadrennial Defense Review (QDR) Report asserts, "From non-state actors using highly advanced military technology and information operations to states employing unconventional technologies, our adversaries have shown that they will tailor their strategies and employ their capabilities in sophisticated ways."[16] (see Table 2)

By exploiting weaknesses in ways that outflank our strengths—to include massive post- 9/11 security investments and enhancements—nation-state and non-state adversaries, including domestic terrorist groups and so-called "lone wolves," can launch relatively easy-to-achieve physical and cyber attacks that exploit the gap between security strategies and capabilities that were designed and deployed during the Cold War era to counter a very different adversary, and those that we need today. As the 9/11 attacks demonstrated, bad actors may opt to pursue a high-payoff approach, not only seeking to destroy U.S. infrastructure directly, but using it as a means to inflict unacceptable human loss, economic disruption and psychological trauma. The QDR Report stresses that future adversaries may use surrogates to include terrorists, criminal networks and disaffected individuals; manipulate the global information environment; impede access to energy resources and markets and exploit the fragility of the international economy to gain advantage over the U.S. and its allies.[17] Disturbingly, Al Qaeda and like organizations are likely to continue to focus on prominent political, economic and infrastructure targets designed to produce mass casualties, visually dramatic destruction, significant economic aftershocks and fear among the population. More powerful and capable nation-state adversaries also may borrow from this asymmetric approach, and dramatically transform the scale and nature of the threat to the U.S. and its allies by striking at our infrastructure "soft underbelly."

Table 2. Challenges Facing Our National Infrastructure

Infrastructure	Condition
Bridges	More than 26% of the nation's bridges are either structurally deficient or functionally obsolete. While some progress has been made in recent years to reduce the number of deficient and obsolete bridges in rural areas, the number in urban areas is rising.
Dams	The number of deficient dams has risen to more than 4,000, including 1,819 high hazard dams. Over the past six years, for every deficient, high hazard potential dam repaired, nearly two more were declared deficient. There are more than 85,000 dams in the U.S., and the average age is just over 51 years old.
Drinking Water	Significant need to replace aging facilities near the end of their useful life. Leaking pipes lose an estimated 7 billion gallons of clean drinking water a day. Although Americans still enjoy some of the best tap water in the world, the costs of treating and delivering that water where it is needed continue to outpace the funds available to sustain the system.
Energy	Progress has been made in grid reinforcement since 2005, and substantial investment in generation, transmission, and distribution is expected over the next two decades. Demand for electricity has grown by 25% since 1990. Public and government opposition and difficulty in the permitting processes are restricting much needed modernization.
Inland Waterways	Of the 257 locks still in use on the nation's inland waterways, 30 were built in the 1800s and another 92 are more than 60 years old. The average age of all federally owned or operated locks is nearly 60 years, well past their planned design life of 50 years.
Levees	More than 85% of the nation's estimated 100,000 miles of levees are locally owned and maintained. The reliability of many of these levees is unknown. Many are more than 50 years old and were originally built to protect crops from flooding.
Rail	Freight and passenger rail generally share the same network, and a significant potential increase in passenger rail demand will add to the freight railroad capacity challenges.
Roads	Americans spend 4.2 billion hours a year stuck in traffic at a cost to the economy of $78.2 billion, or $710 per motorist. Poor conditions cost motorists $67 billion a year in repairs and operating costs. One-third of America's major roads are in poor or mediocre condition and 45% of major urban highways are congested.
Transit	Transit use increased 25% between 1995 and 2005, faster than any other mode of transportation. However, nearly half of American households do not have access to bus or rail transit, and only 25% have what they consider to be a good alternative.
Wastewater	Aging systems discharge billions of gallons of untreated wastewater into U.S. surface waters each year. In future years, the U.S. must update or replace existing systems and build new ones to meet increasing demand.

Source: "2009 Report Card for America's Infrastructure." *American Society of Civil Engineers*, 2010. http://www.infrastructurereportcard.org/sites/default/files/RC2009_full_report.pdf.

B. Cascading Consequences Resulting from Catastrophic Manmade and Naturally Occurring Disasters

Taken in combination, many of the threats and vulnerabilities discussed previously have given rise to a new strategic landscape which portends disasters with the potential to bring about devastating human life, economic, national security and psychological consequences in a wide array of scenarios. As summed up by a team of international disaster experts: "We are increasingly faced with catastrophes that don't fit our usual terms of reference, response doctrines or operational scripts. More worrying is that while such crises used to be exceptional and marginal phenomena and had no long-term impact on our essential dynamics, they now tend to affect and destabilize the very core of our systems."[18]

In other words, the 21st century risk environment is begetting an alarming trend in which the so-called hyper-consequential, "500-year" event is becoming more and more commonplace. This is a startling new reality that calls for a thorough review of how we as a nation prepare and plan for all-hazards catastrophic disasters. It also raises the need to rethink our current approach across a broad front and consider a series of bold, creative solutions to the complex problems that we most likely face in this ever evolving and ever more dangerous risk environment.

Hurricane Katrina and the more recent hybrid Great East Japan Earthquake-Tsunami-Fukushima nuclear reactor disaster provide important examples of "unthinkable" events that we must be prepared to deal with on a more commonplace basis. Moreover, the wide array of high-impact consequences represented by these events should help frame the capacity we will need to develop as a nation regarding catastrophic disaster preparedness, response and recovery.

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Hurricane Katrina—August 2005

Nature of the Problem: Hurricane Katrina struck the U.S. Gulf Coast on Monday, August 29, 2005. Katrina represented the most destructive domestic disaster in U.S history and ranked third overall in terms of loss of human lives. Katrina transformed into a hybrid natural/technological catastrophe following the breaching of the New Orleans levees and subsequent flooding of the city. Katrina was followed in quick succession by Hurricane Rita, which struck the Gulf Coast of Western Louisiana and Eastern Texas on September 24th, compounding Katrina's devastation and complicating response and recovery operations.[19] Within days of the levee breech, large sections of the city of New Orleans were subject to looting, shootings, violence and other forms of lawlessness. Katrina also destroyed approximately 80 miles of Mississippi's Gulf Coast, leaving most structures along the coast uninhabitable and completely destroying many coastal towns.

Scope and Scale: Katrina made landfall as a Category 3 hurricane with winds at 115-130 mph, and an accompanying storm surge as high as 27 feet along a stretch of the Northern Gulf Coast from Mobile, Alabama to New Orleans. The storm surge extended as far as six miles inland in many parts of coastal Mississippi and up to twelve miles inland along many rivers and bays. Katrina impacted nearly 93,000 square miles of territory, including 138 parishes/counties—roughly an area the size of Great Britain.[20] Within 18 hours of the levee breech, approximately 80 percent of the city of New Orleans flooded under 6-20 feet of water, necessitating one of the largest search and rescue operations in U.S. history.[21] The area flooded, approximately 80 square miles, represented 7-8 times the total size of Manhattan Island.[22]

Overall Losses and Costs: The overall costs associated with Katrina totaled more than $200 billion, according to figures tabulated six months after landfall. This figure surpasses any other recorded world catastrophe in terms of economic loss. More than 110,000 residential housing units, representing about half the total, were submersed below 1.2 meters of water; 30-50 percent of this number were thought to be beyond repair. Close to 300,000 homes were seriously damaged or destroyed.[23] Additionally, Hurricane Katrina created an estimated 118 million cubic yards of debris.[24]

Population/Societal Impacts: More than 1.5 million people were evacuated from the region, including key elements of the services' industry workforce; more than 250,000 individuals were housed in temporary shelters.[25] Approximately 230,000 jobs were lost across the Gulf Coast. 40 percent of Louisiana businesses were damaged or destroyed.

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Hurricane Katrina (continued)

Critical Infrastructure Impacts: In overall terms, 80-90 percent of regional infrastructure services were destroyed in less than three hours in the hardest hit areas of Louisiana and Mississippi.

- ***Electricity:*** The storm winds devastated the region's power infrastructure. Electric outages affected more than 2.5 million customers in Alabama, Louisiana, and Mississippi and produced ripple effects across all other infrastructure sectors.[26] Three weeks following Katrina's landfall, approximately 250,000 customers remained without power in Louisiana and Mississippi.[27] According to a Department of Energy study released in 2009, the principal cause of the extended outages associated with Katrina was the extensive damage suffered by the power transmission and distribution systems across the affected region. Katrina resulted in the destruction of more than 72,00o poles, and damage to more than 8,000 transformers and more than 1,500 transmission structures. Additionally, more than 3,500 miles of power lines were reported down in the storm by one Louisiana electric cooperative.[28]

- ***Communications:*** More than 3 million telephones lines were down and unable to be repaired in the short term. Additionally, numerous key telephone switching centers were seriously damaged, and 1,477 cell towers were incapacitated. Broadcast communications, including 50 percent of area radio stations and 44 percent of area television stations, were also affected.[29] Additionally, the State of Louisiana's 800 MHZ disaster communications system was completely destroyed, leaving emergency responders without a reliable coordination network.

- ***Oil and Gas:*** 75 percent of the Gulf's offshore facilities were in the path of Katrina and Rita; out of a total of approximately 4,000 facilities, 114 were destroyed and 69 were damaged. Katrina temporarily caused the shutdown of most crude oil and natural gas production in the Gulf of Mexico, as well as much of the refining capacity in Louisiana, Mississippi and Alabama. Additionally, eleven petroleum refineries, or one-sixth of the Nation's refining capacity, were shut down.[30] Three weeks after Katrina, 55 percent of crude oil and 34 percent of natural gas production were still suspended.[31] Major elements of the country's oil and natural gas pipeline systems from the Gulf up through the East Coast were severely impacted or shut down. Gasoline prices doubled in major urban areas east of the Mississippi for weeks.

- ***Water, Wastewater and Toxic Waste:*** The storm surge struck 466 facilities that handle large amounts of dangerous chemicals, thirty-one hazardous waste sites and sixteen Superfund toxic waste sites, three of which flooded. The storm also destroyed or compromised approximately 170 drinking water facilities and forty-seven wastewater treatment works along the Gulf Coast.[32]

- ***Health Care and Public Health:*** The New Orleans medical system effectively ceased to operate. More than 200,000 people with chronic medical conditions, displaced by the storm and isolated by the flooding, found themselves without access to their usual medications and sources of medical care. Several large hospitals were totally destroyed and many others were rendered inoperable throughout the region. Nearly all smaller health care facilities were shut down.[33]

- ***Transportation:*** Approximately 100 miles of U.S. Highway 90 between New Orleans and Pascagoula, Mississippi, were severely damaged or destroyed. More than 30 miles of U.S. 90 were completely inundated. The I-10 bridge across Lake Pontchartrain and other important highway bridge structures throughout the hurricane impact area suffered significant structural damage. Additionally, many key railroad bridges were destroyed, causing a major disruption of regional rail traffic. CSX sustained extensive damage to two-thirds of its track mileage between Biloxi, Mississippi and New Orleans, amounting to over $300 million in repair costs. Passenger rail was similarly impacted, with Amtrak service to New Orleans suspended through early October. All barge shipping on the Mississippi River in the vicinity of New Orleans was suspended as was export grain traffic out of the Port of New Orleans, the country's largest grain export terminal. Ports across the impacted region suffered heavy damage, with all facilities along the Industrial Canal in New Orleans as well as the Port of Gulfport, Mississippi, completely destroyed. The U.S. Coast Guard estimated that approximately 1,800 aids to navigation were destroyed, missing or relocated due to the impacts of Katrina.[34]

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Great East Japan Earthquake/Tsunami/Fukushima Nuclear Reactor Disaster—March 2011

Nature of the Problem: *O*n March 11, 2011, an earthquake took place 80 miles off the coast of Honshu—Japan's most populous island—approximately 240 miles from Tokyo. The initial shock registered at 9.0 on the Richter scale, making it the fourth most intense earthquake in recorded history. As a result of the quake, a massive tsunami engulfed the northeast coast of Japan, reaching several miles inland and flooding hundreds of square miles of land across 42 municipalities and four prefectures.

The tsunami resulted in severe damage to the facilities at the Fukushima Daiichi nuclear power station. The wide-scale flooding produced by the tsunami disabled generators that had powered the cooling systems in the reactors and the pools in which fuel rods were stored. The loss of coolant resulted in overheating, which caused the breech of the containment vessels and subsequently the release of radiation into the air, ground and water, requiring officials to order mass evacuations of the local population.[35]

Scope and Scale: This event caused catastrophic destruction and damage to roads, bridges, ports, railroads, buildings and other infrastructure across a wide area. Additionally, there were more than 28,000 people dead or missing as a result of the overlapping catastrophic disasters with the total population impacted estimated at over 15 million.[36]

Overall Losses and Costs: Current estimates of the cost of the destruction exceed $300 billion (approximately 4 percent of Japan's GDP), making it the world's costliest natural disaster to date.[37]

Population/Societal Impacts: Approximately 200,000 homes were severely damaged or destroyed. More than 392,000 people were still housed in over 2,200 shelters a month after the earthquake occurred. More than 3,000 people were forced to evacuate their homes and businesses in the vicinity of the Fukushima nuclear facility.[38]

Critical Infrastructure Impacts: All major critical infrastructures were impacted by the combined effects of the earthquake, tsunami and nuclear reactor breech.

- ***Electricity:*** The storm winds devastated the Honshu's regional power infrastructure. Four nuclear power plants were forced to shut down. Rolling blackouts affected approximately 3 million customers. It is estimated that the rolling blackouts and other energy conservation measures imposed in the tsunami's aftermath will cause the Japanese gross domestic product for manufacturing to decrease by $60 billion in 2011.[39] Additionally, three percent of Japan's power supply has been taken off-line permanently.[40]
- ***Communications:*** More than 1.88 million land lines were down or damaged and unable to be repaired in the short term. Additionally, numerous key telephone switching centers were seriously damaged, and 13,000 mobile cell towers were incapacitated. Two segments of a vital trans-Pacific submarine telecommunications network were put out of service, and at least two others were severely damaged.[41]
- ***Critical Manufacturing:*** The disruption to production and the transport of raw materials and key components had a major impact on the supply chains feeding Japanese industry. Many key firms in the greater Tokyo area suspended operations due to severe storm damage or power rationing brought about by the devastation to the national power grid. The computer chip industry—representing numerous facilities critical to the international supply chain of computer products—was particularly hard hit. Numerous Japanese companies suspended their U.S.-based production operations due to supply chain disruptions, including Toyota, Suzuki and NEC Corporation; many major U.S. companies were forced to follow suit. Japanese auto exports to the U.S. were down by 75 per cent in the quarter following the quake.[42]

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Japan Disaster (continued)

- ***Oil and Gas:*** one week after the tsunami struck, 1.4million bbl/day of Japan's 4.5 million bbl/day and 1.7 million tons of naptha-cracking capacity continued to be off-line. Six major oil refineries suspended operations in the aftermath of the quake, accounting for almost one-third of Japan's total refining capacity.[43]
- ***Water, Wastewater and Toxic Waste:*** At the peak of the disaster, 720,000 homes were without potable water. By the second week of the disaster, the water supply in many areas was found to have levels of radiological contamination unsafe for infants. The sale of food from areas proximate to the Fukushima facility was banned.[44]
- ***Health Care and Public Health:*** Many hospitals in the impacted area were closed or operated at very limited capacity. The Japanese Ministry of Health reported that all 33 hub hospitals in Iwate, Miyagi, and Fukushima prefectures were partially damaged, with 24 of these temporarily reducing service. Additionally, fears of radiation exposure traumatized the health care system nationwide.[45]
- ***Transportation:*** In the initial aftermath of the earthquake, all public transportation in Tokyo was suspended. Approximately 2,126 roads, 56 bridges and 26 railways were damaged in the Tohoku District of Tokyo alone. Tokyo's Narita International Airport was also closed, as were numerous other airports across the impacted area. Rail traffic was disrupted nationwide, with 990 kilometers of high speed rail shut down and several trains reported missing. All Japanese ports were closed with major port berths sustaining heavy damage, resulting in trading losses of approximately $41 million per day. Additionally, 6 Japanese seaports experienced major damage, including Sendai, the largest seaport on the Northeast coast, which was completely destroyed.[46]

III. IN SEARCH OF SOLUTIONS: THE LINK BETWEEN DOMESTIC MANUFACTURING AND NATIONAL SECURITY, ECONOMIC SECURITY AND DISASTER PREPAREDNESS

As discussed previously, the principal factors that comprise the 21st century risk environment—a wide array of potentially catastrophic manmade and naturally occurring threats and hazards, systemic vulnerabilities tied to growing interdependencies within a globalized economy and cascading cross-sector impacts associated with infrastructure disruption or failure in any part of the system—present numerous significant challenges. Overcoming these challenges will require a creative mix of comprehensive public-private solutions across the preparedness spectrum. In crafting these solutions, the nation would be best served by following a two-track approach—reducing our vulnerabilities related to the most catastrophic threat scenarios we potentially face and building the capacity to respond and recovery quickly and efficiently in the aftermath of a catastrophic disaster. The primary focus of this two-track approach should be our nation's critical infrastructures and the at-risk population centers and communities they support. Mitigating our most significant vulnerabilities and/or mounting a timely and efficient response and recovery effort at a major municipal, regional or national level requires strategic thinking, investment and capacity-building well in advance of a paralyzing disaster.

Critical to this approach moving forward is a robust, diverse and resilient domestic manufacturing sector. In fact, there is a direct nexus between a strong domestic manufacturing sector—representing a wide array of readily available and highly reliable products, materials and technologies—and a nation's ability to prevent, mitigate, recover from and rebuild quickly in the wake of catastrophic "500 year, $100 billion-plus" events. This nexus was aptly showcased by the overall efficacy of the public and private sector response and recovery effort in Japan in the aftermath of the Great East Japan Earthquake and Tsunami in 2011. Not surprisingly, this nexus represents a key consideration regarding the future of U.S. national and economic security.

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A. Prevention and Mitigation: Hardening and Revitalizing Critical Infrastructure

America relies on various types of complex, sophisticated and interconnected critical infrastructure nodes and systems to provide the foundation for its national security, economic vitality, public health and safety and everyday way of life. These infrastructure systems and services form an important part of our national identity and strategic purpose, and allow us to enjoy a historically unprecedented standard of living. Unfortunately, they are also vulnerable to a wide array of threats and hazards and are presently in a state of deterioration across sectors as discussed in the previous section. A terrorist attack, natural disaster or other catastrophic event inflicting damage to U.S. infrastructure—bridges, highways, rail lines, ports, chemical plants, power grid, water/wastewater systems, dams, communications networks, Internet backbone or other key assets—can have catastrophic physical, virtual and psychological

impacts well beyond the initial event or disruption from both a geographic and functional perspective, as well as over time. The cascading impacts brought about by the 9/11 attacks, Hurricane Katrina and other like events clearly demonstrate this point.

Fortunately, steps can be taken, in advance of a potential catastrophic event, to improve investments in security and resilience and mitigate vulnerabilities associated with our critical infrastructures and the communities they serve. These steps involve a combination of measures such as hardening, built-in redundancy, back-up capabilities and asset dispersal. The focus of these "in-advance" mitigation measures involves increasing the capacity to successfully withstand an attack or disruption and lessening the potential damage inflicted as a result of catastrophic disasters, particularly in the context of critical supply chain interdependencies. An example would be modernizing our aging infrastructure as well as "hardening" or "reinforcing" critical power plants or key transportation infrastructure assets with high-quality, reinforced and readily available U.S.-made steel, iron, concrete, glass and other materials, as well as technologies designed to mitigate the impacts of the destruction or disruption of any given node within the overall system. These specific mitigation activities, in turn, must be enabled through comprehensive public-private sector collaboration in planning, risk/feasibility analysis, modeling and structural design.

The U.S. domestic manufacturing sector can play a hugely valuable role as an enabler of a wide range of "in-advance" mitigation approaches. The contributions of a robust, dynamic domestic manufacturing sector to our national defense and defense are well established. One analyst noted that "The American steel industry and the thousands of skilled men and women who comprise its work force produce high quality,

CRITICAL INFRASTRUCTURE SECTORS


Agriculture and Food


Banking and Finance


Chemical


Commercial Facilities


Communications


Critical Manufacturing


Dams


Defense Industrial Base


Emergency Services

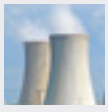

Energy

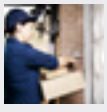

Government Facilities


Healthcare and Public Health


Information Technology


National Monuments and Icons


Nuclear Reactors, Materials and Waste


Postal and Shipping


Transportation Systems


Water

Source: http://www.dhs.gov/files/programs/gc_1189168948944.shtm

cost-competitive steel products for military use in applications ranging from aircraft carriers and nuclear submarines to Patriot and Stinger missiles, armor plate for tanks and field artillery pieces, as well as every major military aircraft in production today."[47] The factors that make "on-shore" domestically manufactured products and technologies critical to our national defense in its military application include the following: U.S. ownership, reduced likelihood of compromise by adverse foreign influences; consistency of quality, availability, delivery and cost; measurable performance; synergistic development of R&D and production capabilities; and shorter production lead times. These same factors hold true in the context of bolstering domestic preparedness for all-hazards contingencies and reducing our vulnerability to the same, particularly those vulnerabilities in key infrastructure sectors and systems corresponding to the scenarios of highest consequence.

B. Response and Recovery Following an Attack, Disaster or Technology Failure

As in the case of "in-advance" mitigation approaches, a robust and dynamic domestic manufacturing base is integral to timely, effective and efficient response and recovery in the wake of a catastrophic manmade or naturally occurring disaster. This statement applies to the timely restoration of disrupted infrastructures and lifeline services, as well as the stabilizing and rebuilding of impacted communities and economies. Reliable domestic supply chains could help mitigate the risk associated with our current over reliance on long-lead-time offshore supplies and suppliers regarding those products and materials critical to supporting response and recovery requirements. This means helping to ensure the availability and timely delivery of sufficient quantities of U.S. standards-compliant components, high-quality construction materials and advanced technologies, particularly with respect to high-consequence, geographically distributed "500 Year" events. It also means putting ourselves back in the driver's seat regarding the efficacy of catastrophic disaster response and recovery, particularly in the context of those offshore suppliers and supply chains that do not have the capacity to support us in a timely way with sufficient quantities of quality products or those who interests might not necessarily coincide with ours during a time of national emergency.

The construction of the new 5.5-mile-long twin I-10 bridges across Lake Pontchartrain in the aftermath of Hurricane Katrina illustrates the importance of a robust domestic manufacturing capacity to a successful long-term recovery effort. These replacement bridges are state-of-the-art and are designed to withstand a catastrophic hurricane event within a 100-year service life. Design features include "foundations capable of withstanding tremendous wave impact, heavily reinforced concrete restraining walls that allow expansion and contraction but prevent uplift and lateral shifting and high performance concrete (HPC) to ensure the longevity of the structure."[48] Component elements of the new bridges—including the road deck, substructure, piles and girders—were manufactured by several domestic construction firms in two separate construction contracts.[49] Design standards and materials for this project were governed by the Louisiana Department of Transportation and Development (LADOTD) *Standard Specifications for Roads and Bridges*—ensuring the quality of products used in the construction effort. According to *HPC (High Performance Concrete) Bridge Views*, a joint publication of the Federal Highway Administration and the National Concrete Bridge Council, all work on the project has proceeded on schedule with quality results as demonstrated in numerous stress and performance tests and evaluations.[50]

C. The Dangers of Reliance on Foreign Manufacturers

Unfortunately, at its own peril, the U.S. has become dangerously reliant on foreign suppliers of products, materials and technologies that are critical to our ability to prepare for, respond to and recover from manmade and naturally occurring disasters. This situation could present serious problems in the context of a catastrophic event, particularly one brought about by a creative adversary with a working knowledge of nodal analysis and our supply chain interdependencies, or a natural disaster with acute, far-reaching international supply chain implications. As succinctly put in a WorldSteel Association report examining the nexus between the U.S steel industry and national defense, "Consider the potential difficulties the U.S. would face in defending, maintaining and rebuilding infrastructure in an environment where our nation is largely dependent upon foreign steel."[51]

Unfortunately, at its own peril, the U.S. has become dangerously reliant on foreign suppliers of products, materials and technologies that are critical to our ability to prepare for, respond to and recover from manmade and naturally occurring disasters.

Major security and preparedness concerns associated with America's growing dependence on off-shore manufacturing vary greatly, including the following:

- Higher average and highly variable costs;
- Quality, design and performance problems;
- Lack of reliable product specifications and standards;
- Unreliable/uncertain supply in time of great demand;
- Just-in-time delivery, long lead times and extended construction schedules;
- Global economic volatility;
- Unknown off-shore vulnerabilities and cascading impacts of system disruption;
- Deliberate introduction of design flaws, vulnerabilities or cyber "bugs" into products and technologies key to U.S. national security;
- Suppliers associated with nations unfriendly to or competitors of the U.S.;
- Drain of high tech innovation, basic research and advanced development from U.S. to offshore suppliers; and
- Huge investments required to restore capacity lost to offshore manufacturers.

Additionally, hostile trading partners may make a deliberate choice to not supply needed products, materials or technologies during a time of domestic crisis. Relying on a potentially hostile trading partner in a time of need puts our national security at risk in many important ways. This is one of the principal reasons to enforce our trade laws, have a national manufacturing strategy, and pursue related policies to make domestic industry more competitive. In one telling example, Chinese investments in antibiotics as a targeted growth sector virtually wiped the slate clean in terms of international competitors. As a result, "the last U.S. source of key ingredients for antibiotics—a Bristol-Myers Squib plant in East Syracuse, New York—has now closed, leaving the U.S. dependent on foreign sources in a future conflict."[52] This situation does not bode well regarding U.S. preparedness for or response to a global pandemic or sophisticated bioterrorism attack.

This negative trend signifying the decline of the U.S. industrial base has accelerated greatly in recent years, with a corresponding increase in our reliance on critical products and technologies manufactured abroad. For example, China is now the leading supplier of foreign steel to the U.S. market. Also, a variety of critical commodity imports are on the rise from foreign competitors who often engage in unfair trade practices—dumping, subsidization, and unfair market barriers—to undercut our domestic industry. In fact, in 2001, the U.S. Commerce Department levied anti-dumping duties of roughly 33 percent on all aluminum extrusion imports—used in transportation and distribution systems and building construction—from China in response to unfair trade practices.[53] The government of China is also heavily involved in its domestic steel industry, providing significant subsidies to that industry in the form of favorable tax treatment and export credits, R&D support, incentivized foreign investment and technology transfers, and direct funding of certain key projects.[54]

In some cases, these offshore manufactured good imports have raised significant safety or quality concerns. For example, Chinese imports of bridge span sections for the Oakland Bay Bridge were rejected because of inadequate welds. This action compounded an already unacceptable situation in which the first delivery of Chinese steel was more than a year late and the whole project is years behind schedule and $5.2 billion over budget according to information compiled by the National Steel Bridge Alliance.[55] In a similar situation, the Chicago Transit Authority (CTA) took action in March 2012 to restructure a $1 billion-plus contract in which a Chinese manufacturer, through "inferior craftsmanship," had produced "internally defective and potentially dangerous steel parts" for the next generation of CTA trains.[56] Further, in the aftermath of Hurricane Katrina, imports of wallboard from China increased dramatically to support the surge in business and residential housing reconstruction across the impacted area. According to the New York Daily News, this surge peaked in 2006, with Chinese wallboard used in as many as 100,000 reconstruction projects—mainly residential housing.[57] Unfortunately, these materials were found to contain excessive amounts of toxic sulfur, and homeowners and businesses are facing costly "rebuilds" to counter the health and safety issues that have been associated with them. Specifically, these materials have been traced to extensive corrosion of electric wires, air conditioning coils, appliances and other metals and metals products in homes and businesses.[58] Significantly, the Chinese wallboard is also "suspected of causing health problems that include nosebleeds, headaches, sinus problems and respiratory ailments."[59]

Relying on a potentially hostile trading partner in a time of need puts our national security at risk in many important ways. This is one of the principal reasons to enforce our trade laws, have a national manufacturing strategy, and pursue related policies to make domestic industry more competitive.

IV. THE STATE OF CRITICAL MANUFACTURING IN THE UNITED STATES

A. The Steady Decline of U.S. Manufacturing

"For over half a century, American Manufacturing has dominated the globe. It turned the tide in World War II and hastened the defeat of Nazi Germany; it subsequently helped rebuild Europe and Japan; it enabled the United States to outlast the Soviet Empire in the Cold War. At the same time, it met all the material needs of the American people." Robert Morley, *"The Death of American Manufacturing,"* www.trumpet.com, February 2006.

American manufacturing has been in a steady state of decline for decades. As summed up by Richard McCormack in *The Plight of American Manufacturing*, "Long before the banking collapse of 2008, such important industries as machine tools, consumer electronics, auto parts, appliances, telecommunications equipment and many others that once dominated the global marketplace suffered their own economic collapse."[60] Disturbingly, the American work force in manufacturing peaked in numbers in 1979, with an overall decline of approximately 40 percent since that time to about 11.7 million workers today. Almost 6 million factory jobs disappeared between 2000 and 2009 alone, a decline as "a share of total manufacturing jobs (33 percent) that exceeded the rate of loss in the Great Depression."[61] Today, less than 10 percent of the American work force is employed in manufacturing—the smallest number of Americans employed in this sector since before the Second World War.[62] And, importantly, for every job lost in manufacturing, approximately 2.3 additional jobs are lost elsewhere in the economy.[63]

Additionally, between 2000 and 2011, America saw the permanent closure of some 66,486 factories, with almost 1,300 manufacturing jobs lost per day during that same time period.[64] It is also estimated that an additional 90,000 manufacturing companies are currently at risk of shutting their doors permanently.[65] Importantly, these permanent closures have cascading negative supply chain impacts far beyond any

Figure 1. Percent change in manufacturing employment during the Great Depression and the 2000's.

Source: Atkinson, Robert D.; Stewart, Luke A.; Andres, Scott M.; Ezell, Stephen J. *"Worse than the Great Depression: What Experts Are Missing About American Manufacturing Decline,"* The Information Technology and Innovation Foundation, March 2012, page 6.

given individual facility. Regarding loss of U.S. output, a March 2012 report published by the Information Technology and Innovation Foundation stipulates that "In 2010, 13 of the 19 U.S. manufacturing sectors (employing 55 percent of manufacturing workers) were producing less than they were in 2000" as adjusted for inflation.[66] On the employment front, this same report argues that "if from 2000 to 2010 manufacturing output had grown at the same rate as that of the rest of the business sectors, the U.S. would currently have some 13.8 million more jobs."[67] With respect to our balance of trade, American imports of manufactured goods totaled approximately $2.52 trillion in 2008, with exports totaling $1.29 trillion for that same year—leaving a deficit of approximately $821 billion representing almost 17.2 percent of the U.S. GDP for that year.[68] Perhaps most important of all, the U.S. is also steadily losing ground in the industries that represent the future. For instance, the U.S. lost world dominance in high tech exports to China in 2004, "when China exported $180 billion worth of information- and communications-technology products and the U.S. exported just $149 billion."[69] In the printed circuit board industry alone, Asian countries account for 84 percent of global production, which accounts for circuit boards used in tens of thousands of consumer and defense products.[70]

The pattern of decline described above bodes ill for maintenance of domestic manufacturing capacity—not to mention future innovation and advancement—to support multiple sectors of the economy, national security and catastrophic disaster preparedness. Simply put, we are rapidly losing the capacity to manufacture products, materials and technologies critical to America's version of the most basic level of Maslow's Hierarchy of Needs. In the world of steel, we are steadily losing domestic production capacity, while China, in the year 2008 alone, made more than five times the amount of steel produced by U.S. companies in that same year despite the greater efficiency of our domestic production processes.[71] Regarding the manufacturing of aluminum products, the U.S. capacity plunged by 25 percent from 2006 to 2010, with domestic smelters operating at 55 percent of capacity in 2010.[72] Regarding the manufacturing of cement—the building block of the U.S. construction industry—the U.S. produced 63,500 tons of cement in 2010, compared to 220,000 tons by India and an overwhelming 1,800,000 tons by China in that same year.[73] Prior to the economic crisis, Chinese cement was used in 50% of all home foundations poured in the U.S., putting enormous pressure on U.S. producers.[74]

Many U.S. manufacturers have chosen to outsource or relocate their operations abroad for a number of reasons. They have set up shop overseas to take advantage of a more favorable tax structure, immediate access to an expanding market, less expensive labor and unfair trade practices—all of which also means competitively priced exports back to the United States.

Similarly, the U.S. machine tool industry—considered a core component of national security capacity—accounted for only 5.1 percent of the global output in 2008.[75] In the area of metal casting, China is the largest producer of any country in the world, out-producing the second place U.S. by a factor of five.[76] High-tech R&D and large-scale high tech manufacturing also have begun to follow the flight path of this national security-related manufacturing capacity, with China, South Korea, Singapore, Brazil, India, and the European Union all surpassing the U.S. in technological capacity in 2007 according to a scale developed by Georgia Tech University.[77] Further, in 2006, China replaced the U.S. as the world's largest producer of electronics, and has increased the gap every year since.[78]

These disturbing trends can be accounted for in several important ways. American workers are more productive today than ever before, principally through the increased innovation and automation associated with our manufacturing processes. In fact, American workers today "crank out twice what they did in the early 1990s, and three times what they produced in the early 1980s."[79] Another contributing factor is related to the fact that Americans increasingly have shifted consumption away from manufactured goods and towards services. As noted in the White House's *Framework for Revitalizing American Manufacturing*, "In 1950, U.S. households spent 67 percent of personal consumption expenditures on goods and 33 percent on services. By 2008, the share of expenditures on goods had fallen to

THE PLIGHT OF AMERICAN MANUFACTURING

- U.S. demand for manufactured goods has increased by 400 percent since 1980…but U.S. production of those goods increased by only 40 percent.
- China surpassed the United States as the world's largest export nation in 2004. Only 5 years earlier, the United States exported double the amount China did.
- Worldwide in 2008, there were 80 major chemical plants costing more than $1 billion either on the drawing boards or being constructed. None of them were being built in the United States.
- In 2007, the United States produced 17 percent of the world output of semiconductors, a number that has been declining since 1995, when the U.S. accounted for 25 percent of global output.
- The U.S. steel industry produced 91.5 million tons of steel in 2008, down from the 97.4 million tons in produced in 1999. By comparison, China's steel industry produced 500 million tons in 2008, more than five times the amount of U.S. producers and up from the 124 million tons it produced in 1999.

Source: McCormack, Richard. "The Plight of American Manufacturing". Manufacturing a Better Future for America. *Alliance for American Manufacturing*, 2009.

42 percent and the share of expenditures on services had risen to 58 percent."[80] Yet another factor is that many U.S. manufacturers have chosen to outsource or relocate their operations abroad for a number of reasons. They have set up shop overseas to take advantage of a more favorable tax structure, immediate access to an expanding market, less expensive labor and unfair trade practices—all of which also means competitively priced exports back to the United States.

This latter trend is representative of by far the largest factor accounting for the steady decline of U.S manufacturing: the rise of globalization and significant international competition over the last 50 years or so. Some of this competition is the result of the growth of quality manufacturing capacity abroad as well as the accelerated expansion of a truly global economy, with sharp declines in transportation costs, increased mobility of labor and capital, dramatically increased supply chain efficiencies and reductions in international trade and investment barriers. However, the more recent acceleration in America's decline as a manufacturing nation can be attributed directly to the huge growth in offshore manufacturing in countries like Malaysia, Singapore and others where corporate taxes are low, labor is cheap, "bargain rate" loans are readily available, regulatory compliance thresholds are low and economies of scale can be achieved.

This decline is also the direct result of the loss of U.S. manufacturing output due to the rise of countries such as China, India, Brazil, et.al.—many of whom are full-fledged members of the World Trade organization (WTO) with complete access to the global trade system—and who typically resort to unfair trade practices, subsidize domestic manufacturing, undervalue their currency and engage in other like practices, effectively undercutting the market forces on which free trade depends. In fact, it is estimated that between 2001 and 2010, alone, more than 2.8 million net American jobs were lost due to our rising bilateral trade deficit with China—representing the biggest challenge that our domestic manufacturing sector has ever had to face across virtually every product category.[81] Summing up this issue, Richard McCormack notes that "American companies have difficulty competing against foreign countries (whose governments) undervalue their currencies; pay health care for their workers; provide subsidies for energy, land, buildings and equipment; grant tax holidays and rebates and provide zero-interest financing; pay their workers poverty wages that would be illegal in the United States; and don't enforce safety or environmental regulations."[82]

B. Foreign Manufacturing of U.S. Infrastructure and Components

Many of our nation's critical infrastructure sectors and systems have been negatively impacted by the steady erosion of our domestic manufacturing base over time. These impacts directly affect our ability to mitigate the potential consequences of catastrophic disasters in advance of their occurrence as well as mobilize a rapid, effective disaster response.

In the public health and health care sector, a growing overreliance on imported products and technologies has put our ability to respond to and recover from a global pandemic, natural disaster or weapon-of-mass-destruction terrorism event seriously at risk. During the 2009 H1N1 outbreak, many hospital systems, nationwide, experienced significant supply chain disruptions and faced an acute shortage of critical supplies. These shortages included commonly used items such as protective face masks and exam gloves, more than 90 percent of which are currently manufactured overseas.[83] Alarmingly, this situation extends to other elements critical to sector preparedness and resilience. For example, almost half of all the supplies and equipment used to support America's public health and health care sector come from foreign suppliers, including Mexico, Ireland, Germany and China. Similarly, 30 percent of all precision surgical instruments are imported. Additionally, approximately 70 percent of the world's supply of penicillin and two-thirds of its supply of aspirin are manufactured in China.[84] Perhaps

HIGH-TECH INDUSTRY DECLINE

Semiconductors

- Industry lost nearly 1,200 plants of all sizes between 1998 and 2008, a 17% drop, including a 37% loss in large establishments and a 41% loss of mid-sized plants.
- In 2007, imports accounted for nearly one-half the U.S. market.
- The U.S. share of global capacity has been in descent, falling to 14% in 2009.
- Once the world leader, the U.S. fell to 4th place in 2009.

Printed Circuit Boards

- Industry has shrunk an estimated 74% since 2000.
- The U.S. once dominated PCB production with 42% of global revenues in 1984, but revenues have since fallen to less than 8% in 2008.
- By 2005, between 40-50% of North America's PCB orders had migrated offshore.
- Parts and materials suppliers to the industry have also largely disappeared from the U.S.

Machine Tools

- Between 2001 and 2008, the metal cutting machine tool industry shed 16% of its establishments and 22.4% of its workforce, and the metal forming machine tool industry lost 17% of its establishments and 14% of its workforce.
- Foreign penetration of the U.S. machine tool market rose steadily from about 30% in 1983 to 72% in 2008.
- The U.S. fell from the world's third largest machine tool producer in 2000 to 7th in 2008, when Japan and German each produced 4 times, and China 3½ times the worth of those produced in the U.S.

Advanced Materials

- The U.S. advanced materials industry's global trade deficits doubled from 2002 to 2006.
- Plant capacity and employment have both declined, and production of critical materials, such as specialty steels, advanced ceramics, and magnesium, has been moving offshore.

Source: "Manufacturing Insecurity". International Union Council. AFL-CIO. http://www.aflcio.org/issues/jobseconomy/manufacturing/upload/manufsumm_092010.pdf

During the 2009 H1N1 outbreak, many hospital systems, nationwide, experienced significant supply chain disruptions and faced an acute shortage of critical supplies. These shortages included commonly used items such as protective face masks and exam gloves, more than 90 percent of which are currently manufactured overseas.

most disturbing of all, much of the extensive all-hazards planning that has taken place across the sector at all levels over the past decade fails to account for these potentially disastrous foreign supply chain dependencies. As the 2009 H1N1 pandemic pointed out, this remains a serious chink in our national armor.

The defense industrial base sector suffers from a similar over reliance on products and technologies formerly made in the U.S.A. but now manufactured offshore based on the pressures from foreign competition. This situation is the result of many factors, principal among them being the fact that America's domestic manufacturing capacity can no longer meet even some of the military's most broad-based needs. These include things like: specialty metals, flat panel displays, hard disk drives, semiconductors, batteries, photovoltaics, machine tools, electronics components and information technology systems.[85] Worse yet, according to manufacturing sector expert Dr. Joel S. Yudken, is that "Continued migration offshore is both undercutting U.S. technology leadership while enabling foreign countries to catch up, if not leap frog, U.S. capabilities in critical technologies, important to national security."[86] This disturbing trend portends a cascading impact on future weapons system research and development and other aspects of future innovation.

The following case studies provide a more detailed look at the negative impacts of overreliance on foreign goods and international supply chains on our critical infrastructure sectors.

Case Study

Critical Manufacturing and the U.S. Steel Industry

A strong and viable steel industry is an essential component of our national and economic security and national preparedness. In fact, steel products and applications are critical to supporting the continuum of preparedness from in-advance disaster mitigation to post-disaster response and recovery. The U.S. steel industry employs a labor force of more than 160,000 skilled workers engaged in the production of over $60 billion of high quality steel and high-technology specialty alloy products annually.[87] Steel plays a critical role in nearly all aspects of domestic manufacturing. For example, carbon and alloy steel is used in all major end-use markets, including construction, automotive, machinery, appliances and containers. Additionally, specialty steels are designed for use in extreme environments that require exceptional hardness, toughness, strength and resistance to heat, corrosion and abrasion, such as in the aerospace and chemical processing industries.[88]

Given this wide array of products—particularly those that employ more durable, hazard-resistant and state-of-the-art materials—all segments of the domestic steel industry have the potential to play a vital role in hardening and improving the resilience of our critical infrastructures against all-hazards disasters. This logic applies to pre-construction design enhancement as well as post-construction security and resilience augmentation. On the post-incident side of a catastrophic disaster, timely and reliable access to an uninterrupted supply of quality and cost-competitive steel products and materials is essential. These products must also be available in sufficient quantities to support regional-level response and recovery activities—including the rebuilding of affected population centers, supporting infrastructures and businesses.

Steel products and materials are essential components of our nation's critical infrastructure base, including those infrastructure systems that provide "lifeline" services to the American people and serve as drivers of the U.S. economy on an everyday basis. These include:

- ***Energy Infrastructure***—petroleum refineries, oil and gas pipelines, storage tanks, electric power generating plants, electric power transmission towers and utility distribution poles
  - ***Typical steel applications***—specialty pipe, boilers, pressure vessels, custom made valves and fittings, pressure gauges, generators, towers and poles[89]
- ***Transportation Infrastructure***—highways, bridges, tunnels, railroads, ferries, mass transit systems, airports, seaports, navigation systems, vehicles and other conveyances
  - ***Typical steel applications***—rebar, guardrails, signage, light poles, girders, spans, roadbed, rails, rolling stock, framing, lighting structures, pilings, plates and support equipment[90]
- ***Public Health and Safety Infrastructure***—dams and drinking water reservoirs, water infrastructure and supply systems, wastewater treatment facilities, medical and health care facilities, and medical supply and logistics systems and facilities
  - ***Typical steel applications***—tubular goods, tanks, culverts, plates, ribar, piping, building materials and framing[91]
- ***Government and Commercial Infrastructure***—government facilities, emergency management and first responder systems and facilities, commercial centers, manufacturing plants, industrial complexes, retail stores, warehouses, logistics facilities, hotels, etc.
  - ***Typical steel applications***—building materials and framing, including structural, plate, sheet and reinforcing steel, fittings, sections and environmental systems[92]

These infrastructures derive huge benefits from a robust domestic steel industry that is on the cutting edge of material design supporting the construction of more hardened and hazard-resistant structures and more resilient infrastructure systems and components. This fact was well illustrated by Hurricanes Katrina and Rita, the consequences of which were made far worse as a result of the inferior or inappropriate building materials used in infrastructure and residential construction across the impacted region. Moreover, restoring vital services and rebuilding our critical infrastructures has proven a top priority in the aftermath of catastrophic disasters such as the 9/11 attacks, Hurricane Katrina and flooding along the Mississippi River. Having the domestic manufacturing capacity necessary to guarantee reliable access to sufficiently large quantities of a wide variety of safety-compliant steel products and materials when and where needed is a critical aspect of any post-disaster response and recovery effort. This is particularly true in the context of those disasters with widespread impacts. Lack of such capacity means significantly extended population displacement, lifeline services restoration and economic recovery time frames.

Continued erosion of America's steelmaking capacity represents a significant risk to our national and economic security and national preparedness.

Unfortunately, America's domestic steel manufacturing capacity is undergoing a steady decline. As noted in *"World Steel in Figures 2011,"* steel production in the NAFTA countries decreased from 15.8 percent to 7.8 percent of the world total during the period 2000-2008, while China's production increased from 15.1 percent to 44.3 percent during that same period.[93] Of significant note, the U.S. became the fourth largest *importer* of steel in the world in 2009, with China leading the pack in terms of steel exports to the U.S.[94]

Continued erosion of America's steelmaking capacity represents a significant risk to our national and economic security and national preparedness. Turning this situation around will require a concerted national effort, as much of this deterioration is accounted for by losses to artificially advantaged offshore competitors, insufficient enforcement of trade laws and policies here at home and a less-than-favorable U.S. domestic investment climate.

Case Study

The Water/Wastewater Sector

Our nation's water and wastewater infrastructure includes surface and ground water sources of untreated water for municipal, industrial, agricultural and household needs; dams, reservoirs, aqueducts and pipes that provide for the storage and transport of raw water; treatment facilities that decontaminate raw water; treated water reservoirs; end-user distribution systems; and wastewater collection and treatment facilities. Nationwide, this infrastructure consists of approximately 77,000 dams and reservoirs; thousands of miles of pipes, aqueducts, water distribution and sewer lines; 168,000 public drinking water facilities; and about 16,000 publicly-owned wastewater treatment facilities.[95]

These water and wastewater systems are vulnerable to variety of different manmade threats, including physical disruption, bioterrorism/chemical contamination and cyber attack. They typically are also heavily impacted by natural disasters like hurricanes, earthquakes and floods as detailed in the references to Hurricane Katrina and the Great East Japan Earthquake provided earlier in this report. Damage or destruction of water/wastewater infrastructure in a catastrophic disaster affects health and public safety, industrial production, emergency services and other critical functions across numerous interdependent infrastructure sectors such as energy, transportation, manufacturing, communications and others. The extent of damage incurred by the water/wastewater infrastructure of a region affected by a catastrophic disaster also impacts response and recovery strategies, capabilities and timelines. As noted in a December 2010 Congressional Research Service report, "These types of vulnerable interconnections were evident, for example, during the August 2003 electricity blackout in the Northeast United States: wastewater treatment plants in Cleveland, Detroit, New York and other locations that lacked backup generation systems lost power and discharged millions of gallons of untreated sewage during the emergency, and power failures at drinking water plants led to boil-water advisories in many communities. Likewise, natural disasters such as the 2005 Gulf Coast hurricanes and 2007 Mississippi River floods caused extensive and costly damage to multiple infrastructure systems—transportation, water, electric power and telecommunications."[96]

Another key vulnerability in this sector is the fact that our nation's water and wastewater systems also are in need of serious rehabilitation. The 2009 ASCE Infrastructure Report Card gives the state of our water infrastructure an overall D- rating. According to this report, "Drinking water systems face an annual shortfall of at least $11 billion in funding needed to replace aging facilities that are near the end of their useful life and to comply with existing and future federal water regulations. The shortfall does not account for any growth in the demand for drinking water over the next 20 years."[97] Similarly, many of our nation's most critical dams are in need of significant repair due to the combined effects of aging, structural deterioration and lack of ongoing maintenance. As reported in the 2009 ASCE Report Card, "In 2009, the Association of State Dam Safety Officials (ASDSO) estimated that the total cost to repair the nation's dams totaled $50 billion and the needed investment to repair high hazard potential dams totaled $16 billion."[98]

Rehabilitating our water and wastewater systems is an effort that necessarily extends downward through the myriad of manufactured products and technologies that comprise critical components of the sector. These range from the steel that is used in control valves, pipes, storage tanks, storm water management systems and the like—to the glass, electronics and technology components that are used in sophisticated gauges, security sensors and environmental monitoring equipment. As in the case of the other sectors detailed in this report, the manufacturing of many of these key products and technologies has migrated offshore. A key example is the deterioration in domestic production of ductile iron waterworks fittings—a common product used to make pipes, valves and hydrants and change, divert, divide or direct the flow of raw or untreated water, primarily in municipal water systems.[99] Domestic production of these fittings peaked in 1999, followed by sharp declines, worker layoffs and factory closings. In 2003, the U.S. International Trade Commission determined that ductile iron waterworks fittings imported from China were causing unfair market disruptions with respect to domestic producers of like or directly competitive products.[100] Concurrently, the Commission recommended the imposition of increased duties on

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ductile iron waterworks fittings from China, but the President declined to intervene. Today, only a single American manufacturer of ductile iron products remains open for business in the United States.

The depth of the dependence of the country's water and wastewater systems on offshore suppliers is illustrated by the quantity and diversity of products that meet "Buy American" waiver requirements under the provisions of the American Recovery and Reinvestment Act. In an August 2011 memorandum issued by the Congressional Research Service, these offshore products span the sector and include the following key examples:

- Sanitary manhole covers and frames
- Wastewater aeration blowers
- Water flow regulators
- Ultraviolet disinfection systems
- Cast iron valve boxes
- Membrane filtration systems
- Hydroelectric generators
- Dewatering presses
- Flushing systems
- Water meters
- Leak detection indicators[101]

Today, only a single American manufacturer of ductile iron products remains open for business in the United States.

Clearly, the extent of these offshore dependencies puts us in a much weakened position regarding overall water sector preparedness—from in-advance mitigation to disaster response and recovery to vulnerability to potential acts of terrorism aimed at contaminating the water supply.

The across-the-board importance of our water and wastewater systems dictates that we take prudent measures to mitigate system vulnerabilities as well as the potential consequences of catastrophic disasters as part of our national preparedness efforts at all levels across the country. In the aftermath of a disaster, we must do everything we can to get these critical systems back on line in safe fashion as quickly as possible. Again, a strong domestic manufacturing capacity comprises an extremely important part of this approach.

Case Study

The Commercial Power Grid

The commercial power grid is one of America's most critical infrastructure systems. Comprised of more than 200,000 miles of high-voltage lines, thousands of generation plants and millions of digital controls, it is essential to almost every aspect of our government, society, economy, national defense and Americans' everyday lives.[102] Current planning criteria used within the electricity sector assumes—mostly correctly—that the commercial grid is highly reliable and is subject mainly to infrequent, weather-related and short-term disruptions, and that available backup power is sufficient to meet critical needs.

The reality, however, is that the overall security and reliability of the commercial grid is increasingly threatened by a complex nexus of challenges including: increased user demand, aging infrastructure, decreased resilience, industrial sabotage, ease of physical attack on key nodes, increased reliance upon automated control systems highly vulnerable to cyber attacks, long lead times for the replacement of key components and interruptions in fuel supplies to electricity-generating plants. In turn, these challenges cascade into other critical infrastructures which feed from the grid, including communications, water, transportation, pipelines, etc.,

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Case Study – The Commercial Power Grid (continued)

and which are needed also for the normal operation of the grid, as well as its quick recovery in emergency situations. In the context of national security, the Department of Defense (DoD) is overwhelmingly dependent on commercial electrical power sources outside its ownership and control for secure, uninterrupted power to support its critical missions and functions. As noted in the February 2008 *Report of the Defense Science Board (DSB) Task Force on DoD Energy Strategy,* "In most cases, neither the grid nor on-base backup power provides sufficient reliability to ensure continuity of critical national priority functions and oversight of strategic missions in the face of a long term (several months) outage."[103]

As noted in a June 2010 report issued by the North American Electric Reliability Council (NERC), the high end of the threat spectrum faced by the commercial power grid, today, may bring about serious physical damage on a regional scale to key components of the overall bulk power system, including high-capacity transformers, high-voltage towers, generation stations and control equipment.[104] Such damage could, in turn, lead to major outages ranging from months to years due to low inventory levels, extremely long component procurement cycles (up to 12-24 months) and the fact that most of the manufacturing capacity for these components is limited to a small number of overseas suppliers.[105] As stated in the NERC report, "Throughout the sector there is an increased reliance on foreign manufacturers, with critical components and essential spare parts manufactured abroad (e.g. HV transformers), and a trend toward lower overall inventory levels…The supply chain itself represents an important potential vulnerability."[106]

A key recommendation of the NERC report—representing the opinions of a wide array of government and industry experts—is that the electricity sector provide for more immediate access to critical components and other spare parts to enhance response and recovery efforts in the context of catastrophic disasters.[107] Specifically, the report recommends that "Ultimately, efforts should be considered to bring more of the supply chain and manufacturing base for these critical assets back to North America." This recommendation extends to digital and solid-state devices such as relays and system controls on the cyber-security side, where the potential could exist to pre-install malicious code or vulnerability into the device prior to shipping to North America."[108] As evidenced by the depth of detail and concern expressed in this report, ponderous foreign supply chains and the ability of malicious actors to tamper with goods manufactured offshore raise significant security, preparedness and response challenges.

V. RECOMMENDATIONS

As discussed throughout this report, our national and economic security interests make it imperative that the U.S. maintain a strong and diverse manufacturing sector. Congress, the President, state governments and industry should pursue legislation, policies and other actions to ensure that we revitalize our critical infrastructure and manufacturing base, reduce serious offshore dependencies and attendant vulnerabilities and build the domestic capacity to help bolster national catastrophic disaster preparedness, response and recovery.

A. Develop a comprehensive national vision and strategy and promote awareness for including a strong domestic manufacturing sector as a key component of U.S. national and economic security and national preparedness.

Revitalizing America's domestic manufacturing capacity must become a clear and urgent national priority. As pointed out clearly throughout this report, the future vitality of our national and economic security goes hand-in-hand with that of our domestic manufacturing base. If we fail to pay attention to this reality, we will not fare well as a nation in the highly dynamic global risk environment we now face, and which will grow even more challenging as we move into the future. Unfortunately, there are too many individuals in key leadership positions both in government and the private sector, and across the American public writ large, who fail to make this important connection.

The first step in getting serious about reversing the decades' long erosion of our critical manufacturing capacity is to develop a comprehensive national vision and strategy and promote awareness for including a strong domestic manufacturing sector as a key component of U.S. national and economic security. The *"Framework for Revitalizing American Manufacturing,"* released by the Obama Administration in December 2009 is a start, but not a substitute for a concrete plan of action with supporting milestones, timelines and accountability.

The next step includes the inclusion of a revitalized domestic manufacturing sector as a core element of our National Security Strategy, Presidential Policy on National Preparedness, National Mitigation Framework, National Response Framework, National Recovery Framework and other foundational government documents. It should be highlighted that none of the current versions of these key national strategies, plans and policies—some of which have been recently issued—addresses the requirement for a strong domestic manufacturing capacity. The *National Security Strategy* issued in 2010 comes closest to hitting the mark with its emphasis on renewing the American economy through increased growth and competitiveness. However, it fails to even mention in brief the need for a strong, revitalized domestic manufacturing sector as a core means of achieving this goal. At best, this is a glaring oversight; at worst, it is a failure to recognize a strategically important fact—without a robust domestic manufacturing capability, the U.S. is ultimately at the mercy of a highly interdependent and vulnerable global security and economic environment. Reversing this situation will require a focused and coordinated effort among the National Security Council, National Economic Council, Domestic Policy Council and the Office of Management and Budget.

The forces of globalization are irreversible. The global market is interdependent and becoming more competitive every day. It is inconceivable that the United States—300 million citizens strong—can possibly sustain its standard of living and way of life without preserving and expanding its manufacturing base. The U.S. Congress has a critical role to play in developing a comprehensive approach to revive our manufacturing base, consistent with our international commitment

to open markets, expand exports, and enhance our productivity. We cannot afford to continue to miss opportunities to build in the need for a strong and vibrant domestic manufacturing base as part and parcel of our grand vision for national and economic security and global competitiveness.

Finally, the Administration should work closely with the government and industry entities that comprise the Critical Manufacturing Government and Sector Coordinating Councils under the National Infrastructure Protection Plan (NIPP) framework to establish a national-level education and awareness campaign focusing on the nexus between America's national and economic security risks and the revitalization of our domestic manufacturing capacity. This campaign should begin with a targeted focus on senior government leaders at all levels—Federal, State and Local—and across branches of government, as well as industry chief executives and board members. A second phase of the campaign would target mid-level government functionaries, infrastructure owners and operators, technologists, standards setters, etc.—enabled through existing public-private partnership forums, professional associations, chambers of commerce, etc. A third phase of the campaign would be focused on garnering the active support of the general public for investing in our domestic manufacturing base to reduce national vulnerabilities, promote economic competitiveness and boost employment.

B. Recapitalize and reinvest in America's infrastructure, enhancing national resilience and hardening key infrastructure nodes and systems using U.S.-made materials and components.

A review of major infrastructure development projects of the past—particularly the Eisenhower Interstate Highway System—reveals a clear nexus and synergy between such transformational projects and national economic productivity, national security and national preparedness for major disasters. Hence, rehabilitating and modernizing our infrastructure base across the critical sectors must be recognized as a key component of U.S. national and economic security into the future.

…every new investment should be made with a strategic view towards ensuring the continued growth, security and safety of America as the sole priority. And, to the extent these investments are made with federal procurement dollars, they should be based upon domestic content preference (i.e. Buy America laws)…

Unfortunately, traditional approaches to this complex challenge involving piecemeal patches, marginal improvements over time and strategic neglect clearly have failed and provide no vision for the future.

We must take *concerted national action* now—according to a comprehensive, well-thought-out strategic vision and plan developed in partnership between the public and private sector—to revitalize and provide full life-cycle sustainment of the interdependent critical infrastructure nodes and systems that represent the life blood of America. This action will have an important side effect—an increased demand for products, materials and technologies via the domestic supply chain. The formula for success is clear: investment breeds demand; demand spurs manufacturing; and manufacturing supports resilience, economic competitiveness and national preparedness. As part of this formula, security, resilience, life-cycle sustainment and maintenance costs, and reducing vulnerabilities stemming from key interdependencies should be primary considerations with each new investment to ensure that these essential factors are "built in" from the ground up, rather than "bolted on" after the fact.

Further, it is important to highlight that *how* public reinvestment money is spent is just as important as *how much* is spent. Simply put, infrastructure recapitalization funding should help buy down long-neglected safety and security risks across the country, as opposed to the "pork barrel" considerations that all too often drive government funding. In other words, every new investment should be made with a strategic view towards ensuring the continued growth, security and

safety of America as the sole priority. And, to the extent these investments are made with federal procurement dollars, they should be based upon domestic content preference (i.e. Buy America laws) which is fully compliant with our international obligations.

As we take action to modernize our failing infrastructure we should also do so using innovative approaches that leverage one of America's greatest strengths—innovation in domestic manufacturing, including futuristic products, materials and technologies. Rehabilitating our nation's electric power grid serves as an important case in point. As we modernize our power grid to meet 21st century demand, we should do so in a way that promotes energy efficiency, maintains reliability, accommodates emergent sources of renewable energy and is resilient in the face of catastrophic disasters. Leveraging new "Smart Grid" technologies developed in the U.S., will result in the manufacturing sector and other critical industries better managing their energy use and costs, reduce strain on the grid and increase reliability, even in times of emergency.

The path forward to recapitalizing America's failing infrastructure involves a multifaceted approach, taken in tandem with revitalization of our domestic manufacturing base. First, the Administration should work closely with Congress to develop and strictly adhere to criteria that will govern how public infrastructure recapitalization funds will be prioritized, allocated, distributed and accounted for. This process can be accelerated by using infrastructure risk data and priorities already assessed individually by the Departments of Transportation and Homeland Security, Environmental Protection Agency, U.S. Army Corps of Engineers, Federal Emergency Management Agency, and their State and local government counterparts.

Second, the funding of individual risk-based recapitalization projects should also be linked to an all-encompassing public-private national infrastructure strategic rehabilitation plan that pulls everything together, including technological innovations and future life-cycle costs and maintenance–compounding the value of every dollar spent. This plan must also take a "network perspective," accounting for key infrastructure interdependencies and eliminating wasteful, stove-piped single sector, system or facility approaches to project design and development.

Finally, a long term "overseer" of this effort—perhaps a permanent public-private Presidential Commission or Congressional Panel—should be identified to build out the essential elements of a national infrastructure rehabilitation plan, integrate public-private approaches and resources, prioritize and target project funding, chart and assess progress, explore incentives to boost public-private collaboration, recommend appropriate legislative and policy fixes and help raise public awareness.

C. Build risk assessment capacity and increase communication and coordination between government and private sector experts to determine and recommend ways to mitigate critical vulnerabilities in our infrastructure and manufacturing base.

In February 2011, Washington was abuzz regarding the need for a National Intelligence Estimate (NIE) on the state of American manufacturing. The impetus for such an effort was a growing concern over the security impacts corresponding to the loss of U.S. domestic manufacturing capacity and ever increasing dependence on foreign suppliers of critical industrial components, materials and technologies. As summed up in an article in *Forbes*, "So the fact that the nation's top intelligence official thinks a National Intelligence Estimate is needed for manufacturing isn't a good sign. It suggests that America's industrial decline is approaching a crisis."[109] In this sense, the call for a NIE represents an important notion, but it also should be regarded as only the first step in exploring an important new national capacity.

Understanding where our key vulnerabilities exist and addressing them in an informed way are vital components of our national security, economic competitiveness and catastrophic disaster preparedness capacity across the spectrum of prevention, protection, response and recovery. Vulnerabilities inherent within our critical infrastructures and domestic manufacturing base stem from a combination of many interrelated

factors. Foremost among these are the dependencies, interdependencies and single-points-of-failure associated with our complex, interwoven domestic and international supply chains. Identifying and mitigating these ever-expanding, interlinked vulnerabilities requires a sophisticated public-private risk analysis and decision making capability tied to our infrastructure and domestic manufacturing revitalization plans and programs at all levels—national, state, local, and by sector. Such capacity is critical in allowing us to more effectively deal with the complicated problems that we face today as well as the even more troubling potential scenarios that the future portends.

Building this risk assessment capacity will require close coordination between government, industry, science and technology community, think tanks and academia at all levels. This cooperation is essential as risk data, infrastructure data and mitigation data reside within and cut across each of these different communities. Achieving the capacity to analyze and visualize this data, create realistic models and simulations to help pinpoint key vulnerabilities—particularly as they relate to domestic and international supply chains—and recommend viable, cost-effective mitigation solutions also calls for such collaboration. Moreover, prioritizing and putting recommended solutions into practice will be a responsibility shared by many different stakeholders across the nation.

As a key component of our strategic infrastructure and domestic manufacturing revitalization plans—beginning at the national level—our "end-game" risk assessment capacity must be able to provide answers to the following questions:

- What are our most critical infrastructure nodes and systems and domestic manufacturing capacities?
- What are the most significant vulnerabilities faced by these critical infrastructure nodes/systems, the population centers they service and the domestic manufacturing capacity that supports them?
- What are the most likely and/or consequential threats/hazards they face in combination?
- What are the likely first, second and third order impacts of service or manufacturing supply chain disruptions with respect to our most at-risk infrastructure systems and population centers?
- What are the key dependencies/interdependencies and global supply chain issues associated with our most critical infrastructure nodes/systems, the population centers they service and the domestic manufacturing capacity that supports them?
- How and where should we bolster our domestic manufacturing capacity to mitigate risk to our critical infrastructures and population centers and enable an effective, efficient response to catastrophic disasters that we are unable to prevent or avoid?
- How will the future risk environment and ever-evolving nature of our interdependent critical infrastructure systems and consumer needs affect our approach to catastrophic disaster preparedness in 10-20 years?
- What investments should we be making now and in what priority to ensure that we are prepared for the world the future will most likely bring?

Having the ability to develop comprehensive answers to questions such as those posed above is critical to our national security, economic stability and catastrophic disaster preparedness—now and in the future. Disaster mitigation and response and recovery plans at all levels of government and the private sector should be evaluated and adjusted to account for supply chain vulnerabilities highlighted through the risk assessment process. The Administration and Congress must act now and in cooperation with one another to lay the groundwork for the future through focused legislation and policy, with an eye toward appropriate incentives to spur public-private collaboration in this area. The March 2012 Executive Order on National Defense Resources Preparedness—with its focus on strengthening the domestic industrial and technological base to meet urgent requirements in both times of peace and during national emergencies—is an important step in this direction.[110]

D. Adopt new laws and policies and otherwise incentivize the revitalization of domestic manufacturing, building capacity to meet surge demand to rebuild America's infrastructure and enable "all-hazards" catastrophic emergency response and recovery.

As we proceed with the massive undertaking discussed above, we should not miss an important opportunity to revitalize the domestic manufacturing sector as we rebuild America's decaying infrastructure base. Adherence to domestic content preference should be our guiding theme in this effort, rejuvenating lost capacity, providing jobs to America's work force and ensuring that quality materials, products and technologies are used in infrastructure recapitalization. There are undoubtedly a few areas where Congress may require the use of domestic manufactured materials to preserve a unique defense production capability and the attendant labor skill sets and technologies critical to surge production. The Domestic Sourcing Restriction on Specialty Metals is a good example where Congress acted to ensure the long term survival of a critical capacity, essential to our national security. We should maximize the power of federal procurement funds, especially in light of a high federal budget deficit, to promote domestic sourcing through strengthening and expanding the application of domestic content preferences, all in compliance with our international obligations. Passage of the highway transportation bill by Congress in July 2012 will continue infrastructure project funding at current levels for two years and initiate needed reforms such as expediting projects destroyed by a disaster. While this action is encouraging, US infrastructure requires continued investment beyond this two year cycle.

Next, Congress and the Administration should also pursue policies and legislation that support direct investment—domestic or foreign—in America's industrial base. Similarly, Congress and the Administration should ensure that policies and regulations do not unduly discriminate or otherwise create a disproportionate disadvantage for U.S. manufacturers.

We should maximize the power of federal procurement funds, especially in light of a high federal budget deficit, to promote domestic sourcing through strengthening and expanding the application of domestic content preferences, all in compliance with our international obligations.

Additionally, priority should be given to restructure our capital markets so that those manufacturers who invest in the equipment, facilities and training to make American labor more productive have better access to the credit they need to do so. Sound policy in these areas is essential to creating the impetus required to provide viable alternatives to the critical offshore dependencies and supply chains that ultimately weaken our national security and limit our options in the context of catastrophic disaster response and recovery.

Next, government must approach our national infrastructure recapitalization effort with the private sector as a full and equal partner, with many important shared roles and responsibilities—including the establishment of investment priorities—as well as accountability for outcomes and progress. Importantly, the public and private sectors must also share responsibility in funding this nationally critical effort. Consideration of a range of general and sector-specific incentives—including tax credits, low-cost loans, R&D burdensharing, etc.—to spur private investment in the rehabilitation and modernization of those infrastructures critical to our national and economic security is in order, where appropriate. This is particularly essential in those instances in which the market is currently not leading to such investments. The president's emphasis on a revitalized domestic manufacturing base in his 2012 State of the Union address—particularly in regard to restructuring U.S. tax codes to reward investment in domestic capacity and deter the outsourcing of American manufacturing jobs—reinforces this important notion.

The 2010 National Security Strategy offers some additional supportive language in this regard:

> "The private sector, which owns and operates most of the nation's critical infrastructure, plays a vital role in preparing for and recovering from disasters. We must, therefore, strengthen public-private partnerships by developing incentives for government and the private sector to design structures and systems that can withstand disruptions and mitigate associated consequences, ensure redundant systems where necessary to maintain the ability to operate, decentralize critical operations to reduce our vulnerability to single points of disruption, develop and test continuity plans to ensure the ability to restore critical capabilities, and invest in improvements and maintenance of existing infrastructure."[111]

It's time to put these words to the test and develop a range of incentives appropriate to the task at hand.

E. Ensure market access and encourage mutually beneficial market liberalization strategies, while ensuring that the trade policies of foreign competitors are consistent with international rules as stipulated in WTO agreements.

The long-term solvency of our domestic manufacturing sector is dependent on its continued ability to remain competitive in an open global market place. Unfortunately, our domestic manufacturing capacity continues to suffer because of the fact that, simply put, international trade and market competition oftentimes are neither "free" nor "fair." Increasingly, many nations fail to abide by the rules of free trade, including those established by the WTO and agreed to by its member countries. Because of this situation, U.S. manufacturers oftentimes find themselves on the wrong side of inappropriate foreign government interventions and anti-free trade foreign competition. Such unfair competition may take several forms, including massive government subsidies, currency manipulation, dumping, high overseas tariffs on U.S. goods and other non-tariff barriers to free trade. The Administration and Congress, while encouraging mutually beneficial market liberalization strategies, must enforce trade and intellectual property laws and demand the consistent enforcement of free trade principles on the part of our trading partners around the world as stipulated in WTO or other trade agreements. They must also call on other governments to refrain from unfairly subsidizing domestic capacity that will jeopardize our commercial markets and, hence, the long-term solvency of our domestic manufacturing base. Not doing so will continue the downward trend in vital domestic manufacturing and push more and more critical capacity offshore.[112] Accordingly, the president's announcement in his 2012 State of the Union address of the creation of a Trade Enforcement Unit to investigate unfair trading practices in countries like China and "level the playing field" is most welcome news.[113]

Within this issue set, it is also extremely important that U.S. national and economic security not be crippled by overextended dependencies on off-shore sources of products, materials and technologies, particularly in the context of national security or preparedness for catastrophic disasters. In this light, U.S. economic and trade policy vis-à-vis competitor nations must take into consideration impacts to our domestic manufacturing capacity and the security and preparedness impacts of allowing U.S. industries to suffer the effects of foreign government manufacturing policies that provide unfair advantages in the U.S. market.

F. Promote aggressive public-private analytic, research and development and technological advancement in domestic manufacturing.

The dynamic nature of the challenges we face in the 21st century risk environment calls for innovative, adaptive and cost-effective approaches to risk management—including catastrophic disaster prevention, protection, response and recovery capacity—at the national level. The foundation for such approaches must include strong analytical, R&D and technology components as we build out and implement our vision for infrastructure revitalization and enhance domestic manufacturing capacity into the future. If we do it properly, such components can serve as core enablers in helping shape requirements, inform strategic decision-making, target prioritized investments, measure

effectiveness and efficiency and adjust our infrastructure and domestic manufacturing strategic recapitalization plans as necessary over time. They can also help ensure that we build in security and resilience into new investments as a forethought—not an afterthought—and that each investment helps buy down national risk appropriately and in a cost-effective way. Most importantly, according to Mitchell Erickson of DHS' S&T Directorate, a robust focus on analytics, R&D and technology "can contribute to shaping our blueprint by instilling scientific rigor into the process that will shape our future."[114]

Tying robust analytics, R&D and technologies into our strategic vision and plan for the renewal of our infrastructure and domestic manufacturing base presents numerous advantages. Taken in concert, these "enablers" can provide enhanced capabilities to design smart, state-of-the-art and cost-effective manufacturing processes and end products; augment our understanding of complex existing and future infrastructure risks and interdependencies; mitigate systemic vulnerabilities; inform realistic appraisals of infrastructure life-cycle sustainment costs; and, monitor infrastructure condition and performance over time.[115] They can also help forge a dynamic strategic linkage between infrastructure and domestic manufacturing revitalization, with an eye towards enhancing national security while promoting economic competitiveness through innovative and cost-effective solutions. This strategic linkage is vital in getting America on the correct path to the future.

To move forward in this area, government and industry must partner together at all levels to make the case for an integrated, "analytics-technologies-R&D" driven approach to the renewal of America's infrastructure and domestic manufacturing base. The White House and senior industry leaders should join forces to lead this effort, ensuring that this approach takes root at the strategic level as part of our national R&D and technology agenda with a clear path to grassroots engagement nationwide. This national engagement should also be focused on the rapid, sector-wide adoption of new technologies, innovative product concepts and designs and operational and management best-practices.[116] This effort should focus in areas in which the private sector is unable or unlikely to "go it alone," particularly regarding basic research and advanced R&D projects without near term commercial application. Such an approach could lead to the realization of huge synergies, as illustrated by ongoing government-industry collaboration in this sphere. For example, the DoD and numerous domestic steel manufacturers participate in regular joint R&D activities that have led to important breakthroughs in metals technology for both military and commercial applications.[117] Another example is the Specialty Metals Processing Consortium, a partnership between industry and Sandia Laboratories designed to improve the quality of steel ingots to enhance the competitiveness of U.S. industry while maintaining high quality suppliers to the Department of Energy Nuclear Weapons Complex.[118]

To advance these measures, further work on the part of the National Science and Technology Council, National Research Council of the National Academies, national science agencies and laboratories, homeland security centers of excellence, DoD R&D entities, academia, private research foundations and industry is also warranted. At a strategic level, this type of collaboration could help spur a focused, yet distributed "knowledge and technology integration capability" coupling public and private sector thought leadership and analytical capacity to help solve existing problems, serve as a catalyst for best-practices and help us get ahead of future challenges.[119] The U.S. Congress can also play an important role in this area, providing for new legislation including multiple types of incentives—including permanent tax credits and anti-trust waivers—for public-private analytical, technology and R&D collaboration and shared investment in pre-competitive technology as appropriate.

This "analytics-technologies-R&D" approach should serve as a specific core focus area of our national vision and strategic plan for infrastructure recapitalization and a revitalized domestic manufacturing sector. In this regard, the Administration's pledge to "develop a strategy for coordinating the Federal government's investments in research with the goal of establishing U.S. leadership in advanced manufacturing technologies" holds considerable promise.[120] Initial focus areas included in this effort are nanomanufacturing, advanced robotics and the integration of manufactured goods and cyber technology to create highly adaptable, autonomous, efficient and safe production processes.[121]

G. Invest in America's workforce to ensure that domestic producers have access to highly-qualified and skilled labor.

The skills of our critical manufacturing work force directly impact sector productivity and competitiveness. It is critical that our educational and technical training systems hone the skills necessary to posture the manufacturing sector workforce for success. As noted in the White House's *Framework for Revitalizing American Manufacturing*, "New manufacturing process technologies, advanced materials, the demand for new and innovative products and the growing need for manufacturers to utilize sustainable and green business practices all require a manufacturing workforce with an increasingly advanced set of skills and competencies."[122] In short, the American workforce must once again become among the best trained and educated in the world.

As noted by Professor James Jacobs of Macomb Community College, "Twenty years ago, training and education of manufacturing workers was considered to be a pillar of global economic power. Yet…attention to improving the technical and management skills of workers has largely disappeared."[123] Progress in this area will require a variety of improvements in our general education system—including championing a restructuring of secondary school "vocational education" curricula, investment in community colleges offering specialized training in manufacturing skills and a renewed focus on math and science at all educational levels—as well as the development and enhancement of technically-focused worker training programs. Both the public and private sectors need to support investment in high-quality job training, including specific discipline-or trade- focused technical training, training on new technologies, professional development and management training, training programs for unemployed workers and training and mentoring in entrepreneurship.[124]

…the American workforce must once again become the best trained and educated in the world.

The need for workforce education and training must be firmly established as a priority component of the national vision and strategy for revitalizing domestic manufacturing. Much of the focus of workforce education and training should be directed towards innovative small- and medium-sized companies owned by local entrepreneurs and tied to local communities across the country "where the rubber meets the road." Federal involvement in this effort is critical, with vital "seed" resources applied along the lines of National Institute for Standards and Technology's (NIST) Manufacturing Extension Partnership.[125] Increased State government and private sector resourcing is also vital, channeled through activities such as sponsorship of community college courses providing specialized training in manufacturing skills, management development, business best practices and technology innovation.[126] Progress has been made recently in this area via an initiative in which 30 states, with Federal government and industry backing, are developing a nationally recognized credentialing system for community college students and employers across manufacturing sectors.[127] On the private side, more focus is required on the creation of on-the-job learning systems and the reinvigoration of apprenticeship training programs, particularly those focusing on information technology. Partnerships between technology and software providers and manufacturers could spur the funding and technical knowledge necessary to support such efforts.

VI CONCLUSION: THE FUTURE OF AMERICAN MANUFACTURING AND NATIONAL SECURITY, ECONOMIC SECURITY AND PREPAREDNESS

"The majestic steel beams of a soaring office tower beginning to rise from the ruins of the World Trade Center are a tribute to American resilience, but also a marker in the decline of yet another industry. Not an inch of imported glass went into the two lost towers, built 40 years ago. The lower floors of the new one will soon be sheathed in Chinese glass." Louis Uchitelle, *"Glassmaking Thrives Offshore but Is Declining in U.S.,"* *The New York Times*, January 19, 2010.

As clearly highlighted in this report, today's world grows increasing complex, interconnected and dangerous. We face an ever more challenging array of threats—both manmade and naturally occurring—and vulnerabilities, that, when taken in combination, are capable of producing unprecedented impacts and distortions from a public health, economic and national security perspective. Our growing dependence on critical concentrations of global suppliers and just-in-time global supply chains—whose reliability and resilience are not "givens"—compounds this dilemma in the context of a number of high-risk scenarios.

To successfully navigate our way through this 21st century risk environment, we must avail ourselves of creative and adaptive solutions on many fronts. One of these prospective solutions—*rebuilding our dilapidated infrastructure base and reestablishing a strong, diversified domestic manufacturing capacity*—seems intuitively obvious. Common sense dictates that in an interconnected world of uncertainty and danger in which one blip anywhere can have potentially serious and instantaneous consequences elsewhere across the entire system, we must maintain a core internal capacity ready to meet critical needs. Unfortunately, common sense has not prevailed in the situation in which we now find ourselves.

In a world in which the "500-year" event is occurring with increasing frequency across a wide range of threats and hazards, we can no longer rely on global suppliers—many of whom may not have our best interests at heart in a time of crisis—and a highly complex and vulnerable global supply chain to bolster our weak points or come to our rescue in the midst of an emergency.

The American way of life is dependent upon a vibrant economy, the existence of which is based upon a skilled work force, innovation and a world class critical infrastructure. Much of this critical infrastructure is vulnerable to attack, catastrophic weather events and obsolescence and deterioration. Immediate national security, preparedness and economic needs require an equally strong domestic manufacturing base which, for many reasons, has eroded over the years. In a world in which the "500-year" event is occurring with increasing frequency across a wide range of threats and hazards, we can no longer rely on global suppliers—many of whom may not have our best interests at heart in a time of crisis—and a highly complex and vulnerable global supply chain to bolster our weak points or come to our rescue in the midst of an emergency.

It is not too late for us to begin to reverse the deterioration of the core domestic manufacturing capacity that has served us so well throughout our history during times of international crisis and domestic need. We must, however, be cognizant of the fact that time is not on our side, as we lose more capacity each passing day. Now is the time for government and the private sector at all levels to consider the recommendations provided in this report—beginning with the development of a comprehensive vision and strategy and promoting national awareness for capital infrastructure and domestic manufacturing investment and revitalization. The totality of this effort will prove no small feat and will require the active engagement and cooperation between the senior leadership of the Executive Branch, Congress, State and local governments and industry. It will also require the adoption of the right mix of creative, forward-thinking laws and policies to push action, assign accountability and enable the measurement of progress. Further, it will require bold action to modify the behaviors of those international actors who choose not to play by the established rules of the international free trade system—a primary factor in the untenable position we find ourselves in today regarding core manufacturing capacity.

History has shown time and time again that Americans have never failed to realize and execute our responsibilities in meeting a rising threat or complex international challenge. The 21st century risk environment poses perhaps the most significant set of challenges we have yet had to face. It is time once again to step up to the plate and leverage our core strengths as a nation—our people, our productive capacity, and our ability to innovate and out-think the threat—to get back on the right track. To do otherwise is to dangerously place our national and economic security and national preparedness in the hands of others.

Endnotes

1 Miller, Robert A., and Lachow, Irving. *"Strategic Fragility: Infrastructure Protection and National Security in the Information Age,"* in *Defense Horizons*, Center for Technology and National Security Policy, National Defense University, January 2008, page 1.

2 U.S. Department of Homeland Security. *Quadrennial Homeland Security Review Report; A Strategic Framework for a Secure Homeland*, February 2010, page vii.

3 Ibid., page 5.

4 Ibid., page 7.

5 Parfomak, Paul W. *"Vulnerability of Concentrated Critical Infrastructure,"* in *Congressional Research Service Report for Congress*, September 12, 2008, page i.

6 Miller, Robert A., and Lachow, Irving. *"Strategic Fragility: Infrastructure Protection and National Security in the Information Age,"* in *Defense Horizons*, Center for Technology and National Security Policy, National Defense University, January 2008, page 3.

7 Parfomak, Paul W. *"Vulnerability of Concentrated Critical Infrastructure,"* in *Congressional Research Service Report for Congress*, September 12, 2008, pages 4-5.

8 California Seismic Safety Commission. *"The Tsunami Threat to California,"* CSSC 05-03, December 2005, page 6.

9 Miller, Robert A., and Lachow, Irving. *"Strategic Fragility: Infrastructure Protection and National Security in the Information Age,"* in *Defense Horizons*, Center for Technology and National Security Policy, National Defense University, January 2008, page 3.

10 *"Special Report: The Infrastructure."* *Civil Engineering*, January 2008, page 3.

11 American Society of Civil Engineers. *"2009 Report Card for America's Infrastructure,"* March 2009, page 2.

12 Ibid., page 1.

13 Stephan, Robert B. *"Fixing the Nation's Infrastructure,"* in *The Washington Times*, March 22, 2009.

14 *"Special Report: The Infrastructure,"* *Civil Engineering*, January 2008, page 6.

15 Toffler Associates. *"Guarding our Future: Protecting our Nation's Infrastructure,"* 2008, page 16.

16 U.S. Department of Defense. *Quadrennial Defense Review Report*, February 2010, page 31.

17 Ibid.

18 Guihou, Xavier, Lagadec, Patrick, and Lagadec, Erwan. "Non-Conventional Crises and Critical Infrastructure: Katrina," EDF Risk Management Division, February-March 2006, page 10.

19 Ibid., page 11.

20 The White House, *"The Federal Response to Hurricane Katrina: Lessons Learned,"* February 2006, page 2.

21 Ibid., pages 2-3.

22 Ibid.

23 Ibid.

24 The White House. *"The Federal Response to Hurricane Katrina: Lessons Learned,"* February 2006, pages 8-9.

25 Ibid.

26 Ibid.

27 Office of Electricity Delivery and Reliability, U.S. Department of Energy. *"Hurricane Katrina Situation Report #42,"* September 23, 2005.

28 Office of Electricity Delivery and Reliability, U.S. Department of Energy. *"Comparing the Impacts of the 2005 and 2008 Hurricanes on U.S. Energy Infrastructure,"* page 8.

29 Ibid.

30 Ibid.

31 Ibid., page 13.

32 Ibid., page 9.

33 Ibid.

34 Grenzeback, Lance R., and Lukmann, Andrew T. *"Case Study of the Transportation Sector's Response to and Recovery from Hurricanes Katrina and Rita,"* Cambridge Systematics, Inc.

35 The Heritage Foundation. "The Great Eastern Japan Earthquake: Assessing Disaster Response and Lessons Learned for the United States," SR-94, May 25, 2011, page 2.

36 Ibid.

37 Center for Naval Analysis. "Altered Landscapes of Catastrophes: Insights from the Great East Japan Earthquake," April 26, 2011, page 85.

38 Ibid., page 100.

39 Ibid., page 94.

40 Ibid., page 103.

41 Ibid., page 92.

42 Ibid., page 93.

43 Ibid.

44 Ibid., page 107.

45 Fukue, Natsuko. "3/11: A Lesson in Hospital Vulnerability," *The Japan Times*, October 1, 2011.

46 Center for Naval Analysis. "Altered Landscapes of Catastrophes: Insights from the Great East Japan Earthquake," April 26, 2011, page 119.

47 WorldSteel Association. *"Steel and the National Defense,"* January 2007, page 1.

48 Horn, John, Volkert Construction Services. *"HPC for the I-10 Bridges in Louisiana,"* *HPC Bridge Views*, Issue 62, July/August 2010.

49 Ibid.

50 Ibid.

51 WorldSteel Association. *"Steel and the National Defense,"* January 2007, page 3.

52 Thompson, Loren. *"Intelligence Community Fears U.S. Manufacturing Decline,"* *Forbes*, February 14, 2011.

53 Reuters. *"U.S. Panel Oks Steep Duties on Chinese Aluminum Goods,"* April 28, 2011.

54 WorldSteel Association. *"Steel and the National Defense,"* January 2007, page 7.

55 Alliance for American Manufacturing Blog Site. *"Deceitful Chinese Bid for Oakland Bay Bridge Hurts California,"* July 18, 2011.

56 Hilkevitch, John. "New CTA Train Cars Had Serious Flaw," *The Chicago Tribune, March 8, 2012.*

57 The Associated Press. *"Hurricane Katrina Victims Who Rebuilt with Chinese Drywall Face Problems," New York Daily News*, April 12, 2009.

58 Kessler, Aaron. *"Katrina Survivors Battle a New Foe: Chinese Drywall," Herald Tribune*, December 27, 2009.

59 Ibid.

60 McCormack, Richard. *"The Plight of American Manufacturing," BusinessWeek*, December 21, 2009.

61 Atkinson, Robert D.; Stewart, Luke A.; Andres, Scott M.; Ezell, Stephen J. *"Worse than the Great Depression: What Experts Are Missing About American Manufacturing Decline,"* The Information Technology and Innovation Foundation, March 2012, page 3.

62 Morley, Robert. *"The Death of American Manufacturing,"* www.trumpet.com, February 2006.

63 Atkinson, Robert D.; Stewart, Luke A.; Andres, Scott M.; Ezell, Stephen J. *"Worse than the Great Depression: What Experts Are Missing About American Manufacturing Decline,"* The Information Technology and Innovation Foundation, March 2012, page 20.

64 Ibid., page 5.

65 McCormack, Richard. *"The Plight of American Manufacturing," BusinessWeek*, December 21, 2009.

66 Atkinson, Robert D.; Stewart, Luke A.; Andres, Scott M.; Ezell, Stephen J. *"Worse than the Great Depression: What Experts Are Missing About American Manufacturing Decline,"* The Information Technology and Innovation Foundation, March 2012, page 3.

67 Ibid., page 4.

68 McCormack, Richard. *"The Plight of American Manufacturing," BusinessWeek*, December 21, 2009.

69 Ibid.

70 Ibid.

71 Ibid.

72 United States Geological Survey. Mineral Commodity Studies, January 2011.

73 Ibid.

74 U.S.-China Economic and Security Review Commission 2008 Annual Report, page 184.

75 McCormack, Richard. *"The Plight of American Manufacturing," BusinessWeek*, December 21, 2009.

76 The Folk Group, *"State of the Metal Casting Industry by Country,"* www.folkgroup.com, 2011.

77 McCormack, Richard. *"The Plight of American Manufacturing," BusinessWeek*, December 21, 2009.

78 Thompson, Lauren. *"Intelligence Community Fears U.S. Manufacturing Decline," Forbes*, February 14, 2011.

79 Engardio, Pete. *"Can the Future Be Built in America?" Bloomberg BusinessWeek*, September 10, 2009.

80 The White House. *"A Framework for Revitalizing American Manufacturing,"* December 2009, page 10.

81 Economic Policy Institute Report. http://www.epi.org/publication/growing-trade-deficit-china-cost-2-8-million/.

82 McCormack, Richard. "The Plight of American Manufacturing," *BusinessWeek*, December 21, 2009.

83 Bush, Haydn. *"Reliance on Overseas Manufacturers Worries Supply Chain Experts," Hospital and Health Networks Journal*, July 2011.

84 Ibid.

85 Yudken, Joel S. "Manufacturing Insecurity: America's Manufacturing Crisis and the Erosion of the U.S. Defense Industrial Base," September 2010, page 1.

86 Ibid., page 7.

87 Ibid., page 2.

88 Ibid.

89 WorldSteel Association. *"Steel and the National Defense,"* January 2007, Appendix 3, page 4.

90 Ibid., page 5.

91 Ibid., page 6.

92 Ibid., page 7.

93 WorldSteel Association. "*World Steel in Figures,"* 2011, pages 14-15.

94 Ibid.

95 Copeland, Claudia. *"Terrorism and Security Issues Facing the Water Infrastructure Sector,"* Congressional Research Service, RL32189, December 15, 2010, page 4.

96 Ibid.

97 American Society of Civil Engineers. *"2009 Report Card for America's Infrastructure,"* March 2009.

98 Ibid.

99 U.S. International Trade Commission. *"Certain Ductile Ironworks Fittings from China,"* Investigation No. TA-421-4, December 2003, page 5.

100 Ibid., page 3.

101 Congressional Research Service. *"Waivers of the "Buy American" Requirements in the American Recovery and Reinvestment Act,"* Memorandum, August 10, 2011.

102 North American Electric Reliability Corporation. *"High-Impact, Low-Frequency Event Risk Impact to the North American Bulk Power System,"* June 2010, page 1.

103 Defense Science Board. "*Report of the Defense Science Board (DSB) Task Force on DoD Energy Strategy,"* February 2008.

104 North American Electric Reliability Corporation. *"High-Impact, Low-Frequency Event Risk Impact to the North American Bulk Power System,"* June 2010, page 12.

105 Ibid.

106 Ibid., page 37.

107 Ibid., page 14.

108 Ibid.

109 Thompson, Lauren. *"Intelligence Community Fears U.S. Manufacturing Decline," Forbes*, February 14, 2011.

110 http://www.whitehouse.gov/the-press-office/2012/03/16/executive-order-national -defense-resource-preparedness.

111 The White House. *National Security Strategy*, 2010, page 26.

112 WorldSteel Association. "*Steel and the National Defense,*" January 2007, page 6.

113 http://www.whitehouse.gov/the-press-office/2012/01/24/remarks-president-state-union-address.

114 Erickson, Mitchell D. PhD. *"A Bridge to Prosperity: Resilient Infrastructure Makes a Resilient Nation," Proceedings of the Aging Infrastructure Workshop*, July 21-23, 2009, Columbia University, New York, page 1.

115 National Research Council of the National Academies. *"Sustainable Critical Infrastructure Systems—A Framework for Meeting 21st Century Imperatives,"* Washington, D.C., 2009, page S-3.

116 The White House. *"A Framework for Revitalizing American Manufacturing,"* December 2009, page 18.

117 WorldSteel Association. "*Steel and the National Defense*," January 2007, page 5.

118 Ibid.

119 Toffler Associates. *"Guarding our Future: Protecting our Nation's Infrastructure,"* 2008, page 38.

120 The White House. *"A Framework for Revitalizing American Manufacturing,"* December 2009, page 15.

121 Ibid, pages 15-16.

122 Ibid., page 12.

123 Jacobs, James. *"The Diminished Role of Training and Education in Manufacturing and the Imperative for Change,"* In *Manufacturing a Better Future for America*, Alliance for American Manufacturing, Washington, D.C., 2009, page 217.

124 The White House. *"A Framework for Revitalizing American Manufacturing,"* December 2009, page 13.

125 Jacobs, James. *"The Diminished Role of Training and Education in Manufacturing and the Imperative for Change,"* In *Manufacturing a Better Future for America*, Alliance for American Manufacturing, Washington, D.C., 2009, page 237.

126 Ibid., page 239.

127 Olson, Elizabeth G. *"How to Train U.S. Workers Back into Manufacturing Jobs,"* June 29, 2011.

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The Alliance for American Manufacturing is a non-profit, non-partisan partnership formed in 2007 by some of America's leading manufacturers and the United Steelworkers to explore common solutions to challenging public policy topics such as job creation, infrastructure investment, international trade, and global competitiveness.

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