# Climate 1AC

#### Observation One: Current efforts to protect transportation infrastructure from climate change are inadequate.

#### **Ongoing climate change threatens the entire foundation of transportation infrastructure**

Transportation Research Board of the National Academies ’11 [Transportation Research Board, “ Adapting Transportation to the Impacts of Climate Change”, June 2011, Transportation Research Circular, E-C152, <http://www.trb.org/Publications/Blurbs/165529.aspx> AD]

**The transportation planners, designers, and operators of this nation’s transportation systems face many** daunting concerns**, not the least of which is funding to maintain and improve the country’s infrastructure and competitiveness. To these concerns is now added climate change or global warming**. This paper does not address the science of climate change or the issue of mitigation to reduce the emissions of greenhouse gases (GHG). Rather it accepts the current state of knowledge on global warming and focuses on adaptation. How does the transportation community develop solutions and approaches that will minimize or eliminate the impact of climate change? To many, this question is a paramount one as the nation builds, rebuilds, operates, and maintains its transportation infrastructure. Even if there are major strides in the mitigation of GHG emissions, the world very likely will be facing a significantly altered climate in coming decades with impacts that test our current ability to forecast accurately. Nonetheless, one can develop scenarios of probable impacts and how the United States might adapt to conditions that could occur 25 to 50 years hence. While most of these scenarios deal with transportation, a few others are included to demonstrate the breadth of the impacts. • Rising sea levels **will place** people, homes, businesses, and **infrastructure at risk**, especially along the Atlantic and Gulf Coasts and Alaska. Coupled with land subsidence, prevalent in many areas such as the Gulf Coast, the impacts will be felt tens of miles inland. More intense hurricanes packing higher wind speeds coming on shore on higher sea levels **are a recipe for even greater disaster**. Efforts to restore barrier islands to protect the mainland will be extensive and expensive. Sea walls along miles of shoreline may protect densely populated areas, but relocation inland of some communities may well be necessary. Transportation systems must be designed to permit faster and orderly evacuation of coastal communities. Are there new structural and nonstructural solutions to these problems? Can more resilient systems be developed that can withstand a certain amount of inundation during high storm surges, but restore service and utility rapidly? • Heat will be a growing concern throughout much of the United States. Warmer temperatures and longer heat waves will create demand for more air conditioning, even in northern latitudes such as New England. By the end of the century, the climate in Illinois is forecast to be like Texas today. Sustained higher temperatures will stress pavement materials, bridge structures, and rails. The impact of prolonged heat waves will impact the most vulnerable of our population, the poor, the elderly, and the very young. With rising temperatures will come greater desertification and drought, particularly in the southwest. Water scarcity, already an issue in those regions, will necessitate changes in water laws and interstate compacts. Lower air densities will reduce aircraft takeoff payloads and require longer runways. • Water levels in the Great Lakes will drop, impacting shipping through the Saint Lawrence Seaway, but elsewhere higher temperatures of inland waterways and the Arctic will lengthen the shipping season. Power plant efficiencies will decrease absent new T Schwartz 3 technologies to improve heat transfer systems. Construction and other outside work will increasingly be performed in evening and nighttime hours to protect workers’ health. Are there more effective ways to protect the most vulnerable from the impacts of heat waves? Can more heat resistant materials be developed with which to pave our highways and build our infrastructure? Can new developments in aerodynamic design improve aircraft liftoff capacities? • With the shift in temperatures, there will be a concomitant migration of plant, insect, and disease vectors northward in the United States. The unprecedented infestation by the log pole pine beetle in the Rocky Mountains and the spruce beetle in Alaska will have eliminated those native trees, [create] a tinderbox for forest fires. As amply demonstrated in California, Florida, and Colorado, such fires directly impact transportation visibility and are invariably followed by rainstorms generating mudslides that destroy rail lines and highways. Crops once confined to southern climes will now be grown farther north, and the growing season may well permit two harvests per year in new locales. Conversely, drought and water reallocations may change the crops grown in some of the nation’s most productive regions such as the southwest. Weeds and other invasive plant species will rapidly move northward as will disease vectors thereby placing larger populations at risk. It is likely that natural mutations of some of these diseases will create new problems. Plant science will be particularly challenged to arrest some of these migrations as will the health sciences. On a positive note, warmer winters may well reduce the need for and cost of snow and ice removal while improving vehicle safety. • Increased intensity of precipitation in many parts of the continental United States and perhaps Alaska will place new stresses on the environment. Rainfall frequency– duration profiles will have changed very significantly: more frequent, heavier storms. Culverts, stormwater **drainage systems**, and natural drainage basins **will all experience overloads with the increase in heavy rainfall. Infrastructure, such as bridges, levees, and dikes, will have to be designed to withstand greater hydraulic loads**. Hydrological analyses will be revised, flood plains redefined, and new engineering standards developed. Social and environmental questions must be addressed as the nation wrestles with the entire issue of sustainable development especially in coastal communities. See the sidebar (page 10), which graphically shows effects of increased precipitation. • Alaska is a special case as temperatures are expected to rise much more rapidly in far northern regions. The Arctic ice sheet will retreat even farther, opening the Northwest Passage to shipping but exposing the northern slope of Alaska to greater storm erosion. Many native villages will have to be relocated. Infrastructure built on permafrost will be endangered, necessitating new structural approaches and replacement. Cold weather roads will disappear, creating yet another challenge to accessing parts of Alaska by rail or road.

#### **Climate change is increasingly impacting transportation infrastructure-Now is the key time to develop adaptation strategies.**

Transportation Research Board of the National Academies ’11 [Transportation Research Board, “ Adapting Transportation to the Impacts of Climate Change”, June 2011, Transportation Research Circular, E-C152, <http://www.trb.org/Publications/Blurbs/165529.aspx> AD]

**In 2010, transportation** **agencies** in Tennessee, Rhode Island, and Iowa **saw** firsthand **the effect of extreme rainfall** events that brought severe flooding and a wide range of impacts to the transportation system. These effects are likely to be early signs of climate change. • March 2010: Rhode Island experienced record flooding due to intense rainfall, not just once but twice. The unprecedented rainfall forced closure of 98 roads and 20 bridges, including closure of critical parts of Interstate 95 for 36 hours. To avoid having to also close nearby I-295, Rhode Island Department of Transportation (DOT) used thousands of sandbags and pumper trucks from the Warwick Fire Department. Ten days after the worst rainfall, 15 roads and bridges were still closed despite heroic efforts by 150 Rhode Island DOT maintenance crews and 50 engineering crews working around the clock to get them open. • July–August 2010: In July, northeast Iowa saw torrential rainfall (as much as 9 in. in places) that pushed the Maquoketa River to 23.92 ft—more than 2 ft above its previous record of 21.66 ft in 2004. In August, intense waves of thunderstorms over 3 days fell on already-saturated ground and forced closure of I-35 northbound and southbound near Ames, Iowa, along with many other roadways. Just 2 years earlier, in 2008, Iowa experienced record Traffic on I-40, a major east–west corridor across the United States, halted in West Nashville, Tennessee, due to flood waters after heavy rainfall in May 2010. Burbank 11 levels of flooding that closed roads and damaged roads and bridges. Iowa DOT’s website carries sites that feature dozens of pictures of the impacts of the 2008 flooding and the 2010 flooding. • **May 2010**: On May 1–2, **rainfall in Nashville, Tennessee, was more than double the previous record** for a 2-day period—and the previous record was set during a hurricane. Forty-one counties suffered highway and bridge damage, including a large landslide that covered parts of US-70. In Maury Country, two sections of State Route 7 sank as much as 20 ft below its original elevation due to ground saturation and collapse of pavement. Multiple sinkholes emerged, including a large sinkhole in eastbound I-24 that was 25 ft wide and 25 ft deep, which emerged 2 weeks after the flooding. **Estimated impacts included 100 routes affected, $45 million in repair costs, and 83,000 state DOT maintenance hours to assess damage and recover.** Severe rainfall is one of the signs of climate change. Warmer temperatures put more moisture in the air and increase the probability of more severe precipitation—greater rainfall in short periods, occurring more often. Scientists and weather experts who track the climate are convinced that climate change is already happening, at a faster rate than climate models predicted a few years ago, and that many parts of the world will see this intensify over time. The 2010 experiences of transportation agencies in Iowa, Tennessee, and Rhode Island are likely to be repeated there and elsewhere in future years, making it important to begin climate adaptation planning now to evaluate the new vulnerabilities and risks associated with climate change, to develop plans for coping with these events, and to incorporate these risks into asset management and infrastructure design for the future.

#### Plan:

#### The United States Federal Government should increase its transportation infrastructure investment for climate adaptation including changes in design, construction, and maintenance of infrastructure.

#### Advantage \_\_ Economy

#### **Current recovery is fragile-long-term growth is uncertain**

The Guardian 6/26 (Ewen MacAskill and Dominic Rushe, “OECD Says US economy recovery but income equality problematic” June 26th, 2012, http://www.guardian.co.uk/business/2012/jun/26/oecd-us-economy-income-inequality)

The OECD report said that growth in the US will remain moderate this year but concludes that America's economic recovery has "gained momentum".¶ Consumer and business spending have risen and unemployment, though still high at 8.2%, has fallen nearly two percentage points from its peak in 2009.¶ "Even with these substantial improvements, however, the recovery is far from complete," the OECD warns. The US housing market has picked up but the large overhang of unsold homes and "the ongoing tide of foreclosures will continue to put downward pressure on house prices," according to the report.¶ Europe's economic crisis and the looming political fight over the expiration on 31 December expiration of Bush-era tax cuts and imposition of automatic spending cuts – also remain serious threats, the report warns.¶ It called on Congress to seek to trim government spending gradually rather than make drastic cuts at the end of this year, the so-called 'fiscal cliff' when $1.2tn in automatic spending cuts are due to kick in.¶ The slow pace of recovery in construction, normally an important source of growth following recessions, is also a worry, said the OECD. In addition, "uncertainty about the sustainability of the recovery has restrained business investment and slow growth in some trading partners has held back exports."¶

#### Climate change will unravel current transportation infrastructure networks-This will wreck the economy

Joanne R. Potter et al, March 2008, Michael J. Savonis, Virginia R. Burkett U.S. Climate Change Science Program Synthesis and Assessment Product 4.7 “Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: Gulf Coast Study, Phase I” <http://files.library.northwestern.edu.turing.library.northwestern.edu/transportation/online/restricted/200819/PB2008110533.pdf>

Transportation is such an integral part of daily life in the United States that few pause to consider its importance. Yet the Nation’s strong intermodal network of highways, public transit, rail, marine, and aviation is central to our ability to work, go to school, enjoy leisure time, maintain our homes, and stay in touch with friends and family. U.S. businesses depend on reliable transportation services to receive materials and transport products to their customers; a robust transportation network is essential to the economy. In short, a sound transportation system is vital to the Nation’s social and economic future. Transportation professionals – including planners, designers, engineers, financial specialists, ecologists, safety experts, and others – work hard to ensure that U.S. communities have access to safe and dependable transportation services. Given the ongoing importance of the Nation’s transportation system, it is appropriate to consider what effect climate change may have on this essential network. Through a regional case study of the central Gulf Coast, this report begins to examine the potential implications of climate change on transportation infrastructure, operations, and services. Investments in transportation are substantial and result in infrastructure that lasts for decades. Transportation plans and designs should, therefore, be carefully considered and well informed by a range of factors, including consideration of climate variability and change. Climate also affects the safety, operations, and maintenance of transportation infrastructure and systems. This research investigates the potential impacts of climate variability and change on transportation, and it assesses how planners and managers may incorporate this information into their decisions to ensure a reliable and robust future transportation network. This report does not contain recommendations about specific facilities or adaptation strategies, but rather seeks to contribute to the information available so that States and local communities can make more informed decisions when planning for the future.

The climate models used to estimate temperature changes agree that it will be warmer in the future. According to the IPCC report, global average warming is expected to be about 0.4°C (0.72°F) during the next 20 years. Even if the concentrations of all greenhouse gases and aerosols had been stabilized at 2000 levels, warming of 0.2°C (0.36°F) would be expected during this period (IPCC, 2007). Over the longer term, the IPCC models project average global temperature increases ranging from 1.1°C (1.98°F) to 6.4°C (11.5°F) by the end of the 21st century, although climate responses in specific regions will vary. These projections are the result of reviewing a robust set of global climate models under a variety of future scenarios – using a range of assumptions for future economic activity and energy use – for the Earth as a whole. The average increase in temperature may not be as important to the transportation community as the changes in extreme temperature, which also are expected to increase. Over the last 50 years, the frequency of cold days and nights has declined, while hot days, hot nights, and heat waves have become more frequent. The number of days with temperature above 32°C (90°F) and 38°C (100°F) has been increasing since 1970, as has the intensity and length of periods of drought. The IPCC report finds that it is virtually certain that the next century will witness warmer and more frequent hot days and nights over most land areas (IPCC, 2007). Increasing temperatures have the potential to affect multiple modes of transportation, primarily impacting surface transportation. The transportation impacts mentioned most often in the literature included pavement damage; rail buckling; less lift and fuel efficiency for aircraft; and the implications of lower inland water levels, thawing permafrost, reduced ice cover on seaways, and an increase in vegetation. These are discussed in greater detail below:

• Pavement damage – The quality of highway pavement was identified as a potential issue for temperate climates, where more extreme summer temperatures and/or more frequent freeze/thaw cycles may be experienced. Extremely hot days, over an extended period of time, could lead to the rutting of highway pavement and the more rapid breakdown of asphalt seal binders, resulting in cracking, potholing, and bleeding. This, in turn, could damage the structural integrity of the road and/or cause the pavement to become more slippery when wet. Adaptation measures mentioned included more frequent maintenance, milling out ruts, and the laying of more heat resistant asphalt.

• Rail buckling – Railroads could encounter rail buckling more frequently in temperate climates that experience extremely hot temperatures. If unnoticed, rail buckling can result in derailment of trains. Peterson (2008) noted, “Lower speeds and shorter trains, to shorten braking distance, and lighter loads to reduce track stress are operational impacts.” Adaptation measures included better monitoring of rail temperatures and ultimately more maintenance of the track, replacing it when needed.

• Vegetation growth – The growing season for deciduous trees that shed their leaves may be extended, causing more slipperiness on railroads and roads and visual obstructions. Possible adaptation measures included better management of the leaf foliage and planting more low-maintenance vegetation along transportation corridors to act as buffers (Wooler, 2004).

• Reductions in aircraft lift and efficiency – Higher temperatures would reduce air density, decreasing both lift and the engine efficiency of aircraft. As a result, longer runways and/or more powerful airplanes would be required. However, one analyst projected that technical advances would minimize the need for runway redesign as aircraft become more powerful and efficient (Wooler, 2004).

• Reduced water levels – Changes in water levels were discussed in relation to marine transport. Inland waterways such as the Great Lakes and Mississippi River could experience lower water levels due to increased temperatures and evaporation; these lower water levels would mean that ships and barges would not be able to carry as much weight. Adaptation measures included reducing cargo loads, designing vessels to require less draft, or dredging the water body to make it deeper.

• Reduced ice cover – Reduced ice cover was generally considered a positive impact of increasing temperatures in the literature. For example, a study conducted by John D. Lindeberg and George M. Albercook, which was included in the Report of the Great Lakes Regional Assessment Group for the U.S. Global Change Research Program, stated, “the costs of additional dredging [due to lower water levels] could be partially mitigated by the benefits of additional shipping days on the [Great] Lakes caused by less persistent ice cover” (Sousounis, 2000, p. 41). Additionally, arctic sea passages could open; for example, the Arctic Climate Impact Assessment noted, “projected reductions in sea-ice extent are likely to improve access along the Northern Sea Route and the Northwest Passage” (Instanes et al., 2005, p. 934). However, negative environmental and security impacts also may result from reduced ice cover as well from as the increased level of shipping. These are discussed below in the subsection on indirect impacts (Section 1.3.6.).

• Thawing permafrost – The implications of thawing permafrost for Arctic infrastructure receive considerable attention in the literature. Permafrost is the foundation upon which much of the Arctic’s infrastructure is built. The literature consistently noted that as the permafrost thaws the infrastructure will become unstable – an effect being experienced today. Roads, railways, and airstrips are all vulnerable to the thawing of permafrost. Adaptation measures vary depending on the amount of permafrost that underlies any given piece of infrastructure. The literature suggested that some assets will only need rehabilitation, other assets will need to be relocated, and different construction methods will need to be used, including the possibility of installing cooling mechanisms. According to the Arctic Research Commission, “roads, railways, and airstrips placed on ice-rich continuous permafrost will generally require relocation to well-drained natural foundations or replacement with substantially different construction methods” (U.S. Arctic Research Commission Permafrost Task Force, 2003, p. 29).

• Other – Other impacts of increasing temperatures included a reduction in ice loads on structures (such as bridges and piers), which could eventually allow them to be designed for less stress, and a lengthening of construction seasons due to fewer colder days in traditionally cold climates.

#### **Proactive measures now are critical to avert structural economic decline**

Winkleman et al, ’12 [Steve Winkleman, Jan Muller, Erica Jue, associated with the CCAP and EESI, “CLIMATE ADAPTATION & TRANSPORTATION Identifying Information and Assistance Needs”, http://files.eesi.org/Climate\_Adaptation\_Transportation.pdf]

Extreme weather events, including coastal storm surges, flooding, heating and freezing, and severe rain, snow, ice, and wind events, as well as changing average conditions and seasonal weather patterns – including, sea level rise, precipitation totals, mean temperatures, evapotranspiration rates, and ecosystem changes, are projected to affect safety, cost-effectiveness, efficiency, and technical feasibility of transportation investment and asset management decisions. These impacts will vary from region to region and may even vary at the local and site scale. Anticipating the consequences of such disruptive changes and planning prudent responses before they become reality will help transportation agencies protect the transportation infrastructure upon which communities, regions, and the national economy depend for the movement of goods and people.

The general nature of potential climate change impacts on transportation has been reasonably well-defined. The specific operational implications for transportation agencies and the broader transportation community, however, are not well understood.

#### Economic collapse causes escalatory global conflicts

Mathew J. Burrows (counselor in the National Intelligence Council (NIC), PhD in European History from Cambridge University) and Jennifer Harris (a member of the NIC’s Long Range Analysis Unit) April 2009 “Revisiting the Future: Geopolitical Effects of the Financial Crisis” http://www.twq.com/09april/docs/09apr\_Burrows.pdf

Of course, the report encompasses more than economics and indeed believes the future is likely to be the result of a number of intersecting and interlocking forces. With so many possible permutations of outcomes, each with ample opportunity for unintended consequences, there is a growing sense of insecurity. Even so, history may be more instructive than ever. While we continue to believe that the Great Depression is not likely to be repeated, the lessons to be drawn from that period include the harmful effects on fledgling democracies and multiethnic societies (think Central Europe in 1920s and 1930s) and on the sustainability of multilateral institutions (think League of Nations in the same period). There is no reason to think that this would not be true in the twenty-first as much as in the twentieth century. For that reason, the ways in which the potential for greater conflict could grow would seem to be even more apt in a constantly volatile economic environment as they would be if change would be steadier. In surveying those risks, the report stressed the likelihood that terrorism and nonproliferation will remain priorities even as resource issues move up on the international agenda. Terrorism’s appeal will decline if economic growth continues in the Middle East and youth unemployment is reduced. For those terrorist groups that remain active in 2025, however, the diffusion of technologies and scientific knowledge will place some of the world’s most dangerous capabilities within their reach. Terrorist groups in 2025 will likely be a combination of descendants of long established groupsinheriting organizational structures, command and control processes, and training procedures necessary to conduct sophisticated attacksand newly emergent collections of the angry and disenfranchised that become self-radicalized, particularly in the absence of economic outlets that would become narrower in an economic downturn. The most dangerous casualty of any economically-induced drawdown **of U.S. military presence** would almost certainly be **the Middle East**. Although Iran’s acquisition of nuclear weapons is not inevitable, worries about a nuclear-armed Iran could lead states in the region to develop new security arrangements with external powers, acquire additional weapons, and consider pursuing their own nuclear ambitions. It is not clear that the type of stable deterrent relationship that existed between the great powers for most of the Cold War would emerge naturally in the Middle East with a nuclear Iran. Episodes of low intensity conflict and terrorism taking place under a nuclear umbrella could lead to an unintended escalation and broader conflict if clear red lines between those states involved are not well established. The close proximity of potential nuclear rivals combined with underdeveloped surveillance capabilities and mobile dual-capable Iranian missile systems also will produce inherent difficulties in achieving reliable indications and warning of an impending nuclear attack. The lack of strategic depth in neighboring states like Israel, short warning and missile flight times, and uncertainty of Iranian intentions may place more focus on preemption rather than defense, potentially leading to escalating crises Types of conflict that the world continues to experience, such as over resources, could reemerge, particularly if protectionism grows and there is a resort to neo-mercantilist practices. Perceptions of renewed energy scarcity will drive countries to take actions to assure their future access to energy supplies. In the worst case, this could result in interstate conflicts if government leaders deem assured access to energy resources, for example, to be essential for maintaining domestic stability and the survival of their regime. Even actions short of war, however, will have important geopolitical implications. Maritime security concerns are providing a rationale for naval buildups and modernization efforts, such as China’s and India’s development of blue water naval capabilities. If the fiscal stimulus focus for these countries indeed turns inward, one of the most obvious funding targets may be military. Buildup of regional naval capabilities could lead to increased tensions, rivalries, and counterbalancing moves, but it also will create opportunities for multinational cooperation in protecting critical sea lanes. With water also becoming scarcer in Asia and the Middle East, cooperation to manage changing water resources is likely to be increasingly difficult both within and between states in a more dog-eat-dog world.

#### Advantage \_\_ Trade

#### **Even small changes in climate will have serious implications for the transportation sector and global trade**

World Trade Organization and United Nations Environment Programme ’09 [WTO and UNEP, “Trade and Climate Change”, 2009, WTO and UNEP, <http://www.wto.org/english/res_e/booksp_e/trade_climate_change_e.pdf>, AD]

As greenhouse gas emissions and temperatures increase, the impacts from climate change are expected to become more widespread and to intensify. For example, even with small increases in average temperature, the type, frequency and intensity of extreme weather – such as hurricanes, typhoons, fl oods, droughts, and storms – are projected to increase. Th e distribution of these weather events, however, is expected to vary considerably among regions and countries, and impacts will depend to a large extent on the vulnerability of populations or ecosystems. Developing countries, and particularly the poorest and most marginalized populations within these countries, will generally be both the most adversely aff ected by the impacts of future climate change and the most vulnerable to its eff ects, because they are less able to adapt than developed countries and populations. In addition, climate change risks compound the other challenges which are already faced by these countries, including tackling poverty, improving health care, increasing food security and improving access to sources of energy. For instance, climate change is projected to lead to hundreds of millions of people having limited access to water supplies or facing inadequate water quality, which will, in turn, lead to greater health problems. Although the impacts of climate change are specifi c to location and to the level of development, most sectors of the global economy are expected to be affected and these impacts will often have implications for trade. For example, three trade-related areas are considered to be particularly vulnerable to climate change. Agriculture is considered to be one of the sectors most vulnerable to climate change, and also represents a key sector for international trade. In low-latitude regions, where most developing countries are located, reductions of about 5 to 10 per cent in the yields of major cereal crops are projected even in the case of small temperature increases of around 1° C. Although it is expected that local temperature increases of between 1° C and 3° C would have benefi cial impacts on agricultural outputs in mid- to high-latitude regions, warming beyond this range will most likely result in increasingly negative impacts for these regions also. According to some studies, crop yields in some African countries could fall by up to 50 per cent by 2020, with net revenues from crops falling by as much as 90 per cent by 2100. Depending on the location, agriculture will also be prone to water scarcity due to loss of glacial meltwater and reduced rainfall or droughts. Tourism is another industry that may be particularly vulnerable to climate change, for example, through changes in snow cover, coastal degradation and extreme weather. Both the fi sheries and forestry sectors also risk being adversely impacted by climate change. Likewise, ix Part IV Part III Part II Part I there are expected to be major impacts on coastal ecosystems, including the disappearance of coral and the loss of marine biodiversity. Finally, one of the clearest impacts will be on trade infrastructure and routes. The IPCC has identified port facilities, as well as buildings, roads, railways, airports and bridges, as being dangerously at risk of damage from rising sea levels and the increased occurrence of instances of extreme weather, such as fl ooding and hurricanes. Moreover, it is projected that changes in sea ice, particularly in the Arctic, will lead to the availability of new shipping routes.

#### **Federal investment in transportation infrastructure is critical to trade**

FHA 02 (Federal Highway Administration, part of the US Department of Transportation “2002 Status of the Nation's Highways, Bridges, and Transit: Conditions & Performance” 11/24/02. http://www.fhwa.dot.gov/policy/2002cpr/pdf/ch12.pdf)

America’s transportation system is the essential element facilitating the movement of goods and people within¶ the country. It forms the backbone of local, regional, national, and international trade, making most economic¶ activity critically dependent upon this resource. The Nation’s urban transportation systems have enabled the¶ growth of America’s cities, linking workers with employers, wholesalers with retailers, markets with buyers,¶ and residents with recreational and cultural facilities. The intercity transportation system helps bring America’s¶ cities, States, and regions together, linking farmers and manufacturers to markets, raw material suppliers to¶ processors, businesses to clients, and tourists to destinations.¶ These transportation functions are served by a wide variety of modes. Airways and airports provide rapid,¶ long-distance transportation services for travelers, mail, and freight. On the surface, freight moves by water,¶ rail, highways, and pipelines, while people move by passenger rail, buses, ferries, and private vehicles.¶ The surface transportation system serving the United States today reflects investment and location decisions¶ made by both governments and private enterprise since the beginning of the Nation. Early settlement and¶ transportation patterns were determined primarily by geography, with waterborne and horse-drawn¶ transportation the dominant modes. Over the years, improvements in vehicle technology, including¶ steamships, locomotives, automobiles, and airplanes, have greatly expanded both the speed and flexibility of¶ transportation movements, allowing economic activity to concentrate in cities and spread across the country.¶ Harnessing the potential of these technologies has required large investments in guideways and facilities,¶ including ports and canals, railroads and terminals, highways and bridges, and airports and airways. The¶ development of these facilities has also been greatly aided by advancements in bridge, tunnel, pavement,¶ building, and communications technologies.¶ The Federal government has played a key role throughout the country’s history in shaping the transportation¶ system, both in regulating interstate commerce and in funding and facilitating transportation improvements.¶ Examples of the latter include the construction of the National Road in the early 19¶ th¶ Century; the Pacific¶ Railroad Act of 1862; inland waterways built by the Army Corps of Engineers; the Federal-Aid Highway¶ Program and the Interstate Highway System of the 20¶ th¶ Century; and Federal assistance for mass transit¶ operators beginning in the 1960’s

#### US Trade leadership is critical to multilateral trade – which solves all global problems

Panitchpakdi ‘4 (Supachai Panitchpakdi, secretary-general of the UN Conference on Trade and Development, 2/26/2004, American Leadership and the World Trade Organization, p. http://www.wto.org/english/news\_e/spsp\_e/spsp22\_e.htm

The second point is that strengthening the world trading system is essential to America's wider global objectives. Fighting terrorism, reducing poverty, improving health, integrating China and other countries in the global economy — all of these issues are linked, in one way or another, to world trade. This is not to say that trade is the answer to all America's economic concerns; only that meaningful solutions are inconceivable without it. The world trading system is the linchpin of today's global order — underpinning its security as well as its prosperity. A successful WTO is an example of how multilateralism can work. Conversely, if it weakens or fails, much else could fail with it. This is something which the US — at the epicentre of a more interdependent world — cannot afford to ignore. These priorities must continue to guide US policy — as they have done since the Second World War. America has been the main driving force behind eight rounds of multilateral trade negotiations, including the successful conclusion of the Uruguay Round and the creation of the WTO. The US — together with the EU — was instrumental in launching the latest Doha Round two years ago. Likewise, the recent initiative, spearheaded by Ambassador Zoellick, to re-energize the negotiations and move them towards a successful conclusion is yet another example of how essential the US is to the multilateral process — signalling that the US remains committed to further liberalization, that the Round is moving, and that other countries have a tangible reason to get on board. The reality is this: when the US leads the system can move forward; when it withdraws, the system drifts. The fact that US leadership is essential, does not mean it is easy. As WTO rules have expanded, so too has as the complexity of the issues the WTO deals with — everything from agriculture and accounting, to tariffs and telecommunication. The WTO is also exerting huge gravitational pull on countries to join — and participate actively — in the system. The WTO now has 146 Members — up from just 23 in 1947 — and this could easily rise to 170 or more within a decade. Emerging powers like China, Brazil, and India rightly demand a greater say in an institution in which they have a growing stake. So too do a rising number of voices outside the system as well. More and more people recognize that the WTO matters. More non-state actors — businesses, unions, environmentalists, development NGOs — want the multilateral system to reflect their causes and concerns. A decade ago, few people had even heard of the GATT. Today the WTO is front page news. A more visible WTO has inevitably become a more politicized WTO. The sound and fury surrounding the WTO's recent Ministerial Meeting in Cancun — let alone Seattle — underline how challenging managing the WTO can be. But these challenges can be exaggerated. They exist precisely because so many countries have embraced a common vision. Countries the world over have turned to open trade — and a rules-based system — as the key to their growth and development. They agreed to the Doha Round because they believed their interests lay in freer trade, stronger rules, a more effective WTO. Even in Cancun the great debate was whether the multilateral trading system was moving fast and far enough — not whether it should be rolled back. Indeed, it is critically important that we draw the right conclusions from Cancun — which are only now becoming clearer. The disappointment was that ministers were unable to reach agreement. The achievement was that they exposed the risks of failure, highlighted the need for North-South collaboration, and — after a period of introspection — acknowledged the inescapable logic of negotiation. Cancun showed that, if the challenges have increased, it is because the stakes are higher. The bigger challenge to American leadership comes from inside — not outside — the United States. In America's current debate about trade, jobs and globalization we have heard a lot about the costs of liberalization. We need to hear more about the opportunities. We need to be reminded of the advantages of America's openness and its trade with the world — about the economic growth tied to exports; the inflation-fighting role of imports, the innovative stimulus of global competition. We need to explain that freer trade works precisely because it involves positive change — better products, better job opportunities, better ways of doing things, better standards of living. While it is true that change can be threatening for people and societies, it is equally true that the vulnerable are not helped by resisting change — by putting up barriers and shutting out competition. They are helped by training, education, new and better opportunities that — with the right support policies — can flow from a globalized economy. The fact is that for every job in the US threatened by imports there is a growing number of high-paid, high skill jobs created by exports. Exports supported 7 million workers a decade ago; that number is approaching around 12 million today. And these new jobs — in aerospace, finance, information technology — pay 10 per cent more than the average American wage. We especially need to inject some clarity — and facts — into the current debate over the outsourcing of services jobs. Over the next decade, the US is projected to create an average of more than 2 million new services jobs a year — compared to roughly 200,000 services jobs that will be outsourced. I am well aware that this issue is the source of much anxiety in America today. Many Americans worry about the potential job losses that might arise from foreign competition in services sectors. But it’s worth remembering that concerns about the impact of foreign competition are not new. Many of the reservations people are expressing today are echoes of what we heard in the 1970s and 1980s. But people at that time didn’t fully appreciate the power of American ingenuity. Remarkable advances in technology and productivity laid the foundation for unprecedented job creation in the 1990s and there is no reason to doubt that this country, which has shown time and again such remarkable potential for competing in the global economy, will not soon embark again on such a burst of job-creation. America's openness to service-sector trade — combined with the high skills of its workforce — will lead to more growth, stronger industries, and a shift towards higher value-added, higher-paying employment. Conversely, closing the door to service trade is a strategy for killing jobs, not saving them. Americans have never run from a challenge and have never been defeatist in the face of strong competition. Part of this challenge is to create the conditions for global growth and job creation here and around the world. I believe Americans realize what is at stake. The process of opening to global trade can be disruptive, but they recognize that the US economy cannot grow and prosper any other way. They recognize the importance of finding global solutions to shared global problems. Besides, what is the alternative to the WTO? Some argue that the world's only superpower need not be tied down by the constraints of the multilateral system. They claim that US sovereignty is compromised by international rules, and that multilateral institutions limit rather than expand US influence. Americans should be deeply sceptical about these claims. Almost none of the trade issues facing the US today are any easier to solve unilaterally, bilaterally or regionally. The reality is probably just the opposite. What sense does it make — for example — to negotiate e-commerce rules bilaterally? Who would be interested in disciplining agricultural subsidies in a regional agreement but not globally? How can bilateral deals — even dozens of them — come close to matching the economic impact of agreeing to global free trade among 146 countries? Bilateral and regional deals can sometimes be a complement to the multilateral system, but they can never be a substitute. There is a bigger danger. By treating some countries preferentially, bilateral and regional deals exclude others — fragmenting global trade and distorting the world economy. Instead of liberalizing trade — and widening growth — they carve it up. Worse, they have a domino effect: bilateral deals inevitably beget more bilateral deals, as countries left outside are forced to seek their own preferential arrangements, or risk further marginalization. This is precisely what we see happening today. There are already over two hundred bilateral and regional agreements in existence, and each month we hear of a new or expanded deal. There is a basic contradiction in the assumption that bilateral approaches serve to strengthen the multilateral, rules-based system. Even when intended to spur free trade, they can ultimately risk undermining it. This is in no one's interest, least of all the United States. America led in the creation of the multilateral system after 1945 precisely to avoid a return to hostile blocs — blocs that had done so much to fuel interwar instability and conflict. America's vision, in the words of Cordell Hull, was that “enduring peace and the welfare of nations was indissolubly connected with the friendliness, fairness and freedom of world trade”. Trade would bind nations together, making another war unthinkable. Non-discriminatory rules would prevent a return to preferential deals and closed alliances. A network of multilateral initiatives and organizations — the Marshal Plan, the IMF, the World Bank, and the GATT, now the WTO — would provide the institutional bedrock for the international rule of law, not power. Underpinning all this was the idea that freedom — free trade, free democracies, the free exchange of ideas — was essential to peace and prosperity, a more just world. It is a vision that has emerged pre-eminent a half century later. Trade has expanded twenty-fold since 1950. Millions in Asia, Latin America, and Africa are being lifted out of poverty, and millions more have new hope for the future. All the great powers — the US, Europe, Japan, India, China and soon Russia — are part of a rules-based multilateral trading system, greatly increasing the chances for world prosperity and peace. There is a growing realization that — in our interdependent world — sovereignty is constrained, not by multilateral rules, but by the absence of rules.

#### Nuclear war

Panzner 8 – faculty at the New York Institute of Finance, 25-year veteran of the global stock, bond, and currency markets who has worked in New York and London for HSBC, Soros Funds, ABN Amro, Dresdner Bank, and JPMorgan Chase (Michael, “Financial Armageddon: Protect Your Future from Economic Collapse,” p. 136-138)

Continuing calls for curbs on the flow of finance and trade will inspire the United States and other nations to spew forth protectionist legislation like the notorious Smoot-Hawley bill. Introduced at the start of the Great Depression, it triggered a series of tit-for-tat economic responses, which many commentators believe helped turn a serious economic downturn into a prolonged and devastating global disaster. But if history is any guide, those lessons will have been long forgotten during the next collapse. Eventually, fed by a mood of desperation and growing public anger, restrictions on trade, finance, investment, and immigration will almost certainly intensify. Authorities and ordinary citizens will likely scrutinize the cross-border movement of Americans and outsiders alike, and lawmakers may even call for a general crackdown on nonessential travel. Meanwhile, many nations will make transporting or sending funds to other countries exceedingly difficult. As desperate officials try to limit the fallout from decades of ill-conceived, corrupt, and reckless policies, they will introduce controls on foreign exchange. Foreign individuals and companies seeking to acquire certain American infrastructure assets, or trying to buy property and other assets on the cheap thanks to a rapidly depreciating dollar, will be stymied by limits on investment by noncitizens. Those efforts will cause spasms to ripple across economies and markets, disrupting global payment, settlement, and clearing mechanisms. All of this will, of course, continue to undermine business confidence and consumer spending. In a world of lockouts and lockdowns, any link that transmits systemic financial pressures across markets through arbitrage or portfolio-based risk management, or that allows diseases to be easily spread from one country to the next by tourists and wildlife, or that otherwise facilitates unwelcome exchanges of any kind will be viewed with suspicion and dealt with accordingly. The rise in isolationism and protectionism will bring about ever more heated arguments and dangerous confrontations over shared sources of oil, gas, and other key commodities as well as factors of production that must, out of necessity, be acquired from less-than-friendly nations. Whether involving raw materials used in strategic industries or basic necessities such as food, water, and energy, efforts to secure adequate supplies will take increasing precedence in a world where demand seems constantly out of kilter with supply. Disputes over the misuse, overuse, and pollution of the environment and natural resources will become more commonplace. Around the world, such tensions will give rise to full-scale military encounters, often with minimal provocation. In some instances, economic conditions will serve as a convenient pretext for conflicts that stem from cultural and religious differences. Alternatively, nations may look to divert attention away from domestic problems by channeling frustration and populist sentiment toward other countries and cultures. Enabled by cheap technology and the waning threat of American retribution, terrorist groups will likely boost the frequency and scale of their horrifying attacks, bringing the threat of random violence to a whole new level. Turbulent conditions will encourage aggressive saber rattling and interdictions by rogue nations running amok. Age-old clashes will also take on a new, more heated sense of urgency. China will likely assume an increasingly belligerent posture toward Taiwan, while Iran may embark on overt colonization of its neighbors in the Mideast. Israel, for its part, may look to draw a dwindling list of allies from around the world into a growing number of conflicts. Some observers, like John Mearsheimer, a political scientist at the University of Chicago, have even speculated that an “intense confrontation” between the United States and China is “inevitable” at some point. More than a few disputes will turn out to be almost wholly ideological. Growing cultural and religious differences will be transformed from wars of words to battles soaked in blood. Long-simmering resentments could also degenerate quickly, spurring the basest of human instincts and triggering genocidal acts. Terrorists employing biological or nuclear weapons will vie with conventional forces using jets, cruise missiles, and bunker-busting bombs to cause widespread destruction. Many will interpret stepped-up conflicts between Muslims and Western societies as the beginnings of a new world war.

#### Advantage \_\_ Hegemony

#### Failure to adopt climate adaptation measures in the transportation infrastructure sector threatens overall US military primacy. We’ll isolate three internal links.

#### First, Highways:

#### **The status quo is failing to respond to the climate issue-Leadership on the highway vulnerability is critical to spur action.**

Meyer et al. 09, (Michael Frederick R. Dickerson Professor, School of Civil and Environmental Engineering, Georgia Institute of Technology, PhD Michael Flood Senior Planner at Parsons Brinckerhoff ¶ Chris Dorney Transportation/Land Use Planner at Parsons Brinckerhoff ¶ Ken Leonard Principal of Cambridge Systematics, ¶ Robert Hyman Associate at Cambride Systematics ¶ Joel Smith expert on climate change policy, lead author of the Intergovernmental Panel on Climate Change 2001 and 2007 assessment report; the latter shared the Noble Peace Prize with former Vice President Al Gore. Vice-President of Stratus Consulting, Boulder, CO. “Climate Change and the Highway System: Impacts and Adaptation Approaches”. National Cooperative Highway Research Program. 5/6/2009 http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-83%2805%29\_Task2-3SynthesisReport.pdf)

There is a growing consensus amongst academic researchers and highway agencies that ¶ climate change is a threat to many aspects of the highway system which warrants spending ¶ resources to investigate the specific risks it poses. Still, the majority of US highway agencies ¶ remain unaware (or dismissive) of the potential threats and have yet to take any adaptation ¶ actions. ¶ x The lack of engineering relevant and spatially precise climate data and the uncertainty ¶ surrounding those data remain obstacles and will likely remain so for the foreseeable future ¶ despite the best efforts of climate modelers. This should not, however, be an excuse for ¶ inaction. Some governments, such as New York City, realize the data shortcomings issue ¶ and have put forth alternative approaches (e.g. flexible adaptation pathways) to enable ¶ prudent decision making in light of the uncertainty. ¶ x Leadership is critical. Strong national mandates to consider adaptation and provide ¶ relevant data greatly encourage adaptation activities. That said, they need not be a ¶ prerequisite. Absent mandates, strong state or local leadership by individuals concerned ¶ about climate changes can also spur action as is the case in most US examples. Visible on the-ground changes, as in Alaska, can also focus attention on the topic. ¶ x Most agencies that are concerned about adaptation begin by conducting a risk assessment ¶ of existing assets. Most of these risk assessments remain largely qualitative and based on ¶ professional judgment. This will likely remain the case until more probabilistic climate ¶ projections become available. ¶ x Both domestically and internationally, limited action has been taken on the ground thus far ¶ to build climate resiliency into the transportation system. Indeed, with some notable ¶ exceptions, much adaptation work remains at a planning or risk assessment level and has ¶ yet to be incorporated into the design of individual projects. This is likely to change in the ¶ near future as the risk assessment studies progress and the global economy picks up ¶ providing more resources for adaptation. ¶ x Some risk assessments to date have shown the highway system to have only modest ¶ vulnerabilities to climate change. Others have indicated enough cause for concern to ¶ recommend action be taken. Whether an agency chooses to take adaptation action depends ¶ on their fiscal and political capacity to effect change and their level of tolerance for risk. It is ¶ quite possible that separate agencies, facing the same risks, might choose very different ¶ courses of action, especially absent any set of national or industry standards. ¶ x Risks to the highway system due to sea level rise and increased precipitation ¶ amounts/intensity appear to be the biggest cause for concern and amongst the first ¶ priorities for action. NCHRP 20-83 (5) Task 2.3 Synthesis Report ¶ Review of Key Climate Impacts to the Highway System ¶ and Current Adaptation Practices and Methodologies ¶ 75 ¶ Future phases of this project will take note of these observations and build off of them to generate ¶ new techniques for ensuring highway system resiliency as we enter a new period of climate ¶ uncertainty.

#### **Climate change threatens road system-multiple reasons-Delaying mitigation measures magnifies the impacts**

FHWA 10’ [Federal Highway Administration, US Department of Transportation, “Regional Climate Change Effects: Useful Information for Transportation Agencies”, http://www.fhwa.dot.gov/environment/climate\_change/adaptation/resources\_and\_publications/climate\_effects/effects03.cfm]

"Climate affects the design, construction, safety, operations, and maintenance of transportation infrastructure and systems. The prospect of a changing climate raises critical questions regarding how alterations in temperature, precipitation, storm events, and other aspects of the climate could affect the nation's roads, airports, rail, transit systems, pipelines, ports, and waterways." CCSP 2008a

The changing climate poses serious challenges to the transportation community, given the community's need to watch over transportation systems and infrastructure designed to last decades or longer. Transportation functions tied to construction, operations, maintenance, and planning should be grounded in an understanding of the environment expected to support transportation facilities. Decisions therefore need to be informed by an understanding of potential future changes in climate… Why should the transportation community care about this information? The impacts of climate change can include weakened bridges and road beds, temporarily or permanently flooded roads, damaged pavements, and changes in road weather that can affect safety and economic activity. Understanding and proactively addressing the potential impacts of climate change can help avoid the potential damage, disruption in service, and safety concerns that climate change may cause.

#### This threatens military effectiveness

Cox and Love 96 (Wendell and Jean, American Highways Users Alliance, "40 Years of the US Interstate Highway System: An Analysis The Best Investment A Nation Ever Made," June, <http://www.publicpurpose.com/freeway1.htm>)

One of the principal reasons for building the interstate highway system was to support national defense. When the system was approved --- during one of the most instable periods of the Cold War, national security dictated development of an efficient national highway system that could move large numbers of military personnel and huge quantities of military equipment and supplies. The interstate highway system effectively performs that function, but perhaps more importantly, its availability provides the nation with a potential resource that could have been reliably called upon if greater military conflict had arisen. Throughout the Cold War (and even to today), America's strategic advantage in effective surface transportation was unchallenged. Even today, no constituent nation of the late Soviet Union has begun to develop such a comprehensive surface transportation system. In the post-communist world, it may be tempting to underestimate the role of the interstate highway system in national defense. But the interstate highway system continues to play a critical role. The U.S. military's Strategic Highway Corridor Network (STAHNET) relies primarily on the interstate highway network, which represents 75 percent of network mileage. The U.S. Army cited the that system as being critical to the success of the 1990-1991 "Desert Shield-Desert Storm operation (the U.S. led operation to free Kuwait from Iraq): Much of the success of the operation was due to our logistical ability to rapidly move troops to the theater. The capacity of the U.S. highway system to support the mobilization of troops and to move equipment and forces to U.S. ports of embarkation was key to successful deployment. NOTE: "Statement of Lieutenant General Kenneth R. Wykle, United States Army, Deputy Commander in Chief, United States Transportation Command before the House Committee on Transportation and Infrastructure, Surface Transportation Committee, United States House of Representatives, on the U.S. Department of Transportation's Recommended National Highway System" (Washington, DC: March 2, 1995). The Army also noted the "modal redundancy" of the highway system, which provided rapid and effective movements of a military division when difficulties with a rail line precluded the planned transport by rail. NOTE: "Statement of Lieutenant General Kenneth R. Wykle." This illustrates the fact that the interstate highway system continues to play an important role in national defense, even in the post-Cold War era.

#### Second, Airports:

#### **Absent adaptation measures, climate change will impair the smooth operation of airports**

Transportation Research Board of the National Academies ’11 [Transportation Research Board, “ Adapting Transportation to the Impacts of Climate Change”, June 2011, Transportation Research Circular, E-C152, <http://www.trb.org/Publications/Blurbs/165529.aspx> AD]

**The potential** serious physical damage **to the** facilities and infrastructure of an airport **mainly result from the changes in precipitation, temperature, sea level, storm surge, and winds**. The risks include flooding, heat buckle and other forms of expansion stress, permafrost thaw buckle in northern regions, perimeter security breaches, and fuel contamination or spills from pipe ruptures. As noted in the previous section, **secondary effects of climate change may also cause new risks**, such as extreme erosion, soil depletion, wild land fires, and facility damage from new species of animals and plants. Addressing potential physical damage from future climate change can generally be done • Rebuilding, relocating, or abandoning shoreline facilities (e.g., seawalls, sewage treatment outfalls, and building and runway foundations) to accommodate expected future higher sea levels It would be unusual for these types of physical improvements to be carried out in isolation from the regular process of continuous planning, design, development, and maintenance that typically goes on at any airport. Climate change adaptation actions for the physical plant can be seen as one of many objectives to be incorporated into the master planning and asset management process. This approach ensures that solutions are thought through in an integrated and comprehensive manner, to minimize the costs of the improvements and maximize the efficiency of the development process over time. The goal is to adapt to this new consideration of climate change in a way that still maximizes the utility of the often very long lived components of the airport infrastructure.

#### Civilian airport infrastructure is vital to theater airlift and air defense capability

Department of the Air Force ’01 [Air Force, “PRESENTATION TO THE COMMITTEE ON ARMED SERVICES, SUBCOMMITTEE ON READINESS AND MANAGEMENT, UNITED STATES SENATE”, March 21, 2001, Air Force, <http://www.globalsecurity.org/military/library/congress/2001_hr/010321js.pdf> AD]

The Air National Guard is a constitutionally unique military organization with roots dating back to the very beginnings of our country and its militia. Our State and Federal missions are accomplished by 88 flying wings and 1,600 support units located at 173 locations in all 50 states, 3 territories and the District of Columbia. The plant value of Air National Guard-managed real estate exceeds $12.6 billion with over 4,800 facilities comprising in excess of 32 million square feet. We partner with 67 civilian airports that provide access to an additional $4.4 billion in airfield infrastructure at a fraction of what it would cost us to own and operate it ourselves. These facilities support a Total Force capability that is unrivaled in the world today. While comprising roughly 34 percent of the Air Force’s mission capability, the Air National Guard specifically provides 100 percent of the Nation’s air defense and 45 percent of the theater airlift mission to name a few. In addition to high visibility missions like last year’s flight to the South Pole to rescue Dr. Gerri Nielsen, the Air Guard is a significant player in the Aerospace Expeditionary Force.

#### Third, Rail:

#### **Climate change increases freight cost**

Rossetti, ’02[Micheal A. Rossetti, Michael Rossetti is a Strategic Planner and Economist at the DOT Volpe Center. He has served as Executive Agent for the DOT/NSTC initiative on Enhanced Transportation Weather Services. He is member of the User Advisory Group of the US Weather Research Program, and of the OFCM Joint Action Group on Weather Information for Surface Transportation. He is the author of many DOT publications on transportation statistics, and technology development. Previously, he was employed at the Federal Communications Commission and National Research Council. Mr. Rossetti holds a M.A. degree from the Pennsylvania State University and an A.B. from Boston College, “The Potential Impacts of Climate Change on Transportation”, 2002, http://climate.dot.gov/documents/workshop1002/rossetti.pdf]

Climate models suggest a future warming of 0.2 - 0.3oC per decade.1 Sea levels are expected to rise at a rate of 4 to 10 cm per decade. Ancillary effects include changes in regional distributions of rainfall and soil moisture, and possibly more frequent and more intense storm systems. In recent years, the complexities of climate change and predictions of climate model outputs have introduced an additional measure of uncertainty for railroad operators. Weather events, climate oscillations, and climate trends hence affect railroad safety, including fatalities, injuries, and property damage. Through their interactions with maintenance, planning, operating efficiency, scheduling, and demand for freight and passenger services, weather and climate may also affect a firm’s balance sheet, and cash flow, capital investment decisions, and even competitive stance within the industry.

#### **Increased freight cost uniquely impact the steel industry**

Cooney, ‘07[Stephen Cooney, Congressional Research Service; Resources, Science, and Industry Division at IRL School at Cornell University, “Steel: Price and Policy Issues”, 10-31-2007, <http://digitalcommons.ilr.cornell.edu/cgi/viewcontent.cgi?article=1492&context=key_workplace>]

Rail transportation costs, seen as railways have consolidated and¶ created more “capitive shippers,” have had a negative effect on industry, particularly¶ in raising the costs and reducing the options for shipping inputs like scrap and¶ delivering finished product to customers. According to the Government¶ Accountability Office (GAO), while rail rates have declined over the long term, they¶ increased by 9% in 2005, basically for all products across the board.90 The steel¶ industry specifically reported increases of around a third in rail costs since 2003, and¶ in some cases as high as 60%. “Transportation costs have escalated to the point that¶ they now account for 15-20% of the total cost of producing steel.”91

#### Stable supply of steel key to military infrastructure

TNS, 7-1-2008[Targeted News Service, “U.S. Steel Industry Critical To Keeping Us Free,” 7-1-2008, <http://www.lexisnexis.com.turing.library.northwestern.edu/hottopics/lnacademic/>]

As we reflect on our country's independence this Fourth of July, we should pause to recognize those who fought for our freedom more than 230 years ago. But we should also recognize those who continue to keep our country free today: the men and women in uniform who offer their noble service in order to preserve America's national security.¶ "Members of the United States Navy, Marine Corps, Army, Air Force and Coast Guard, both at home and overseas, risk their lives everyday to ensure that Americans continue to have the freedoms that our country is founded upon. It is their commitment to our country that has made America what it is today - a beacon for freedom and democracy, "Andrew G. Sharkey, III, president and CEO, American Iron and Steel Institute (AISI), said. "Our veterans represent the very best of America and the U.S. steel industry is continuously working to serve the military in their efforts to defend our nation."¶ ¶ Sharkey said domestically-produced steel is important to "improve our military platforms, strengthen the nation's industrial base and harden our vital homeland security infrastructure."¶ Congressman Peter J. Visclosky (D-IN), Chairman of the Congressional Steel Caucus, has noted that "to ensure that our national defense needs will be met, it is crucial that we have a robust and vibrant domestic steel industry. It is poor policy to rely on foreign steel for our national security - instead, we need a long-term investment in domestically-produced, high-quality and reliable steel that will serve and strengthen our national security interests."¶ Protecting the nation's vast infrastructure is essential to our homeland security. This became an issue in recent times when it was discovered that substandard steel imported from China was being used by the U.S. Department of Homeland Security to construct the border fence between the United States and Mexico. Members of the Congressional Steel Caucus, including Congressman Visclosky (D-IN), have worked to introduce legislation that will help strengthen the domestic steel industry in order to address issues of substandard steel imports.¶ "AISI and its members greatly appreciate the Congressional Steel Caucus' support for the steel industry and their vigilance on behalf of America's national security," Sharkey said.¶ In addition, thousands of skilled men and women of the U.S. steel industry work to produce high quality, cost-competitive products that are used by the military in various applications ranging from aircraft carriers and nuclear submarines to Patriot and Stinger missiles, Sharkey said. Land based vehicles, such as the Bradley Fighting Vehicle, Abrams Tank and the family of Light Armored Vehicles, also utilize significant tonnage of steel plate per vehicle. The up-armored Humvee, in use by the U.S. Army, includes steel plating around the cab of the vehicle, offering improved protection against small arms fire and shrapnel. In fact, the steel plating underneath the cab is designed to survive up to eight pounds of explosives beneath the engine to four pounds in the cargo area. These critical applications require consistent, high quality domestic sources of supply.¶ "We as a country need to make sure that our national defense needs will be met, making it critical for the United States to have a robust and vibrant domestic steel industry that will serve to strengthen our national security interests," Sharkey noted.¶ Historically, American-made steel and specialty metals have been integral components of U.S. military strength and they continue in this role today. The Department of Defense's (DOD's) primary use of steel in weapons systems is for shipbuilding, but steel is also an important component in ammunition, aircraft parts, and aircraft engines. DOD's steel requirements are satisfied by both integrated steel mills and EAF producer mills.¶ "With the desire never to be dependent on foreign nations for the steel used in military applications, it is critical that U.S. trade laws be defended, strengthened and enforced so that American-made steel can continue to play a vital role in our nation's security," Sharkey said. "On this Independence Day, let's pledge to work to uphold that ideal."

#### US primacy is key to solve great power wars

Zhand & Shi 11 - \*Yuhan, a researcher at the Carnegie Endowment for International Peace, Washington, D.C. \*\*\* AND\*\*\* Lin, Columbia University. She also serves as an independent consultant for the Eurasia Group and a consultant for the World Bank in Washington, D.C. “America’s decline: A harbinger of conflict and rivalry” <http://www.eastasiaforum.org/2011/01/22/americas-decline-a-harbinger-of-conflict-and-rivalry/>)

Over the past two decades, no other state has had the ability to seriously challenge the US military. Under these circumstances, motivated by both opportunity and fear, many actors have bandwagoned with US hegemony and accepted a subordinate role. Canada, most of Western Europe, India, Japan, South Korea, Australia, Singapore and the Philippines have all joined the US, creating a status quo that has tended to mute great power conflicts.

However, as the hegemony that drew these powers together withers, so will the pulling power behind the US alliance. The result will be an international order where power is more diffuse, American interests and influence can be more readily challenged, and conflicts or wars may be harder to avoid.

As history attests, power decline and redistribution result in military confrontation. For example, in the late 19th century America’s emergence as a regional power saw it launch its first overseas war of conquest towards Spain. By the turn of the 20th century, accompanying the increase in US power and waning of British power, the American Navy had begun to challenge the notion that Britain ‘rules the waves.’ Such a notion would eventually see the US attain the status of sole guardians of the Western Hemisphere’s security to become the order-creating Leviathan shaping the international system with democracy and rule of law.

Defining this US-centred system are three key characteristics: enforcement of property rights, constraints on the actions of powerful individuals and groups and some degree of equal opportunities for broad segments of society. As a result of such political stability, free markets, liberal trade and flexible financial mechanisms have appeared. And, with this, many countries have sought opportunities to enter this system, proliferating stable and cooperative relations.

However, what will happen to these advances as America’s influence declines? Given that America’s authority, although sullied at times, has benefited people across much of Latin America, Central and Eastern Europe, the Balkans, as well as parts of Africa and, quite extensively, Asia, the answer to this question could affect global society in a profoundly detrimental way.

Public imagination and academia have anticipated that a post-hegemonic world would return to the problems of the 1930s: regional blocs, trade conflicts and strategic rivalry. Furthermore, multilateral institutions such as the IMF, the World Bank or the WTO might give way to regional organisations.

For example, Europe and East Asia would each step forward to fill the vacuum left by Washington’s withering leadership to pursue their own visions of regional political and economic orders. Free markets would become more politicised — and, well, less free — and major powers would compete for supremacy.

Additionally, such power plays have historically possessed a zero-sum element. In the late 1960s and 1970s, US economic power declined relative to the rise of the Japanese and Western European economies, with the US dollar also becoming less attractive. And, as American power eroded, so did international regimes (such as the Bretton Woods System in 1973).

A world without American hegemony is one where great power wars re-emerge, the liberal international system is supplanted by an authoritarian one, and trade protectionism devolves into restrictive, anti-globalisation barriers. This, at least, is one possibility we can forecast in a future that will inevitably be devoid of unrivalled US primacy.

#### Advantage \_\_ Ports

#### Climate change is a major threat to US ports

AAPA and ICF International 08

http://www.epa.gov/sectors/pdf/ports-planing-for-cci-white-paper.pdf

The principal resource for predictions of global climate change is the United Nations Intergovernmental Panel on Climate Change (IPCC). In its Fourth Assessment Report, published in 2007, the IPCC estimated that global average sea level will rise from 18 to 59 cm (7.1 to 23.2 inches) by the last decade of the 21st century. The IPCC further concluded that because of global warming, thermal expansion of the oceans will likely continue to increase sea levels for many centuries after greenhouse gas (GHG) concentrations in the atmosphere have stabilized. These predictions are adequate for long-term projections of impact on ports at a global scale. A January 2008 study for the Organization for Economic Cooperation and Development (OECD) analyzed how climate change could affect the exposure of the world’s 136 largest port cities to coastal flooding due to storm surge by the 2070s. The study took into account the anticipated effects of climate change (sea-level rise and increased storm intensity) as well as worldwide economic and population growth projections. When the cities are considered as a group, there is near certainty (99.9% chance) that at least one of them will be affected by in a 1- in-100 year flood event in any given five year period. When ranked by the number of people that would be exposed to a 1-in-100-year flood event, three U.S. port cities (New Orleans, Miami and New York-Newark) were in the top twenty-five. When ranked by the value of assets exposed, six U.S. cities ranked in the top twenty-five (including the three above) and ten ranked in the top fifty.6 These predictions indicate that several U.S. port cities have a high risk of adverse impacts from climate change, but they do not consider that these cities and their ports may implement particular adaptation measures.

#### **Port security systems are at particular risk-investment in adaptation measures is key**

Gallivan, et all 11 Transportation Research Record 2100)

Planning for Impacts of Climate Change at U.S. Ports

<http://trb.metapress.com/content/p4787426l0853152/fulltext.pdf>

Globally, extreme precipitation events are expected to become more frequent and severe storms are expected to become more intense (2). Stronger wave action and higher storm surges, especially when they are coupled with higher sea levels, are the primary threat to ports. These impacts can damage bridges, wharfs, piers, terminal buildings, ships, and cargo. The infrastructure of harbors may need to be raised or reinforced to withstand these impacts. In addition to contributing to storm surge, wind can also have its own damaging impacts. High winds particularly threaten unreinforced terminal structures. For example, Hurricane Katrina tore roofs and doors off warehouses at the Port of New Orleans (2). One possible response to these threats is to incorporate the risk of stronger storms in design standards for terminals, cranes, lighting systems, and other infrastructure. Port security systems, such as video cameras, radar equipment, and perimeter fencing, could also be damaged by storm events. Damage to monitoring equipment could expose ports to additional security risks. Increased amounts of precipitation and extreme precipitation events could require improvements to the capacities of storm water facilities (2). More and stronger precipitation could also affect harbor channels. Increased erosion and the buildup of underwater silt and debris could decrease the channel depth and require more dredging. Finally, more severe weather events could result in more and longer delays to shipping operations. Ports may more often be required to suspend operations because of severe weather events. The resulting delays would reduce the overall reliability of marine shipping and have business impacts on shippers and receivers

#### **Ports are a target for terrorist attack**

LANE, SR. United States Army, 09

http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA499287

U.S. Seaport Security Threats and Vulnerabilities Prior to 9/11.

U.S. Seaports are naturally at risk to terrorist attacks due to their huge land masses. It is common for seaports to have many avenues of access, by water and land. They are often located in metropolitan areas. They transport large quantities of valuable goods, and provide effective transportation links and nodes to many destinations within U.S. borders. The perceived pre- 9/11 threats and vulnerabilities included internal conspiracies, 2stowaways and smuggling illegal aliens, illegal export, and drug smuggling. Defending against these vulnerabilities proved difficult due to the staggering numbers of U.S. ports and their structural designs. The mission of defending our ports requires us to “uphold U.S. maritime sovereignty and enforce U.S. law, international conventions, and treaties against criminal activities.”3 “The Federal government has the [overall jurisdiction] over harbors and interstate and foreign commerce, but state and local governments are the main port regulators.”4 The United States Coast Guard (USCG) is empowered to enforce all laws, conventions, and treaties in the maritime domain, crafted to suppress illegal migration, human trafficking, smuggling drugs and other contraband, and all other federal or international crime. This enforcement plays an integral role to secure air, land, and sea borders. U.S. Seaport Security Threats and Vulnerabilities after 9/11. US Seaports are vital assets to the US economy and national security strategy. “One of the most vulnerable sectors of the U.S. economy identified during [post 9/11] assessments was the maritime transportation system (MTS), specifically U.S. seaports’ [vulnerability].5 The 9/11attacks tragically demonstrated the vulnerability of the United States to attacks.6 The Al Qaeda network demonstrated to the world that terrorist attacks have the potential to disrupt the global economy.7

#### **Terrorist attack on a port could be catastrophic-risk LNG terminal explosion**

Crowley 4 Making Our Ports a Priority P.J. Crowley | July 1, 2004 senior fellow and director for national defense and homeland security at the Center for American Progress. He is a retired Air Force colonel and served in senior positions at the White House and Department of Defense during the Clinton administration. <http://www.americanprogress.org/issues/2004/07/b106593.html>

On a day that marks a critical deadline in protecting our nation's ports, the Bush administration's failure to set priorities and adequately fund key homeland security programs is all too clear. Reforms and protections that exist on paper have yet to make it to the pier, America's 361 ports remain vulnerable to attack, and dangerous weapons and materials can still too easily find their way into the United States. The Department of Homeland Security has touted July 1 as an important day – one when stricter standards for security go into effect under both DHS regulations and international maritime rules. In theory, as of today, ships not in compliance with U.S. and international security standards could be denied entry by the Coast Guard into U.S. ports. And in theory, our ports are more secure. Reality is different. For while the Coast Guard has estimated that the program required under the Maritime Transportation Security Act of 2002 will cost the nation $7.5 billion over ten years - and $1.3 billion in the coming year alone – the Bush administration has asked for only $46 million for fiscal 2005 to support states agencies and the private sector that operate the ports, facilities and vessels affected by these new regulations.[[1](http://www.americanprogress.org/misc/kfiles/b106593.html#1)] Rather than increasing federal assistance in the face of new security requirements, the Bush administration's port security grant request is actually a huge reduction from the still inadequate total of $500 million allocated for port security in the first three years of the Bush administration. The Bush administration has not matched its homeland security rhetoric with the resources that actually make us more secure. As in other areas vital to homeland security, port security is an unfunded federal mandate. The administration talks the talk of a genuine public-private partnership involving federal, state and local governments and the private sector. However, it does not walk the walk. In the face of growing federal budget deficits, the Bush administration is attempting to push most of the cost of these new security standards down to states and the private sector. This is in stark contrast to the administration's approach to aviation security, where the federal government has largely assumed the security responsibility that the airlines used to perform and the cost as well. [[2](http://www.americanprogress.org/misc/kfiles/b106593.html#2)] Port security needs to be a joint responsibility and port authorities and private operators must do their share. However, confronting an elevated terrorist threat against the United States that is inflamed by the current situation in Iraq, there is no substitute for federal leadership. U.S. ports operate on tight margins and can not easily absorb security costs, nor pass them along to customers in a competitive environment. Of the 153 public agencies that operate ports across the United States, in fact, only the ports of Los Angeles and Long Beach make a profit. The rest require subsidies from states that are themselves strapped for cash. [[3](http://www.americanprogress.org/misc/kfiles/b106593.html#3)] Ultimately, port security – and homeland security – can't be outsourced. The consequences of failure are enormous. An attack on a liquefied natural gas storage facility at an urban port facility like the Port of New York and New Jersey risks mass casualties and chaos that could exceed what we experienced on September 11. Many of our major ports are near urban centers, military bases or other critical infrastructure. An attack involving a dirty bomb or weapon of mass destruction smuggled through a port in a shipping container might force the president to order a temporary closure of U.S. ports, analogous to what was done with the grounding of commercial aircraft on September 11. Since our economy depends heavily on global trade and open ports, an extended closure would break just in time supply chains, interrupt manufacturing operations and have other cascading effects across the United States. The attacks of September 11 created roughly $85 billion in economic losses, and they were directed only at symbols of our economic and military strength. A West Coast port strike two years ago generated a billion dollars a day in economic losses. A carefully coordinated terrorist attack involving multiple ports would cause damage orders of magnitude above that. Or national strategy should be to adequately invest in port security before the next attack, not pay the piper afterwards.

#### 80 Hiroshima Bombs

Bender 5 LNG IMPORTS: NEITHER SAFE NOR WISE

<http://tombender.org/societyworthlivingforarticles/lng.pdf>

Liquefied natural gas (LNG) is considered by transportation officials to be a "hazardous and noxious substance". The Port of Astoria, and the community has been told by Calpine representatives that their proposed Skipanon LNG import terminal would be safe, and that any LNG spills would just fizz and evaporate "like 7-UP". But a just-released Sandia research lab study (SAND2004-6258) joins the voices of long-term government funded researchers to strongly disagree. Although the operational safety of the LNG industry has been good overall, the hazards of our post 9/11 world are not operational safety but intentional acts of destruction. And LNG terminals and tankers are prime terrorist targets. LNG tankers are huge – as long as the World Trade Center buildings were tall – and contain 35,000,000 gallons or more of LNG. That represents the energy equivalent of 60 to 80 Hiroshima bombs. Not one, but sixty to eighty Hiroshima bombs! An accident affecting even a tiny part of that energy can be catastrophic

#### Terrorism risks extinction.

Alexander 2003

Yonah, Terrorism myths and realities,‖Inter-University for Terrorism Studies Director, The Washington Ties, August 28

Last week's brutal suicide bombings in Baghdad and Jerusalem have once again illustrated dramatically that the international community failed, thus far at least, to understand the magnitude and implications of the terrorist threats to the very survival of civilization itself. Even the United States and Israel have for decades tended to regard terrorism as a mere tactical nuisance or irritant rather than a critical strategic challenge to their national security concerns. It is not surprising, therefore, that on September 11, 2001, Americans were stunned by the unprecedented tragedy of 19 al Qaeda terrorists striking a devastating blow at the center of the nation's commercial and military powers. Likewise, Israel and its citizens, despite the collapse of the Oslo Agreements of 1993 and numerous acts of terrorism triggered by the second intifada that began almost three years ago, are still "shocked" by each suicide attack at a time of intensive diplomatic efforts to revive the moribund peace process through the now revoked cease-fire arrangements [hudna]. Why are the United States and Israel, as well as scores of other countries affected by the universal nightmare of modern terrorism surprised by new terrorist "surprises"? There are many reasons, including misunderstanding of the manifold specific factors that contribute to terrorism's expansion, such as lack of a universal definition of terrorism, the religionization of politics, double standards of morality, weak punishment of terrorists, and the exploitation of the media by terrorist propaganda and psychological warfare. Unlike their historical counterparts, contemporary terrorists have introduced a new scale of violence in terms of conventional and unconventional threats and impact. The internationalization and brutalization of current and future terrorism make it clear we have entered an Age of Super Terrorism [e.g. biological, chemical, radiological, nuclear and cyber] with its serious implications concerning national, regional and global security concerns.

#### Observation Two: Solvency

#### **Now is the critical time to increase investment in climate adaptation measures-Delay threatens transportation infrastructure across the board.**

NTPP ‘9 (National Transportation Policy Project, Bipartisan coalition of transportation policy experts, business and civic leaders, and is chaired by four distinguished former elected officials who served at the federal, state, and local levels, Published December 15 2009, Bipartisan Policy Center, <http://bipartisanpolicy.org/sites/default/files/Transportation%20Adaptation%20(3).pdf>)

Background Climate change will impact many sectors of the economy, and while required adaptations for some sectors already have been studied in depth, the same cannot be said of transportation infrastructure. Executive Summary Rising sea levels, greater weather variability, and more extreme weather events like hurricanes, permafrost thawing, and melting Arctic sea ice are just some of the important changes that will impact transportation networks and infrastructure. Coastal areas are particularly vulnerable. A large portion of the nation’s transportation infrastructure is in coastal zones: nearly half of the U.S. population lives within ﬁfty miles of the coast, 1 and many roads, rail lines, and airports were built at or near water’s edge to take advantage of available right-of-way and land. Increasingly intense storm activity and surges, exacerbated by rising sea levels, are putting an ever-increasing range of this coastal infrastructure at risk. The costs of these climate impacts will most likely run into the billions of dollars. Costs will likely be highly variable — extreme events will incur large capital costs in very short periods of time, while other impacts (such assea level rise) will require investments spread out over long periods, integrated with capital replacement cycles. In a recent example of response to extreme events, the Mississippi Department of Transportation (DOT) spent an estimated $1 billion on debris removal, highway and bridge repair, and rebuilding the Biloxi and Bay St. Louis bridges in the four years following Hurricane Katrina, and CSX spent $250 million rebuilding thirty miles of destroyed rail line. Longer term, a study by Associated British Insurers estimated that climate change could increase the annual costs of ﬂooding in the United Kingdom almost 15-fold by the 2080s. 2 At the heart of these policy discussions must be the recognition that strong efforts to reduce greenhouse gas (GHG) emissions from the transportation sector will not eliminate the need to prepare for the impacts of climate change processes that are already underway, and that proactive GHG reduction strategies and adaptation planning need to be undertaken concurrently. Because transportation infrastructure is built to last decades, and represents substantial national investment, it is critical that climate factors be incorporated in transportation siting, investment, and design decisions. Taking action now to increase the transportation system’s resilience will reduce long-term costs from climate change. The National Transportation Policy Project (NTPP) and the National Commission on Energy Policy (NCEP) commissioned this white paper to identify the policy options available to support proactive measures for addressing climate change adaptation in transportation. This white paper is intended to inform Congress and other policy-makers about policy options at the federal level that will ensure a robust transportation system in the face of a changing climate.

#### **Investment in new design, construction, and maintenance of transportation infrastructure is critical to mitigating the effects of climate change**

Transportation Research Board of the National Academies ’11 [Transportation Research Board, “ Adapting Transportation to the Impacts of Climate Change”, June 2011, Transportation Research Circular, E-C152, <http://www.trb.org/Publications/Blurbs/165529.aspx> AD]

T**he projected effects of climate change could have significant implications for the nation’s transportation system**. Rising sea levels**,** increasingly extreme temperatures**, changes in the frequency and intensity of** storm events, **and accelerating patterns of** erosion **could damage infrastructure, flood roadways, and disrupt safe and efficient travel**. Certain effects, such as sea level rise and increases in storm intensity, present obvious challenges. Storm surge can damage and destroy coastal roadways, rail lines, and bridges and sea level rise will only exacerbate such effects. Rising sea levels can also present flooding risks to underground infrastructure such as subways and road tunnels, allowing water to enter through portals and ventilation shafts. Subtle changes, such as those expected in temperature, will also necessitate changes in the design, construction, and maintenance of infrastructure—for instance, the incorporation of materials and building techniques that can withstand temperature extremes. Some climate change effects may positively impact transportation, as higher average temperatures in certain regions could reduce safety and maintenance concerns associated with snow and ice accumulation. Although mitigating the effects of climate change through reductions in greenhouse gases is an important element of the Federal Highway Administration’s (FHWA’s) climate change strategy, the agency places equal importance on acknowledging that certain changes may require appropriate adaptation strategies.

#### **The Federal government is uniquely positioned to encourage climate adaptation in the transportation sector-Leveraging federal public transportation assets is key to motivating changes in the private sector**

Neumann ’09 – Resources for the Future think tank [Resources for the Future, “Adaptation to Climate Change: Revisiting Infrastructure Norms”, December 2009, Resources for the Future Issue Brief 09-15, <http://www.rff.org/rff/documents/RFF-IB-09-15.pdf>]

The main threats presented by climate change to infrastructure assets include damage or

destruction from extreme events, which climate change may exacerbate; coastal flooding and

inundation from sea level rise; changes in patterns of water availability; and effects of higher

temperature on operating costs, including effects in temperate areas and areas currently

characterized by permafrost conditions. Almost half of the more than $60 billion annual federal infrastructure investment is for highways (in excess of $30 billion annually), with smaller but significant capital expenditures in dams and flood control (about 12 percent of the total), mass transit (about 11 percent), and aviation (about 9 percent). The federal role relative to state, local, and private roles is also highest in the transportation subsector. **The best opportunity for the federal government to** influence and enhance infrastructure’s adaptive capacity is thus in the transportation sector**.** In almost all cases, some adaptive capacity exists to respond to these threats through both public and private sector actions, but adaptive capacity can be significantly enhanced in the public sector by adopting three key policy reforms. 􀁺 First, although most public infrastructure is maintained as a capital asset, with annual operating, maintenance, and repair functions and a periodic replacement schedule, adopting a formal asset management approach could yield immediate benefits **and provide a framework for incorporating climate forecasts to enhance adaptive capacity.** 􀁺 Second, **the location of major capital infrastructure should be mapped against those areas of the country considered most vulnerable to climate stress,** and that information should be used to guide current and future investment in public infrastructure. These results should be actively publicized to most effectively signal the private sector about the expectations and limits of federal infrastructure provision. 􀁺 Third, efforts must begin to update infrastructure design standards to ensure that future infrastructure capital is more resilient to anticipated climate change and extreme events.

#### **Only federal leadership can overcome institutional obstacles to climate adaptation reforms.**

NTPP ‘9 (National Transportation Policy Project, Bipartisan coalition of transportation policy experts, business and civic leaders, and is chaired by four distinguished former elected officials who served at the federal, state, and local levels, Published December 15 2009, Bipartisan Policy Center, <http://bipartisanpolicy.org/sites/default/files/Transportation%20Adaptation%20(3).pdf>)

The adaptation challenge is further complicated by the range of institutional players at the local, regional, state, and federal levels involved in transportation, land use, and development planning — as well as the variety of policy and regulatory frameworks in which they operate. Federal leadership can address the institutional barriers that too often inhibit integrated community and regional planning and investment, so that issues of equity, economic development, environmental stewardship, and sustainable communities are addressed in concert with infrastructure planning.

# Plan Text Ideas

#### Plan text ideas?

Develop strategies to address the potential¶ implications of climate change impacts on¶ the railroad sector, including mitigation¶ efforts, adaptation of railroad system¶ operations and infrastructure, and railroad¶ planning under uncertainty to minimize the¶ effects of future climate change.

The Department of Transportation (DOT)¶ and Federal Railroad Administration (FRA)¶ should develop a public-private partnership¶ program for the design and conduct of¶ research on the potential impacts of climate¶ change on transportation systems.¶ This research can be most effectively¶ undertaken through a collaborative effort¶ that builds on the expertise, resources, and¶ common interests of DOT and other¶ agencies. Collaborative technical work by¶ the DOT, the railroad industry, and other¶ research organizations could build on both¶ existing departmental expertise in relevant¶ areas (e.g., radar meteorology, climate¶ analysis) and also take advantage of¶ departmental participation in related¶ activities. These elements should be¶ pursued through an overall private-public¶ partnership on the potential impacts of¶ climate change on railroads.

# TO DO Wave Two

### 2AC Blocks to Write

Topicality

-Substantially

-Investment (maintenance)

Aspec

Counterplans

-States

-Investment Conditions

-Investment Mechanisms e.g. Bonds

-Warming CPs

-Exclude a sector

New Advantages to write

-Warming

-Soft Power/Environmental Leadership

-Oil infrastructure

Disads

-elections

-agenda politics

-Spending/Economy

Kritiks

-Capitalism

-Statism

-Objectivism

### Oil Advantage

Transportation Research Board of the National Academies ’11 [Transportation Research Board, “ Adapting Transportation to the Impacts of Climate Change”, June 2011, Transportation Research Circular, E-C152, <http://www.trb.org/Publications/Blurbs/165529.aspx> AD]

**In 2008, FHWA**, on behalf of the U.S. DOT Center for Climate Change and Environmental Forecasting and in coordination with other modes, **released a groundbreaking assessment of potential climate impacts on the Central Gulf Coast transportation network**, entitled Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: Gulf Coast Study, Phase 1 (Figure 2). The study region, which stretched from Houston and Galveston, Texas, to Mobile, Alabama, was selected due to its combination of population centers, **multimodal transportation systems—including** critical infrastructure focused on freight and petroleum movement**—and the low-lying region’s vulnerability to sea level rise and storm impacts.** The second phase of the study began in 2010 as an in-depth analysis of anticipated climate change effects and impacts on the transportation system of a single metropolitan area—Mobile, Alabama. The Gulf Coast Phase 2 study will generate tools and guidance for assessing vulnerability that can be transferred to other regions, and strategies for adapting transportation systems to anticipated changes in climate. In partnership with the USGS, FHWA is working with representatives from the Mobile MPO and the South Alabama Regional Planning Commission to complete the Gulf Coast Phase 2 study in 2013.

# Extensions-Inherency

## Warming Now

### Warming Real

#### Warming is real- Scientific consensus

United States Country Review 12 (“Global Environmental Concepts” in “United States Country Review 2012” Published by Countrywatch, Inc. 2012. Ebsco.)

A large number of climatologists believe that the increase in atmospheric concentrations of "greenhouse gas emissions," mostly a consequence of human activities such as the burning of fossil fuels, are ¶ contributing to global warming. The cause notwithstanding, the planet has reportedly warmed 0.3°C to 0.6°C over the last century. Indeed, each year during the 1990s was one of the very warmest in the 20th century, with the mean surface temperature for 1999 being the fifth warmest on record since 1880.¶ In early 2000, a panel of atmospheric scientists for the National Research Council concluded in a ¶ report that global warming was, indeed, a reality. While the panel, headed by Chairman John Wallace, ¶ a professor of atmospheric sciences at the University of Washington, stated that it remained unclear ¶ whether human activities have contributed to the earth's increasing temperatures, it was apparent that ¶ global warming exists.¶ In 2001, following a request for further study by the incoming Bush administration in the United ¶ States, the National Academy of Sciences again confirmed that global warming had been in existence ¶ for the last 20 years. The study also projected an increase in temperature between 2.5 degrees and 10.4 ¶ degrees Fahrenheit by the year 2100. Furthermore, the study found the leading cause of global warming to be emissions of carbon dioxide from the burning of fossil fuels, and it noted that greenhouse gas ¶ accumulations in the earth's atmosphere was a result of human activities.¶ Within the scientific community, the controversy regarding has centered on the difference between surface air and upper air temperatures. Information collected since 1979 suggests that while the earth's ¶ surface temperature has increased by about a degree in the past century, the atmospheric temperature ¶ five miles above the earth's surface has indicated very little increase. Nevertheless, the panel stated that ¶ this discrepancy in temperature between surface and upper air does not invalidate the conclusion that ¶ global warming is taking place. Further, the panel noted that natural events, such as volcanic eruptions, ¶ can decrease the temperature in the upper atmosphere.¶ The major consequences of global warming potentially include the melting of the polar ice caps, ¶ which, in turn, contribute to the rise in sea levels. Many islands across the globe have already experienced a measurable loss of land as a result. Because global warming may increase the rate of evaporation, increased precipitation, in the form of stronger and more frequent storm systems, is another ¶ potential outcome. Other consequences of global warming may include the introduction and proliferation of new infectious diseases, loss of arable land (referred to as "desertification"), destructive ¶ changes to existing ecosystems, loss of biodiversity and the isolation of species, and concomitant ¶ adverse changes in the quality of human life.

#### Those who deny warming use outdated theories not supported by science

Klein 11 (Naomi, columnist for the New York Times, “Capitalism vs. The Climate” November 28, 2011, ebsco.)

Claiming that climate change is a plot to steal American ¶ freedom is rather tame by Heartland standards. Over the ¶ course of this two-day conference, I will learn that Obama’s ¶ campaign promise to support locally owned biofuels refineries was really about “green communitarianism,” akin to the ¶ “Maoist” scheme to put “a pig iron furnace in everybody’s ¶ backyard” (the Cato Institute’s Patrick Michaels). That climate change is “a stalking horse for National Socialism” ¶ (former Republican senator and retired astronaut Harrison ¶ Schmitt). And that environmentalists are like Aztec priests, ¶ sacrificing countless people to appease the gods and change ¶ the weather (Marc Morano, editor of the denialists’ go-to ¶ website, ClimateDepot.com). ¶ Most of all, however, I will hear versions of the opinion ¶ expressed by the county commissioner in the fourth row: that ¶ climate change is a Trojan horse designed to abolish capitalism ¶ and replace it with some kind of eco-socialism. As conference ¶ speaker Larry Bell succinctly puts it in his new book Climate ¶ of Corruption, climate change “has little to do with the state ¶ of the environment and much to do with shackling capitalism ¶ and transforming the American way of life in the interests of ¶ global wealth redistribution.” ¶ Yes, sure, there is a pretense that the delegates’ rejection ¶ of climate science is rooted in serious disagreement about the ¶ data. And the organizers go to some lengths to mimic credible scientific conferences, calling the gathering “Restoring ¶ the Scientific Method” and even adopting the organizational ¶ acronym ICCC, a mere one letter off from the world’s leading ¶ authority on climate change, the Intergovernmental Panel on ¶ Climate Change (IPCC). But the scientific theories presented ¶ here are old and long discredited. And no attempt is made ¶ to explain why each speaker seems to contradict the next. (Is ¶ there no warming, or is there warming but it’s not a problem? ¶ And if there is no warming, then what’s all this talk about sunspots causing temperatures to rise?) ¶ In truth, several members of the mostly elderly audience ¶ seem to doze off while the temperature graphs are projected. ¶ They come to life only when the rock stars of the movement ¶ take the stage—not the C-team scientists but the A-team ideological warriors like Morano and Horner. This is the true purpose of the gathering: providing a forum for die-hard denialists ¶ to collect the rhetorical baseball bats with which they will ¶ club environmentalists and climate scientists in the weeks and ¶ months to come. The talking points first tested here will jam he comment sections beneath every article and YouTube video ¶ that contains the phrase “climate change” or “global warming.” They will also exit the mouths of hundreds of right-wing ¶ commentators and politicians—from Republican presidential ¶ candidates like Rick Perry and Michele Bachmann all the way ¶ down to county commissioners like Richard Rothschild. In an ¶ interview outside the sessions, Joseph Bast, president of the ¶ Heartland Institute, proudly takes credit for “thousands of ¶ articles and op-eds and speeches…that were informed by or ¶ motivated by somebody attending one of these conferences.” ¶ The Heartland Institute, a Chicago-based think tank ¶ devoted to “promoting free-market solutions,” has been holding these confabs since 2008, sometimes twice a year. And ¶ the strategy appears to be working. At the end of day one, ¶ Morano—whose claim to fame is having broken the Swift ¶ Boat Veterans for Truth story that sank John Kerry’s 2004 ¶ presidential campaign—leads the gathering through a series of ¶ victory laps. Cap and trade: dead! Obama at the Copenhagen ¶ summit: failure! The climate movement: suicidal! He even ¶ projects a couple of quotes from climate activists beating up ¶ on themselves (as progressives do so well) and exhorts the ¶ audience to “celebrate!” ¶ There were no balloons or confetti descending from the ¶ rafters, but there may as well have been.

### Warming Fast

#### New highs in the weather show climate change is higher than ever before

Bloomberg 7/11 (Bloomberg news, “Warm 2011 weather shows climate change dispite la niña” July 11th, 2012, http://www.businessweek.com/news/2012-07-11/warm-2011-weather-shows-climate-change-despite-la-nina)

Last year was among the 15 warmest since record keeping began in the late 19th century, despite a La Nina weather pattern that should have cooled global temperatures, according to an annual climate assessment.¶ La Nina’s failure to cause significantly cooler global temperatures is one of many indications of long-term climate warming, according to the U.S. National Oceanic and Atmospheric Administration’s State of the Climate report compiled by 378 scientists from 48 nations. La Nina was responsible for droughts in eastern Africa and North America, the scientists reported.¶ Last year “will be remembered as a year of extreme events, both in the United States and around the world,” Deputy NOAA Administrator Kathryn D. Sullivan said in a statement today. “Every weather event that happens now takes place in the context of a changing global environment.”¶ Texas had the hottest summer since data collection began in 1895 and extreme heat may be more common in the future.¶ “Conditions leading to droughts such as the one that occurred in Texas in 2011 are, at least in the case of temperature, distinctly more probable than they were 40-50 years ago,” according to the study. It used as a proxy 2008, another La Nina year, in which it found extreme heat was about 20 times more likely than in the 1960s.¶ Thailand’s 2011 floods weren’t the result of climate change because the amount of rain that fell “was not very unusual,” the report concluded.¶ Carbon dioxide emissions increased in 2011 and the yearly global average surpassed 390 parts per million for the first time since records started.

#### Effects from climate are happening now- loss of ice, sea level rise, more heat waves

NASA 7 [National Aeronautics and Space Administration, <http://climate.nasa.gov/effects/>, 2007]

Global climate change has already had observable effects on the environment. Glaciers have shrunk, ice on rivers and lakes is breaking up earlier, plant and animal ranges have shifted and trees are flowering sooner.¶ Effects that scientists had predicted in the past would result from global climate change are now occurring: loss of sea ice, accelerated sea level rise and longer, more intense heat waves.¶ Scientists have high confidence that global temperatures will continue to rise for decades to come, largely due to greenhouse gasses produced by human activities. The Intergovernmental Panel on Climate Change (IPCC), which includes more than 1,300 scientists from the United States and other countries, forecasts a temperature rise of 2.5 to 10 degrees Fahrenheit over the next century.¶ According to the IPCC, the extent of climate change effects on individual regions will vary over time and with the ability of different societal and environmental systems to mitigate or adapt to change.¶ The IPCC predicts that increases in global mean temperature of less than 1.8 to 5.4 degrees Fahrenheit (1 to 3 degrees Celsius) above 1990 levels will produce beneficial impacts in some regions and harmful ones in others. Net annual costs will increase over time as global temperatures increase.¶ "Taken as a whole," the IPCC states, "the range of published evidence indicates that the net damage costs of climate change are likely to be significant and to increase over time." 1

#### The brink is now; we are seeing the first impacts now

IPCC 7 (Intergovernmental Panel on Climate Change, 2007, governmental climate research group http://environment.nationalgeographic.com/environment/global-warming/gw-effects)

The planet is warming, from North Pole to South Pole, and everywhere in between. Globally, the mercury is already up more than 1 degree Fahrenheit (0.8 degree Celsius), and even more in sensitive polar regions. And the effects of rising temperatures aren’t waiting for some far-flung future. They’re happening right now. Signs are appearing all over, and some of them are surprising. The heat is not only melting glaciers and sea ice, it’s also shifting precipitation patterns and setting animals on the move.¶ Some impacts from increasing temperatures are already happening.¶ Ice is melting worldwide, especially at the Earth’s poles. This includes mountain glaciers, ice sheets covering West Antarctica and Greenland, and Arctic sea ice.¶ Researcher Bill Fraser has tracked the decline of the Adélie penguins on Antarctica, where their numbers have fallen from 32,000 breeding pairs to 11,000 in 30 years.¶ Sea level rise became faster over the last century.¶ Some butterflies, foxes, and alpine plants have moved farther north or to higher, cooler areas.¶ Precipitation (rain and snowfall) has increased across the globe, on average.¶ Spruce bark beetles have boomed in Alaska thanks to 20 years of warm summers. The insects have chewed up 4 million acres of spruce trees.¶ Other effects could happen later this century, if warming continues.¶ Sea levels are expected to rise between 7 and 23 inches (18 and 59 centimeters) by the end of the century, and continued melting at the poles could add between 4 and 8 inches (10 to 20 centimeters).¶ Hurricanes and other storms are likely to become stronger.¶ Species that depend on one another may become out of sync. For example, plants could bloom earlier than their pollinating insects become active.¶ Floods and droughts will become more common. Rainfall in Ethiopia, where droughts are already common, could decline by 10 percent over the next 50 years.¶ Less fresh water will be available. If the Quelccaya ice cap in Peru continues to melt at its current rate, it will be gone by 2100, leaving thousands of people who rely on it for drinking water and electricity without a source of either.¶ Some diseases will spread, such as malaria carried by mosquitoes.¶ Ecosystems will change—some species will move farther north or become more successful; others won’t be able to move and could become extinct. Wildlife research scientist Martyn Obbard has found that since the mid-1980s, with less ice on which to live and fish for food, polar bears have gotten considerably skinnier. Polar bear biologist Ian Stirling has found a similar pattern in Hudson Bay. He fears that if sea ice disappears, the polar bears will as well.

#### Effects of warming being seen, now is key

Harvey 7/10(July 10, 2012, Fiona Harvey, environmental correspondent, Journalist for The Guardian, http://www.guardian.co.uk/environment/2012/jul/10/extreme-weather-manmade-climate-change)

Climate change researchers have been able to attribute recent examples of extreme weather to the effects of human activity on the planet's climate systems for the first time, marking a major step forward in climate research.¶ The findings make it much more likely that we will soon – within the next few years – be able to discern whether the extremely wet and cold summer and spring so far experienced in the UK this year are attributable to human causes rather than luck, according to the researchers.¶ Last year's record warm November in the UK – the second hottest since records began in 1659 – was at least 60 times more likely to happen because of climate change than owing to natural variations in the earth's weather systems, according to the peer-reviewed studies by the National Oceanic and Atmospheric Administration in the US, and the Met Office in the UK. The devastating heatwave that blighted farmers in Texas in the US last year, destroying crop yields in another record "extreme weather event", was about 20 times more likely to have happened owing to climate change than to natural variation.¶ Attributing individual weather events, such as floods, droughts and heatwaves, to human-induced climate change – rather than natural variation in the planet's complex weather systems – has long been a goal of climate change scientists. But the difficulty of separating the causation of events from the background "noise" of the variability in the earth's climate systems has until now made such attribution an elusive goal.¶ To attribute recent extreme weather events – rather than events 10 years ago or more – to human-caused climate change is a big advance, and will help researchers to provide better warnings of the likely effects of climate change in the near future. This is likely to have major repercussions on climate change policy and the ongoing efforts to adapt to the probable effects of global warming.¶ Peter Stott, of the UK's Met Office, said: "We are much more confident about attributing [weather effects] to climate change. This is all adding up to a stronger and stronger picture of human influence on the climate."¶ But the researchers also said that not every extreme weather event could be attributed to climate change. For instance, the extremely cold British winter of 2010-11 – starkly exemplified by the satellite picture of the UK and Ireland covered in white on Christmas Eve, as snow gripped the nations – was owing to variations in the systems of ocean and air circulation. Although such cold winters are now only half as likely as they were several decades ago, owing to a generally warming climate across the world, extremely low temperatures of this type are still possible depending on circulation effects – in this case, a negative North Atlantic Oscillation, the circulation system that is a key determinant of European weather.¶ Floods in Thailand last year, another example studied in the research, were also not judged to be due to climate change but to other factors such as changes in the management of local river systems.¶ Following and predicting temperature rises tends to be much less complex than predicting – and attributing the causes of – changes in precipitation patterns.¶ This year's weather in the UK is an example. The Met Office has said the record wet conditions, which have brought serious flooding to regions from Yorkshire to the south-west, were owing to "a particularly disturbed jet stream". That is the weather system across the north Atlantic that normally lies at higher latitudes during the British summer, but has been lower in latitude than usual for several years running, bringing wet and sometimes cold conditions. Some research has suggested that the massive melting of Arctic ice has been responsible for this effect – by changing the patterns of warmer and colder winds in the upper atmosphere.¶ But the key question – of whether man-made global warming is putting a dampener on British summers – will take several years to solve, according to Stott. "This is an open question in terms of research – it is too early days to be able to say," he said

### Warming Inevitable

#### Scientific consensus proves that climate change is real - we have already past the tipping point - feedback cycles lock it in for the next 1000 years

Soloman et. al 10 [Susan Solomon et. Al, Chemical Sciences Division, Earth System Research Laboratory, National Oceanic and Atmospheric Administration, Ph.D. in Climotology University of California, Berkeley, Nobel Peace Prize Winner, Chairman of the IPCC, Gian-Kasper Plattner, Deputy Head, Director of Science, Technical Support Unit Working Group I, Intergovernmental Panel on Climate Change Affiliated Scientist, Climate and Environmental Physics, Physics Institute, University of Bern, Switzerland, John S. Daniel, research scientist at the National Oceanic and Atmospheric Administration (NOAA), Ph.D. in physics from the University of Michigan, Ann Arbor, Todd J. Sanford, Cooperative Institute for Research in Environmental Science, University of Colorado Daniel M. Murphy, Chemical Sciences Division, Earth System Research Laboratory, National Oceanic and Atmospheric Administration, Boulder Gian-Kasper Plattner, Deputy Head, Director of Science, Technical Support Unit Working Group I, Intergovernmental Panel on Climate Change, Affiliated Scientist, Climate and Environmental Physics, Physics Institute, University of Bern, Switzerland Reto Knutti, Institute for Atmospheric and Climate Science, Eidgenössiche Technische Hochschule Zurich and Pierre Friedlingstein, Chair, Mathematical Modelling of Climate Systems, member of the Science Steering Committee of the Analysis Integration and Modeling of the Earth System (AIMES) programme of IGBP and of the Global Carbon Project (GCP) of the Earth System Science Partnership (ESSP), 8/31/2010, “Persistence of climate changes due to a range of greenhouse gases,” PNAS vol. 107, no. 43, [**http://www.pnas.org/content/107/43/18354.full.pdf+html**](http://www.pnas.org/content/107/43/18354.full.pdf+html)]

Carbon dioxide, methane, nitrous oxide, and other greenhouse gases increased over the course of the 20th century due to human activities. The human-caused increases in these gases are the primary forcing that accounts for much of the global warming of the past fifty years, with carbon dioxide being the most important single radiative forcing agent (1). Recent studies have shown that the human-caused warming linked to carbon dioxide is nearly irreversible for more than 1,000 y[ears], even if emissions of the gas were to cease entirely (2–5). The importance of the ocean in taking up heat and slowing the response of the climate system to radiative forcing changes has been noted in many studies (e.g., refs. 6 and 7). The key role of the ocean’s thermal lag has also been highlighted by recent approaches to proposed metrics for comparing the warming of different greenhouse gases (8, 9). Among the observations attesting to the importance of these effects are those showing that climate changes caused by transient volcanic aerosol loading persist for more than 5 y (7, 10), and a portion can be expected to last more than a century in the ocean (11–13); clearly these signals persist far longer than the radiative forcing decay timescale of about 12–18 mo for the volcanic aerosol (14, 15). Thus the observed climate response to volcanic events suggests that some persistence of climate change should be expected even for quite short-lived radiative forcing perturbations. It follows that the climate changes induced by short-lived anthropogenic greenhouse gases such as methane or hydrofluorocarbons (HFCs) may not decrease in concert with decreases in concentration if the anthropogenic emissions of those gases were to be eliminated. In this paper, our primary goal is to show how different processes and timescales contribute to determining how long the climate changes due to various greenhouse gases could be expected to remain if anthropogenic emissions were to cease. Advances in modeling have led to improved AtmosphereOcean General Circulation Models (AOGCMs) as well as to Earth Models of Intermediate Complexity (EMICs). Although a detailed representation of the climate system changes on regional scales can only be provided by AOGCMs, the simpler EMICs have been shown to be useful, particularly to examine phenomena on a global average basis. In this work, we use the Bern 2.5CC EMIC (see Materials and Methods and SI Text), which has been extensively intercompared to other EMICs and to complex AOGCMs (3, 4). It should be noted that, although the Bern 2.5CC EMIC includes a representation of the surface and deep ocean, it does not include processes such as ice sheet losses or changes in the Earth’s albedo linked to evolution of vegetation. However, it is noteworthy that this EMIC, although parameterized and simplified, includes 14 levels in the ocean; further, its global ocean heat uptake and climate sensitivity are near the mean of available complex models, and its computed timescales for uptake of tracers into the ocean have been shown to compare well to observations (16). A recent study (17) explored the response of one AOGCM to a sudden stop of all forcing, and the Bern 2.5CC EMIC shows broad similarities in computed warming to that study (see Fig. S1), although there are also differences in detail. The climate sensitivity (which characterizes the long-term absolute warming response to a doubling of atmospheric carbon dioxide concentrations) is 3 °C for the model used here. Our results should be considered illustrative and exploratory rather than fully quantitative given the limitations of the EMIC and the uncertainties in climate sensitivity. Results One Illustrative Scenario to 2050. In the absence of mitigation policy, concentrations of the three major greenhouse gases, carbon dioxide, methane, and nitrous oxide can be expected to increase in this century. If emissions were to cease, anthropogenic CO2 would be removed from the atmosphere by a series of processes operating at different timescales (18). Over timescales of decades, both the land and upper ocean are important sinks. Over centuries to millennia, deep oceanic processes become dominant and are controlled by relatively well-understood physics and chemistry that provide broad consistency across models (see, for example, Fig. S2 showing how the removal of a pulse of carbon compares across a range of models). About 20% of the emitted anthropogenic carbon remains in the atmosphere for many thousands of years (with a range across models including the Bern 2.5CC model being about 19 4% at year 1000 after a pulse emission; see ref. 19), until much slower weathering processes affect the carbonate balance in the ocean (e.g., ref. 18). Models with stronger carbon/climate feedbacks than the one considered here could display larger and more persistent warmings due to both CO2 and non-CO2 greenhouse gases, through reduced land and ocean uptake of carbon in a warmer world. Here our focus is not on the strength of carbon/climate feedbacks that can lead to differences in the carbon concentration decay, but rather on the factors that control the climate response to a given decay. The removal processes of other anthropogenic gases including methane and nitrous oxide are much more simply described by exponential decay constants of about 10 and 114 y, respectively (1), due mainly to known chemical reactions in the atmosphere. In this illustrative study, we do not include the feedback of changes in methane upon its own lifetime (20). We also do not account for potential interactions between CO2 and other gases, such as the production of carbon dioxide from methane oxidation (21), or changes to the carbon cycle through, e.g., methane/ozone chemistry (22). Fig. 1 shows the computed future global warming contributions for carbon dioxide, methane, and nitrous oxide for a midrange scenario (23) of projected future anthropogenic emissions of these gases to 2050. Radiative forcings for all three of these gases, and their spectral overlaps, are represented in this work using the expressions assessed in ref. 24. In 2050, the anthropogenic emissions are stopped entirely for illustration purposes. The figure shows nearly irreversible warming for at least 1,000 y due to the imposed carbon dioxide increases, as in previous work. All published studies to date, which use multiple EMICs and one AOGCM, show largely irreversible warming due to future carbon dioxide increases (to within about 0.5 °C) on a timescale of at least 1,000 y (3–5, 25, 26). Fig. 1 shows that the calculated future warmings due to anthropogenic CH4 and N2O also persist notably longer than the lifetimes of these gases. The figure illustrates that emissions of key non-CO2 greenhouse gases such as CH4 or N2O could lead to warming that both temporarily exceeds a given stabilization target (e.g., 2 °C as proposed by the G8 group of nations and in the Copenhagen goals) and remains present longer than the gas lifetimes even if emissions were to cease. A number of recent studies have underscored the important point that reductions of non-CO2 greenhouse gas emissions are an approach that can indeed reverse some past climate changes (e.g., ref. 27). Understanding how quickly such reversal could happen and why is an important policy and science question. Fig. 1 implies that the use of policy measures to reduce emissions of short-lived gases will be less effective as a rapid climate mitigation strategy than would be thought if based only upon the gas lifetime. Fig. 2 illustrates the factors influencing the warming contributions of each gas for the test case in Fig. 1 in more detail, by showing normalized values (relative to one at their peaks) of the warming along with the radiative forcings and concentrations of CO2, N2O, and CH4. For example, about two-thirds of the calculated warming due to N2O is still present 114 y (one atmospheric lifetime) after emissions are halted, despite the fact that its excess concentration and associated radiative forcing at that time has dropped to about one-third of the peak value. Two factors contribute to the differences between decreases in concentrations of greenhouse gases and persistence of the resulting warming, discussed further below: (i) Radiative forcing may not simply follow concentration because of optical depth effects (for CO2 and CH4), and (ii) warming may not match decreases in Fig. 1. Computed surface warming obtained in the Bern 2.5CC model due to CO2, CH4, and N2O emission increases to 2050 following a “midrange” scenario (called A1B; see ref. 23) followed by zero anthropogenic emissions thereafter. The gases are changed sequentially in this calculation in order to explicitly separate the contributions of each. The bumps shown in the calculated warming are due to changes in ocean circulation, as in previous studies (5, 26, 39). The main panel shows the contributions to warming due to CO2, N2O, and CH4. The inset shows an expanded view of the warming from year 2000 to 2200. radiative forcing because of climate inertia, particularly due to the ocean. Climate Change Persistence: (I) Optical Depth Effects. The physics of absorption spectroscopy dictate that radiative forcing will be linearly related to concentration changes for those gases whose atmospheric optical depth is thin, whereas nonlinear forcing occurs for thicker optical depths (24). Because CO2 absorption is not optically thin, the fractional increase in radiative forcing per parts per million by volume of CO2 increase becomes smaller for larger CO2 concentrations. Fig. 2 shows how this factor acts in the reverse sense during relaxation from a peak, enhancing the CO2 radiative forcing relative to the calculated concentration decrease. For example, for a 535 ppmv peak (as in the calculation in Fig. 1), the excess CO2 concentration above the preindustrial value of 278 ppmv remaining in the year 2200 is about 55% of the peak value, whereas the fractional radiative forcing remaining in that year is about 63% of the peak value (i.e., the relative change in forcing is greater than the relative change in concentration by about 14%). Nonlinear optical effects grow as the concentration change grows. For example, for a peak of CO2 of 1,200 ppmv in the 21st century followed by a stop of emissions, the relative change in forcing compared to the relative change in concentration in the year 3000 is about 30%. Thus nonlinear spectroscopy, although not the dominant factor, contributes to rendering the warming from CO2 nearly irreversible, especially for larger values of peak concentration. Methane also displays significant nonlinearities in its radiative absorption, whereas these effects are very small for N2O (Fig. 2). HFCs and perfluorocarbons absorb in the atmospheric window and are optically thin over the full range of plausible future concentrations; therefore, these gases display no nonlinear optical absorption. We find that nonlinear spectral effects exceed 10% contributions to the persistence of warming only for carbon dioxide and methane, and not for any of the other anthropogenic greenhouse gases. Climate Change Persistence: (II) Physical Processes. Climate change is linked to a range of phenomena displaying varying timescales (see, e.g., ref. 28). The atmosphere, clouds, and water vapor respond within a few months following a change in radiative forcing (29). The transfer of heat from the atmosphere to the ocean’s mixed layer (top 100 m or so) is thought to occur on timescales on the order of a decade or less (30), whereas multiple centuries are required to warm or cool the deep ocean (31), and changes in the great ice sheets and vegetation coverage may occur over many thousands of years (4). Much of the energy that has been added to the Earth’s climate system in the 20th century through net radiative forcing has been taken up by the ocean (32). However, a large fraction of the energy that could be trapped due to the impact of radiative forcing has not been added to the climate system at all but rather has been lost to space, because the Earth has already warmed and therefore must radiate more energy. Observations and models both suggest that about two-thirds of the net radiative forcing (warming by anthropogenic greenhouse gases less cooling by stratospheric and tropospheric aerosols) of the past half century has been radiated to space, while about one-third has been absorbed by the ocean (33–35). If anthropogenic radiative forcing were to be stabilized, atmospheric warming would continue for many centuries as the components of the climate system reach a balance. On the other hand, if such forcing were to abruptly cease, some energy would be expected to be lost rapidly through radiation to space, while some would be lost more slowly as the coupled ocean mixed layer/atmosphere system adjusts. Some of the energy loss would occur over centuries depending mainly upon the amount of heat that has been stored in the deep ocean. These processes are linked both to transient climate response and ocean heat uptake, and the uncertainties in these parameters are of order 50% between current state-of-the-art AOGCMs (4, 35). Ocean heat uptake and changes in ocean circulation are not well characterized by observations and contribute to the differences in future climate responses between models (3, 4, 31). Carbon cycle processes that may slowly release carbon back to the atmosphere in a warming world (e.g., through changes in forest cover and soil carbon dynamics) also affect the long-term behavior of warming and differ from model to model (3, 36).

#### We are on track for mass warming- will result in environmental and ecosystem change

Dyer 7/2 [Gywnne Dyer, Journalist for Journal Star, <http://journalstar.com/news/opinion/editorial/columnists/gwynne-dyer-how-bad-could-global-warming-get/article_670c924c-b25e-59aa-9276-87d381c51c2e.html#ixzz20H28jEXb> (7/2/12)]

The scientific consensus is that we are still on track for 3 degrees Celsius of warming (5 degrees Fahrenheit) by 2100, but that’s just warming caused by human greenhouse-gas emissions. The problem is that 3 degrees is well past the point where the major feedbacks kick in: natural phenomena triggered by our warming, like melting permafrost and the loss of Arctic sea-ice cover, that will add to the heating and that we cannot turn off. The trigger actually is about 2 degrees C (3.5 degrees F) higher average global temperature. After that, we lose control of the process: ending our own carbon-dioxide emissions no longer would be enough to stop the warming. We may end up trapped on an escalator heading up to plus-6 degrees C (plus-10.5 degrees F), with no way of getting off. And plus-6 degrees C gives you the mass extinction.

#### Global warming is inevitable because of feedback cycles-will result in massive flooding, warming, and eco system change

Longley 7[Robert Longley, Bachelors in Science from Texas A&M, Works at the the Environmental Protection Agency and U.S. Census Bureau 2007] http://usgovinfo.about.com/od/technologyandresearch/a/climatetochange.htm

Despite efforts to reduce greenhouse gas emissions, global warming and a greater increase in sea level are inevitable, according to a new study performed by a team of climate modelers at the National Center for Atmospheric Research (NCAR) in Boulder, Colo.¶ Indeed, say the researchers, whose work was funded by the National Science Foundation (NSF), globally averaged surface air temperatures would still rise one degree Fahrenheit (about a half degree Celsius) by the year 2100, even if no more greenhouse gases were added to the atmosphere. And the resulting transfer of heat into the oceans would cause global sea levels to rise another 4 inches (11 centimeters) from thermal expansion alone.¶ The team's findings are published in this week's issue of the journal "Science."¶ “This study is another in a series that employs increasingly sophisticated simulation techniques to understand the complex interactions of the Earth,” says Cliff Jacobs of NSF’s atmospheric sciences division. “These studies often yield results that are not revealed by simpler approaches and highlight unintended consequences of external factors interacting with Earth’s natural systems.”¶ “Many people don’t realize we are committed right now to a significant amount of global warming and sea level rise because of the greenhouse gases we have already put into the atmosphere,” says lead author Jerry Meehl. “Even if we stabilize greenhouse gas concentrations, the climate will continue to warm, and there will be proportionately even more sea level rise. The longer we wait, the more climate change we are committed to in the future.”¶ The half-degree temperature rise predicted by the NCAR modelers is similar to what was actually observed by the end of the 20th century, but the projected sea level rise is more than twice the 3-inch (5-centimeter) rise that was observed then. Moreover, these forecasts do not take into account any fresh water from melting ice sheets and glaciers, which could at least double the sea-level rise caused by thermal expansion alone.¶ The models also predict a weakening of the North Atlantic thermohaline circulation, which currently warms Europe by transporting heat from the tropics. Even so, Europe heats up along with the rest of the planet because of the overwhelming effect of greenhouse gases.¶ Though the study finds signs that the temperature rise will level off some 100 years after the greenhouse gases stabilize, it also finds that ocean waters will continue to warm and expand beyond then, causing global sea level to rise unabated.¶ According to the report, the inevitability of climate change results from thermal inertia, mainly from the oceans, and the long lifetime of carbon dioxide and other greenhouse gases in the atmosphere. Thermal inertia refers to the process by which water heats and cools more slowly than air because it is denser than air.¶ The new study is the first to quantify future “committed” climate change using coupled global 3-dimensional climate models. Coupled models link major components of Earth's climate in ways that allow them to interact with each other. Meehl and his NCAR colleagues ran the same scenario a number of times and averaged the results to create ensemble simulations from each of two global climate models. Then they compared the results from each model.¶ The scientists also compared possible climate scenarios in the two models during the 21st century in which greenhouse gases continue to build in the atmosphere at low, moderate, or high rates. The worst-case scenario projects an average temperature rise of 6.3 °F (3.5 °C) and sea level rise from thermal expansion of 12 inches (30 centimeters) by 2100. All scenarios analyzed in the study will be assessed by international teams of scientists for the next report by the Intergovernmental Panel on Climate Change, due out in 2007.

## SQ Inadequate

Transportation Infrastructure Investment does not include climate adaptation measures

Neumann ’09 – Resources for the Future think tank [Resources for the Future, “Adaptation to Climate Change: Revisiting Infrastructure Norms”, December 2009, Resources for the Future Issue Brief 09-15, <http://www.rff.org/rff/documents/RFF-IB-09-15.pdf>, AD]

The American Recovery and Reinvestment Act (ARRA) attempts to address some of these

shortfalls in infrastructure provision; the act authorizes up to $150 billion in infrastructure funding

over three years.4 Most of this funding is focused on the transportation and energy sectors, with

smaller amounts focused on wastewater, drinking water, and flood protection. Some does

consider the impact of climate change on infrastructure operation and demand. For example,

much of the energy infrastructure investments are focused on renewable technologies and

development of a smart grid to accommodate greater reliance on renewables; there is a $1 billion

allocation to the Bureau of Reclamation for water resource development in drought‐likely areas;

and the roughly $4.5 billion allocation to the U.S. Army Corps of Engineers includes upgrades to

flood protection infrastructure, which is perhaps a nod to the likelihood of climate change

increasing flood risks. Nonetheless, virtually no provisions in the transportation funding take

account of the risks of climate change to these resources. The priority instead is on quickly moving

money to maximize the short‐term economic stimulus effect of the spending. As discussed in the next section, this shortcoming in efficiently adapting to climate change is potentially serious,

because shovel‐ready is almost certainly not climate‐ready.

#### We need to change our existing designs – current systems just won’t cut it.

Transportation Research Board of the National Academies ’11 [Transportation Research Board, “ Adapting Transportation to the Impacts of Climate Change”, June 2011, Transportation Research Circular, E-C152, <http://www.trb.org/Publications/Blurbs/165529.aspx> AD]

One of the key challenges in adaptation planning is the uncertainty of future projections regarding climate change and its impacts (Figure 1). Transportation planners must rely on such projections because anticipated climate changes will likely surpass past trends, which have traditionally been the basis for transportation decision making. **Adaptation to climate change necessitates a shift in existing design and planning paradigms,** as **the demands** placed on transportation **will require more robust systems** that can cope with an increasingly extreme and volatile climate. To address the risks that climate change poses, state, regional, and local planning and transportation organizations first need to understand and evaluate the threats facing their systems. In the spring of 2010, FHWA released a report entitled Regional Climate Change Effects: Useful Information for Transportation Agencies (the Effects report), which provides planners with information on the climate changes likely to have the greatest impacts on transportation systems. Drawing on the expertise of multiple federal agencies, including the U.S. Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Department of Energy, the Effects report presents the science of climate change in the context of transportation at a regional level. The report is organized by region (Northeast, Southeast, Midwest, Great Plains, Southwest, Pacific Northwest, Alaska, Hawaii, Puerto Rico), time horizon (2010–2040, 2040–2070, 2070–2100), and climate effect (projected change in temperature, precipitation, storm activity, sea level) and includes the best available climate projections. These projections are presented through narrative descriptions, tables and maps, and a Climate Change Effects Typology Matrix, which aggregates projections by region and, in certain cases, subregions, states, and cities. In addition to summarizing the current understanding of projected climate change effects, the report includes a brief discussion linking these effects to potential impacts on infrastructure, such as flooded roads and damage to bridges. Although the Effects report does not present adaptation strategies, it does provide information that highway planners can use to begin to identify and address vulnerabilities and to generate discussion between the transportation and climate science communities.

## Climate Threatens TI

#### Climate change is already damaging our nation’s infrastructure.

Transportation Research Board of the National Academies ’11 [Transportation Research Board, “ Adapting Transportation to the Impacts of Climate Change”, June 2011, Transportation Research Circular, E-C152, <http://www.trb.org/Publications/Blurbs/165529.aspx> AD]

**In 2010, transportation** **agencies** in Tennessee, Rhode Island, and Iowa **saw** firsthand **the effect of extreme rainfall** events that brought severe flooding and a wide range of impacts to the transportation system. These effects are likely to be early signs of climate change. • March 2010: Rhode Island experienced record flooding due to intense rainfall, not just once but twice. The unprecedented rainfall forced closure of 98 roads and 20 bridges, including closure of critical parts of Interstate 95 for 36 hours. To avoid having to also close nearby I-295, Rhode Island Department of Transportation (DOT) used thousands of sandbags and pumper trucks from the Warwick Fire Department. Ten days after the worst rainfall, 15 roads and bridges were still closed despite heroic efforts by 150 Rhode Island DOT maintenance crews and 50 engineering crews working around the clock to get them open. • July–August 2010: In July, northeast Iowa saw torrential rainfall (as much as 9 in. in places) that pushed the Maquoketa River to 23.92 ft—more than 2 ft above its previous record of 21.66 ft in 2004. In August, intense waves of thunderstorms over 3 days fell on already-saturated ground and forced closure of I-35 northbound and southbound near Ames, Iowa, along with many other roadways. Just 2 years earlier, in 2008, Iowa experienced record Traffic on I-40, a major east–west corridor across the United States, halted in West Nashville, Tennessee, due to flood waters after heavy rainfall in May 2010. Burbank 11 levels of flooding that closed roads and damaged roads and bridges. Iowa DOT’s website carries sites that feature dozens of pictures of the impacts of the 2008 flooding and the 2010 flooding. • **May 2010**: On May 1–2, **rainfall in Nashville, Tennessee, was more than double the previous record** for a 2-day period—and the previous record was set during a hurricane. Forty-one counties suffered highway and bridge damage, including a large landslide that covered parts of US-70. In Maury Country, two sections of State Route 7 sank as much as 20 ft below its original elevation due to ground saturation and collapse of pavement. **Multiple sinkholes emerged, including a large sinkhole in eastbound I-24 that was 25 ft wide and 25 ft deep, which emerged 2 weeks after the flooding. Estimated impacts included 100 routes affected, $45 million in repair costs, and 83,000 state DOT maintenance hours to assess damage and recover.** Severe rainfall is one of the signs of climate change. Warmer temperatures put more moisture in the air and increase the probability of more severe precipitation—greater rainfall in short periods, occurring more often. Scientists and weather experts who track the climate are convinced that climate change is already happening, at a faster rate than climate models predicted a few years ago, and that many parts of the world will see this intensify over time. The 2010 experiences of transportation agencies in Iowa, Tennessee, and Rhode Island are likely to be repeated there and elsewhere in future years, making it important to begin climate adaptation planning now to evaluate the new vulnerabilities and risks associated with climate change, to develop plans for coping with these events, and to incorporate these risks into asset management and infrastructure design for the future.

#### America’s critical infrastructure is currently vulnerable to climate change

Transportation Research Board of the National Academies ’11 [Transportation Research Board, “ Adapting Transportation to the Impacts of Climate Change”, June 2011, Transportation Research Circular, E-C152, <http://www.trb.org/Publications/Blurbs/165529.aspx> AD]

**The transportation planners, designers, and operators of this nation’s transportation systems face many daunting concerns, not the least of which is funding to maintain and improve the country’s infrastructure and competitiveness. To these concerns is now added climate change or global warming**. This paper does not address the science of climate change or the issue of mitigation to reduce the emissions of greenhouse gases (GHG). Rather it accepts the current state of knowledge on global warming and focuses on adaptation. How does the transportation community develop solutions and approaches that will minimize or eliminate the impact of climate change? To many, this question is a paramount one as the nation builds, rebuilds, operates, and maintains its transportation infrastructure. Even if there are major strides in the mitigation of GHG emissions, the world very likely will be facing a significantly altered climate in coming decades with impacts that test our current ability to forecast accurately. Nonetheless, one can develop scenarios of probable impacts and how the United States might adapt to conditions that could occur 25 to 50 years hence. While most of these scenarios deal with transportation, a few others are included to demonstrate the breadth of the impacts. • **Rising sea levels will place** people, homes, businesses, and **infrastructure at risk**, especially along the Atlantic and Gulf Coasts and Alaska. Coupled with land subsidence, prevalent in many areas such as the Gulf Coast, the impacts will be felt tens of miles inland. **More intense hurricanes** packing higher wind speeds coming on shore on higher sea levels **are a recipe for even greater disaster**. Efforts to restore barrier islands to protect the mainland will be extensive and expensive. Sea walls along miles of shoreline may protect densely populated areas, but relocation inland of some communities may well be necessary. Transportation systems must be designed to permit faster and orderly evacuation of coastal communities. Are there new structural and nonstructural solutions to these problems? Can more resilient systems be developed that can withstand a certain amount of inundation during high storm surges, but restore service and utility rapidly? • Heat will be a growing concern throughout much of the United States. Warmer temperatures and longer heat waves will create demand for more air conditioning, even in northern latitudes such as New England. By the end of the century, the climate in Illinois is forecast to be like Texas today. Sustained **higher temperatures will stress pavement materials, bridge structures, and rails.** The impact of prolonged heat waves will impact the most vulnerable of our population, the poor, the elderly, and the very young. With rising temperatures will come greater desertification and drought, particularly in the southwest. Water scarcity, already an issue in those regions, will necessitate changes in water laws and interstate compacts. Lower air densities will reduce aircraft takeoff payloads and require longer runways. • Water levels in the Great Lakes will drop, impacting shipping through the Saint Lawrence Seaway, but elsewhere higher temperatures of inland waterways and the Arctic will lengthen the shipping season. Power plant efficiencies will decrease absent new T Schwartz 3 technologies to improve heat transfer systems. Construction and other outside work will increasingly be performed in evening and nighttime hours to protect workers’ health. Are there more effective ways to protect the most vulnerable from the impacts of heat waves? Can more heat resistant materials be developed with which to pave our highways and build our infrastructure? Can new developments in aerodynamic design improve aircraft liftoff capacities? • With the shift in temperatures, there will be a concomitant migration of plant, insect, and disease vectors northward in the United States. The unprecedented infestation by the log pole pine beetle in the Rocky Mountains and the spruce beetle in Alaska will have eliminated those native trees, [create] a tinderbox for forest fires. As amply demonstrated in California, Florida, and Colorado, such fires directly impact transportation visibility and are invariably followed by rainstorms generating mudslides that destroy rail lines and highways. Crops once confined to southern climes will now be grown farther north, and the growing season may well permit two harvests per year in new locales. Conversely, drought and water reallocations may change the crops grown in some of the nation’s most productive regions such as the southwest. Weeds and other invasive plant species will rapidly move northward as will disease vectors thereby placing larger populations at risk. It is likely that natural mutations of some of these diseases will create new problems. Plant science will be particularly challenged to arrest some of these migrations as will the health sciences. On a positive note, warmer winters may well reduce the need for and cost of snow and ice removal while improving vehicle safety. • Increased intensity of precipitation in many parts of the continental United States and perhaps Alaska will place new stresses on the environment. Rainfall frequency– duration profiles will have changed very significantly: more frequent, heavier storms. Culverts, stormwater **drainage systems**, and natural drainage basins **will all experience overloads with the increase in heavy rainfall. Infrastructure, such as bridges, levees, and dikes, will have to be designed to withstand greater hydraulic loads**. Hydrological analyses will be revised, flood plains redefined, and new engineering standards developed. Social and environmental questions must be addressed as the nation wrestles with the entire issue of sustainable development especially in coastal communities. See the sidebar (page 10), which graphically shows effects of increased precipitation. • Alaska is a special case as temperatures are expected to rise much more rapidly in far northern regions. The Arctic ice sheet will retreat even farther, opening the Northwest Passage to shipping but exposing the northern slope of Alaska to greater storm erosion. Many native villages will have to be relocated. Infrastructure built on permafrost will be endangered, necessitating new structural approaches and replacement. Cold weather roads will disappear, creating yet another challenge to accessing parts of Alaska by rail or road.

#### Climate change could have significant impacts for our infrastructure. However, we are totally unprepared for these scenarios.

Transportation Research Board of the National Academies **’11** [Transportation Research Board, “ Adapting Transportation to the Impacts of Climate Change”, June 2011, Transportation Research Circular, E-C152, <http://www.trb.org/Publications/Blurbs/165529.aspx> AD]

T**he projected effects of climate change could have significant implications for the nation’s transportation system**. **Rising sea levels, increasingly extreme temperatures, changes in the frequency and intensity of storm events, and accelerating patterns of erosion could damage infrastructure, flood roadways, and disrupt safe and efficient travel**. Certain effects, such as sea level rise and increases in storm intensity, present obvious challenges. Storm surge can damage and destroy coastal roadways, rail lines, and bridges and sea level rise will only exacerbate such effects. Rising sea levels can also present flooding risks to underground infrastructure such as subways and road tunnels, allowing water to enter through portals and ventilation shafts. Subtle changes, such as those expected in temperature, will also necessitate changes in the design, construction, and maintenance of infrastructure—for instance, the incorporation of materials and building techniques that can withstand temperature extremes. Some climate change effects may positively impact transportation, as higher average temperatures in certain regions could reduce safety and maintenance concerns associated with snow and ice accumulation. Although mitigating the effects of climate change through reductions in greenhouse gases is an important element of the Federal Highway Administration’s (FHWA’s) climate change strategy, the agency places equal importance on acknowledging that certain changes may require appropriate adaptation strategies.

#### Climate change is an issue now

Transportation Research Board of the National Academies ’11 [Transportation Research Board, “ Adapting Transportation to the Impacts of Climate Change”, June 2011, Transportation Research Circular, E-C152, <http://www.trb.org/Publications/Blurbs/165529.aspx> AD]

Climate adaptation planning is an issue that continues to grow in importance for FHWA. The White House Council on Environmental Quality has recently released guidance directing federal agencies to develop adaptation plans. Building on information generated by the initiatives above, FHWA is currently developing a draft agencywide Strategy for Adaptation to Climate Change Effects. An FHWA Adaptation Working Group established to promote communication and sharing of knowledge and ideas between FHWA offices will work to ensure that the strategy reflects the diverse needs of the agency and its partners. In turn, this strategy will become an integral component of the larger U.S. DOT adaptation planning strategy. For additional information about FHWA’s climate change adaptation and mitigation activities as well as resources, publications, and frequently asked questions, please visit the FHWA Highways and Climate Change website.

#### **Empirics: Climate change affects all Infrastructure**

Hodges, Tina, August 2011, Federal Transit Administration “Flooded Bus Barns and Buckled Rails: Public Transportation and Climate Change Adaptation” Tina Hodges, Program Analyst Office Budget and Policy Federal Transit Administration U.S. Department of Transportation <http://www.fta.dot.gov/documents/FTA_0001_-_Flooded_Bus_Barns_and_Buckled_Rails.pdf>

In Vicksburg, Mississippi, river flooding from heavy rains in spring 2011 forced transit providers to shutter routes and relocate paratransit operations [4]. In New York, record snowfall stranded city buses in 2010 while heavy rainfall in 2007 shut down 19 major segments of the subway system, flooding the third rail and affecting two million customers [5].Flooding of the Cumberland River swamped Nashville MTA’s bus lot, maintenance facility, and administrative offices [6]. Heat waves in New Jersey and Los Angeles stretched overhead catenary, disrupting power supply to rail vehicles. During an East Coast heat wave, the Washington Metro and the Boston “T” experienced rail kinks that caused them to slow trains and to remove and replace enlarged sections of rail [7]. Electronic train control equipment and fare-box machines in Portland overheated during high-heat days in the historically mild Pacific Northwest [8]. Hurricane Katrina’s storm surge devastated transit agencies along the Gulf Coast, flooding buses and depositing debris [9].

#### **Climate change affects all land and sea transportation infrastructure**

Hodges ‘11, Tina, August 2011, Federal Transit Administration “Flooded Bus Barns and Buckled Rails: Public Transportation and Climate Change Adaptation” Tina Hodges, Program Analyst Office Budget and Policy Federal Transit Administration U.S. Department of Transportation <http://www.fta.dot.gov/documents/FTA_0001_-_Flooded_Bus_Barns_and_Buckled_Rails.pdf>

Impacts will vary, but all regions and public transportation systems, large and small, will be affected. The most disruptive near-term impact is likely to be intense rainfall that floods subway tunnels and low-lying facilities, bus lots, and rights-of-way. Heat waves will stress materials, buckle rails, and jeopardize customer and worker safety and comfort. In the longer term, rising sea-levels, compounded by worsening storm surges, will threaten assets in many coastal areas. Landslides, heavy snowfall, wildfires, droughts, and power blackouts also pose threats. The increased frequency of extreme events (such as heat waves and severe storms) will be more challenging to manage than gradual effects such as a steady rise in average temperatures. In addition, of low probability but high risk, there is a potential for abrupt climate change impacts, such as rapid ice sheet collapse and abrupt sea-level rise. Climate impacts on transit assets will hinder agencies’ ability to achieve goals such as attaining a state of good repair and providing reliability and safety, which may then impact ridership. Persons with disabilities, older adults, and low-income individuals—groups who disproportionately depend on public transportation— will suffer disproportionately from disruptions and degradation in service. Transit agencies will also be called upon to provide evacuation services in response to more frequent extreme events. While it is not possible to link individual weather events to climate change, multiple recent incidents are consistent with observed climate trends. Since scientists project the same types of events to become more frequent and severe, the transit impacts associated with this extreme weather offers illustrations.

#### Temperature rise will damage roads, airports and inland waterways.

NTPP ‘9 (National Transportation Policy Project, Bipartisan coalition of transportation policy experts, business and civic leaders, and is chaired by four distinguished former elected officials who served at the federal, state, and local levels, Published December 15 2009, Bipartisan Policy Center, <http://bipartisanpolicy.org/sites/default/files/Transportation%20Adaptation%20(3).pdf>)

Increasing temperatures will have a number of ¶ effects on both structures and operations. These ¶ will result from both increases in average annual ¶ temperatures as well as increases in temperature ¶ extremes (very hot days). As with precipitation, in ¶ many cases the change in the extremes will be more ¶ signiﬁcant than changes in average temperatures.¶ Pavement damage (such as rutting and shoving) ¶ and rail buckling (“sun kinks”) will increase with ¶ very hot days. An increase in the frequency of very ¶ hot days also may cause delays in the air travel ¶ system at airports where runway length is not ¶ sufﬁcient to compensate for decreased lift for aircraft on hot days; this will be particularly true at ¶ high-altitude airports. Increased energy consumption and costs will be experienced for refrigerated ¶ cargo transport, and transit systems also will face ¶ increased air conditioning costs.¶ Shorter winters also will reduce ice cover on the ¶ inland waterway system, increasing the shipping ¶ season. However, as noted previously, in the Great ¶ Lakes this beneﬁt will likely be offset by lower water levels — a robust ﬁnding of the climate models. In another freight-related issue, some northern ¶ states allow higher trucking weight limits in wintertime, when the frozen ground provides better ¶ support for the roadbed. This season will be shortened as winters warm, decreasing load capacity for ¶ trucks in those regions. Construction and maintenance also will be affected. Shorter winters will lengthen the construction season in some parts of the country, but an ¶ increased number of very hot days will limit construction and maintenance activities in the summertime. In another maintenance-related impact, ¶ freeze-thaw cycles will likely shift in location and ¶ duration. Although areas that currently experience ¶ the most damage from freeze-thaw effects on pavement and infrastructure may beneﬁt from warmer ¶ temperatures, it is likely that areas that currently ¶ experience consistently below-freezing temperatures will see an increase in maintenance and repair ¶ costs as temperatures more often cross the freezing ¶ point as part of the daily temperature cycle.¶ A more difﬁcult to assess secondary effect is ¶ changes in production and demographics that ¶ will affect transportation demand. Agricultural ¶ production in particular will be impacted by a ¶ changing climate. This could have major impacts ¶ on use of the inland waterway system, which is ¶ the primary outlet for much of the heartland’s ¶ produce. Demographic shifts could result as ¶ populations move to cooler areas or away from ¶ vulnerable coastal areas, or as resort and recreation ¶ areas change. Potentially, this may result in new ¶ infrastructure needs in areas of population growth, ¶ while areas that experience population declines ¶ may be overserved by existing infrastructure, making it difﬁcult to maintain cost-effectively.

### Sea Levels

#### Climate change’s poses a huge threat North American TI

Humphrey, Senior Program Officer, TRB Division of Studies and Special Program, 8

(Nancy Humphrey, TRB Special Report, “Potential Impacts of Climate

Change on U.S. Transportation”, May-June 2008, <http://onlinepubs.trb.org/onlinepubs/trnews/trnews256climate.pdf>)

The flooding of coastal roads, railways, transit systems, and runways will be a likely result of a projected¶ global rise in sea level coupled with storm surges and¶ exacerbated by land subsidence in some locations. This¶ flooding represents the greatest potential impact of climate change on North America’s transportation system.¶ The vulnerability of transportation infrastructure¶ to climate change, however, will extend beyond coastal¶ areas. Federal, state, and local governments, in collaboration with owners and operators of infrastructure—¶ such as ports, airports, and private railroads and¶ pipelines—should inventory critical transportation¶ infrastructure, identifying whether, when, and where¶ the projected climate changes may be consequential.¶ Incorporate climate change into investment decisions.¶ Every day, public officials at various levels of government and executives of private companies make¶ short- and long-term investment decisions that have¶ implications for how the transportation system will¶ respond to climate change. Transportation decision¶ makers, therefore, should be preparing now for the¶ projected climate changes.¶ State and local governments and private infrastructure providers should incorporate adjustments for climate change into long-term capital improvement¶ plans, facility designs, maintenance practices, operations, and emergency response plans. A six-step¶ approach for determining appropriate investment priorities is presented in the box on page 23.

#### $ea level rise due to GW will severely damage coastal infrastructure – Roads, rails, ports, airports - All at risk

NTPP ‘9 (National Transportation Policy Project, Bipartisan coalition of transportation policy experts, business and civic leaders, and is chaired by four distinguished former elected officials who served at the federal, state, and local levels, Published December 15 2009, Bipartisan Policy Center, <http://bipartisanpolicy.org/sites/default/files/Transportation%20Adaptation%20(3).pdf>)

Rising sea levels can inundate coastal infrastructure and impact coastal areas. While incremental ¶ sea-level rise impacts may not be as immediate ¶ or severe as storm activity, the effects of sea-level ¶ rise could nevertheless seriously affect transportation. More than half of the nation’s population ¶ lives in the 17 percent of its land area bordering ¶ the coastlines,¶ 8¶ and a large portion of the nation’s ¶ trans portation infrastructure is located in coastal ¶ plains. In areas such as the Gulf Coast and North ¶ Carolina, rising sea levels are compounded by ¶ sinking land (subsidence), due to factors such as ¶ compacting sediments or tectonic forces.¶ The impacts of sea-level rise include increased ¶ inundation of coastal infrastruc ture, affecting all ¶ modes of transportation. Many roads and rail lines ¶ were built at the water’s edge to take advantage of ¶ more level routes or long available rights-of-way. ¶ Airports were often built in wetlands and other ¶ “undesirable” coastal areas that afforded large level ¶ plots of land. Underground transit facili ties are ¶ particularly vulnerable to ﬂooding where ventilation openings and other access points are not suf-¶ ﬁciently elevated — as is the case in many coastal ¶ cities, such as New York. Rising sea levels also can ¶ affect low bridges, which may not have the clearances needed in the future.¶ A U.S. DOT study of the Gulf Coast region, for ¶ instance, found that a four-foot relative sea-level ¶ rise (a plausible scenario over the next century) ¶ would threaten 27 percent of major roads in the ¶ region (more than 2,400 miles of roadway), threequarters of the ports, 9 percent of the rail miles ¶ Figure 2.2 Gulf Coast Study: Highways Vulnerable to Relative Sea-Level Rise (RSLR) of ¶ Four Feet¶ Source: CCSP, 2008: Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: Gulf Coast Study, ¶ Phase I. A Report by the U.S. Climate Change Science Program and Subcommittee on Global Change Research [Savonis, M.J., ¶ V.R. Burkett, and J.R. Potter (eds.)]. Department of Transportation, Washington, D.C., USA, 445 pp. ¶ 8¶ Crossett, K.M., T.J. Culliton, et al. (2004). Population trends along the coastal United States: 1980-2008, NOAA National ¶ Ocean Service, Management and Budget Ofﬁce: 54.

#### Rising sea levels devastate domestic TI and economy

ScienceDaily, research news, 8

(Science Daily, “Climate Change Predicted To Have Major Impact On Transportation Infrastructure And Operations”, 3/11/8, http://www.sciencedaily.com/releases/2008/03/080311120617.htm)

In addition to climate changes, there are a number of contributing factors that will likely lead to vulnerabilities in coastal-area transportation systems. Population is projected to grow in coastal areas, which will boost demand for transportation infrastructure and increase the number of people and businesses potentially in harm's way; erosion and loss of wetlands have removed crucial buffer zones that once protected infrastructure; and an estimated 60,000 miles of coastal highways are already exposed to periodic storm flooding.¶ "Rising temperatures may trigger weather extremes and surprises, such as more rapid melting of the Arctic sea ice than projected," Schwartz said. "The highways that currently serve as evacuation routes and endure periodic flooding could be compromised with strong hurricanes and more intense precipitation, making some of these routes impassable." Transportation providers will need to focus on evacuation planning and work more closely with weather forecasters and emergency planners.¶ Infrastructure vulnerabilities will extend beyond coastal areas as the climate continues to change. In the Midwest, for instance, increased intense precipitation could augment the severity of flooding, as occurred in 1993 when farmland, towns, and transportation routes were severely damaged from flooding along 500 miles of the Mississippi and Missouri river systems.¶ On the other hand, drier conditions are likely to prevail in the watersheds supplying the St. Lawrence Seaway and the Great Lakes as well as the Upper Midwest river system. Lower water levels would reduce vessel shipping capacity, seriously impairing freight movements in the region, such as occurred during the drought of 1988, which stranded barge traffic on the Mississippi River. And in California, heat waves may increase wildfires that can destroy transportation infrastructure.

### Permafrost

#### **Permafrost thawing is inevitable, exacerbates climate change**

Schuur, Edward and Abbott, Benjamin 30 November 2011 “Climate change: high risk of permafrost thaw” Edward Schuur is in the Department of Biology at the University of Florida, Gainesville, Florida 32611, USA.¶ Edward A. G. Schuur¶ Benjamin Abbott is in the Institute of Arctic Biology at the University of Alaska, Fairbanks, Alaska 99775, USA. <http://www.nature.com/nature/journal/v480/n7375/full/480032a.html>

Arctic temperatures are rising fast, and permafrost is thawing. Carbon released into the atmosphere from permafrost soils will accelerate climate change, but the magnitude of this effect remains highly uncertain. Our collective estimate is that carbon will be released more quickly than models suggest, and at levels that are cause for serious concern. We calculate that permafrost thaw will release the same order of magnitude of carbon as deforestation if current rates of deforestation continue. But because these emissions include significant quantities of methane, the overall effect on climate could be 2.5 times larger. Recent years have brought reports from the far north of tundra fires[1](http://www.nature.com/nature/journal/v480/n7375/full/480032a.html#ref1), the release of ancient carbon[2](http://www.nature.com/nature/journal/v480/n7375/full/480032a.html#ref2), CH4bubbling out of lakes[3](http://www.nature.com/nature/journal/v480/n7375/full/480032a.html#ref3) and gigantic stores of frozen soil carbon[4](http://www.nature.com/nature/journal/v480/n7375/full/480032a.html#ref4). The latest estimate is that some 18.8 million square kilometres of northern soils hold about 1,700 billion tonnes of organic carbon[4](http://www.nature.com/nature/journal/v480/n7375/full/480032a.html#ref4) — the remains of plants and animals that have been accumulating in the soil over thousands of years. That is about four times more than all the carbon emitted by human activity in modern times and twice as much as is present in the atmosphere now.¶ This soil carbon amount is more than three times higher than previous estimates, largely because of the realization that organic carbon is stored much deeper in frozen soils than was thought. Inventories typically measure carbon in the top metre of soil. But the physical mixing during freeze–thaw cycles, in combination with sediment deposition over hundreds and thousands of years, has buried permafrost carbon many metres deep. The answers to three key questions will determine the extent to which the emission of this carbon will affect climate change: How much is vulnerable to release into the atmosphere? In what form it will be released? And how fast will it be released? These questions are easily framed, but challenging to answer.¶ As soils defrost, microbes decompose the ancient carbon and release CH4 and carbon dioxide. Not all carbon is equally vulnerable to release: some soil carbon is easily metabolized and transformed to gas, but more complex molecules are harder to break down. The bulk of permafrost carbon will be released slowly over decades after thaw, but a smaller fraction could remain within the soil for centuries or longer. The type of gas released also affects the heat-trapping potential of the emissions. Waterlogged, low-oxygen environments are likely to contain microbes that produce CH4 — a potent greenhouse gas with about 25 times more warming potential than CO2 over a 100-year period. However, waterlogged environments also tend to retain more carbon within the soil. It is not yet understood how these factors will act together to affect future climate.¶ The ability to project how much carbon will be released is hampered both by the fact that models do not account for some important processes, and by a lack of data to inform the models. For example, most large-scale models project that permafrost warming depends on how much the air is warming above them. This warming then boosts microbial activity and carbon release. But this is a simplification. Abrupt thaw processes can cause ice wedges to melt and the ground surface to collapse, accelerating the thaw of frozen ground[5](http://www.nature.com/nature/journal/v480/n7375/full/480032a.html#ref5). Evidence of rapid thaw is widespread: you can see it in the 'drunken' trees that tip dangerously as a result of ground subsidence, and in collapsed hill slopes marked by scars from landslides. These are just some of the complex processes that models don't include.¶ At the same time, few data are available to support these models because of the difficulties of gathering data in extreme environments. Only a handful of remote field stations around the world are collecting data to support this research, even though the permafrost zone covers about almost one-quarter of the Northern Hemisphere's land area. The field studies that do exist confirm that permafrost thaw is tightly linked to ground subsidence and soil moisture as well as temperature. So modelling carbon emissions from permafrost thaw is much more complex than a simple response to temperature alone.¶ Models have flaws, but experts intimately familiar with these landscapes and processes have accumulated knowledge about what they expect to happen, based on quantitative data and qualitative understanding of these systems. We have attempted to quantify this expertise through a survey developed over several years.¶ Our survey asks what percentage of the surface permafrost is likely to thaw, how much carbon will be released, and how much of that carbon will be CH4, for three time periods and under four warming scenarios that will be part of the Intergovernmental Panel on Climate Change Fifth Assessment Report. The lowest warming scenario projects 1.5 °C Arctic warming over the 1985–2004 average by the year 2040, ramping up to 2 °C by 2100; the highest warming scenario considers 2.5 °C by 2040, and 7.5 °C by 2100. In all cases, we posited that the temperature would remain steady from 2100 to 2300 so that we could assess opinions about the time lag in the response of permafrost carbon to temperature change.¶ The survey was filled out this year by 41 international scientists, listed as authors here, who publish on various aspects of permafrost. The results are striking. Collectively, we hypothesize that the high warming scenario will degrade 9–15% of the top 3 metres of permafrost by 2040, increasing to 47–61% by 2100 and 67–79% by 2300 (these ranges are the 95%confidence intervals around the group's mean estimate). The estimated carbon release from this degradation is 30 billion to 63 billion tonnes of carbon by 2040, reaching 232 billion to 380 billion tonnes by 2100 and 549 billion to 865 billion tonnes by 2300. These values, expressed in CO2equivalents, combine the effect of carbon released as both CO2 and as CH4.¶ Our estimate for the amount of carbon released by 2100 is 1.7–5.2 times larger than those reported in several recent modelling studies[6](http://www.nature.com/nature/journal/v480/n7375/full/480032a.html#ref6), [7](http://www.nature.com/nature/journal/v480/n7375/full/480032a.html#ref7), [8](http://www.nature.com/nature/journal/v480/n7375/full/480032a.html#ref8), all of which used a similar warming scenario. This reflects, in part, our perceived importance of the abrupt thaw processes, as well as our heightened awareness of deep carbon pools. Active research is aimed at incorporating these main issues, along with others, into models.¶ Are our projected rapid changes to the permafrost soil carbon pool plausible? The survey predicts a 7–11%drop in the size of the permafrost carbon pool by 2100 under the high-warming scenario. That scale of carbon loss has happened before: a 7–14% decrease has been measured in soil carbon inventories across thousands of sites in the temperate-zone United Kingdom as a result of climate change[9](http://www.nature.com/nature/journal/v480/n7375/full/480032a.html#ref9). Also, data scaled up from a single permafrost field site point to a potential 5% loss over a century as a result of widespread permafrost thaw[2](http://www.nature.com/nature/journal/v480/n7375/full/480032a.html#ref2). These field results generally agree with the collective carbon-loss projection made by this survey, so it should indeed be plausible.¶ Across all the warming scenarios, we project that most of the released carbon will be in the form of CO2, with only about 2.7% in the form of CH4. However, because CH4 has a higher global-warming potential, almost half the effect of future permafrost-zone carbon emissions on climate forcing is likely to be from CH4. That is roughly consistent with the tens of billions of tonnes of CH4 thought to have come from oxygen-limited environments in northern ecosystems after the end of the last glacial period[10](http://www.nature.com/nature/journal/v480/n7375/full/480032a.html#ref10).¶ All this points towards significant carbon releases from permafrost-zone soils over policy-relevant timescales. It also highlights important lags whereby permafrost degradation and carbon emissions are expected to continue for decades or centuries after global temperatures stabilize at new, higher levels. Of course, temperatures might not reach such high levels. Our group's estimate for carbon release under the lowest warming scenario, although still quite sizeable, is about one-third of that predicted under the strongest warming scenario.¶ Knowing how much carbon will be released from the permafrost zone in this century and beyond is crucial for determining the appropriate response. But despite the massive amount of carbon in permafrost soils, emissions from these soils are unlikely to overshadow those from the burning of fossil fuels, which will continue to be the main source of climate forcing. Permafrost carbon release will still be an important amplifier of climate change, however, and is in some ways more problematic: it occurs in remote places, far from human influence, and is dispersed across the landscape. Trapping carbon emissions at the source — as one might do at power plants — is not an option. And once the soils thaw, emissions are likely to continue for decades, or even centuries.¶

#### Permafrost is a key obstacle for transportation infrastructure in Alaska

U.S. Arctic Research Commission Permafrost Task Force (2003) “Climate Change, Permafrost, and Impacts on Civil Infrastructure” Special Report 01-03, U.S. Arctic Research Commission, Arlington, Virginia

Thermokarst can have severe effects on engineered structures, in many cases rendering them unusable. Because of its potential for settlement, thawing of ice-rich permafrost constitutes¶ a significant environmental hazard in high-latitude regions, particularly in the context¶ of climatic change. Although hazards related to¶ permafrost have been discussed in specialist literature¶ and textbooks (e.g., Brown and Grave,¶ 1979; Péwé, 1983b; Williams, 1986; Woo et al.,¶ 1992; Andersland and Ladanyi, 1994; Koster¶ and Judge, 1994; Yershov, 1998; Dyke and¶ Brooks, 2000; Davis, 2001), they are given scant¶ attention in most English-language texts focused¶ on natural hazards (e.g., Bryant, 1991; Coch,¶ 1995). Much of the literature treating social¶ science and policy issues in the polar regions¶ (e.g., Peterson and Johnson, 1995; Brun et al.,¶ 1997) also fails to adequately consider issues¶ related to permafrost. Although the permafrost regions are not densely populated, their economic importance has increased substantially in recent decades¶ because of the abundant natural resources in¶ the north circumpolar region and improved methods of extraction and transportation to population centers. Economic development has brought expansion of the human infrastructure: hydrocarbon¶ extraction facilities, transportation networks,¶ communication lines, industrial projects, civil facilities, and engineering maintenance systems¶ have all increased substantially in recent¶ decades. Rapid and extensive development has¶ had large costs, however, in both environmental¶ and human terms (e.g., Williams, 1986; Smith¶ and McCarter, 1997), and these could be¶ aggravated severely by the effects of global¶ warming on permafrost. Construction in permafrost regions requires¶ special techniques at locations where the terrain¶ contains ice in excess of that within soil pores.¶ Prior to about 1970, many projects in northern¶ Alaska and elsewhere disturbed the surface significantly,¶ triggering thermokarst processes and¶ resulting in severe subsidence of the ground¶ surface, disruption of local drainage patterns,¶ and in some cases destruction of the engineered¶ works themselves. The linear scar in Figure 8e¶ marks the route of a winter road constructed in¶ 1968-69 by bulldozing the tundra vegetation and¶ a thin layer of soil (Anonymous, 1970). This¶ disturbance altered the energy regime at the¶ ground surface, leading to thaw of the underlying¶ ice-rich permafrost and subsidence of up to¶ 2 m along the road (Nelson and Outcalt, 1982),¶ which became unusable several years after¶ construction. Environmental restrictions in North America,¶ based on scientific knowledge about permafrost, now regulate construction activities to minimize¶ their impacts on terrain containing excess ice.¶ The Trans-Alaska Pipeline, which traverses¶ 1300 km from Prudhoe Bay on the Arctic¶ coastal plain to Valdez on Prince William Sound¶ near the Gulf of Alaska, carries oil at temperatures¶ above 60oC. To prevent the development¶ of thermokarst and severe damage to the pipe,¶ the line is elevated where surveys indicated the¶ presence of excess ice. To counteract conduction¶ of heat into the ground, many of the pipeline’s¶ vertical supports are equipped with heat¶ pipes that cool the permafrost in winter, lowering¶ the mean annual ground temperature and¶ preventing thawing during summer. In several¶ short sections of ice-rich terrain where local¶ above-ground conditions required burial of the¶ line, the pipe is enclosed in thick insulation and¶ refrigerated.

#### Climate change impacts permafrost based ti

Caldwell et al, Federal Highway Administration 9

(Harry Caldwell, Kate H. Quinn, Jacob Meunier, John Suhrbrier, and Lance Grenzeback, Govenrment Climate document, “Potential Impacts of Climate Change on Freight Transport”, 1/7/9, <http://climate.dot.gov/documents/workshop1002/caldwell.pdf>)

The temperature-related impacts of global ¶ climate change are also likely to be significant. ¶ At northern latitudes, permafrost degradation is ¶ a major concern. In Alaska, melting permafrost ¶ is already causing entire stands of trees to list at ¶ odd angles, a phenomenon that Alaskans have ¶ dubbed “drunken trees.” The softening ground is ¶ causing pavement and tarmac to buckle, ¶ disrupting some freight movements moved by ¶ road, rail, and air. Because frozen pavements ¶ are less susceptible to damage by trucks, they ¶ are legally allowed to carry 10 percent heavier ¶ loads. Warmer winters will reduce the time this ¶ exception is permitted. The impact will be felt ¶ most acutely in Alaska, which relies heavily on the structural integrity of frozen roads and has a ¶ freight rail network less than 500 miles long.

# Economy-Advantage

## Uniqueness

#### Economic Recovery is accelerating, but some issues still hold it back

The Guardian 6/26 (Ewen MacAskill and Dominic Rushe, “OECD Says US economy recovery but income equality problematic” June 26th, 2012, http://www.guardian.co.uk/business/2012/jun/26/oecd-us-economy-income-inequality)

The OECD report said that growth in the US will remain moderate this year but concludes that America's economic recovery has "gained momentum".¶ Consumer and business spending have risen and unemployment, though still high at 8.2%, has fallen nearly two percentage points from its peak in 2009.¶ "Even with these substantial improvements, however, the recovery is far from complete," the OECD warns. The US housing market has picked up but the large overhang of unsold homes and "the ongoing tide of foreclosures will continue to put downward pressure on house prices," according to the report.¶ Europe's economic crisis and the looming political fight over the expiration on 31 December expiration of Bush-era tax cuts and imposition of automatic spending cuts – also remain serious threats, the report warns.¶ It called on Congress to seek to trim government spending gradually rather than make drastic cuts at the end of this year, the so-called 'fiscal cliff' when $1.2tn in automatic spending cuts are due to kick in.¶ The slow pace of recovery in construction, normally an important source of growth following recessions, is also a worry, said the OECD. In addition, "uncertainty about the sustainability of the recovery has restrained business investment and slow growth in some trading partners has held back exports."¶ The report warns that long-term unemployment has become a serious issue for the US. About 5.3 million Americans, 40% of unemployed people, have been out of work for 27 weeks or more. More training programmes are needed to get the long-term unemployed back to work, says the OECD.¶ The OECD expects unemployment to have fallen to 7.6% by 2013 7.6%, the low end of the Fed's latest estimates of 7.5-8%.¶ It recommends that the Obama administration's proposals for job training "should be implemented without delay". It noted the US was only one of three countries in the OECD that spends less on disadvantaged students than on students from a better-off.¶ The report also suggests that higher-income Americans should pay more in taxes to help boost the US economy. The report singles out tax breaks on "debt-financed corporate investment and housing." Buffett has pointed out that lower tax rates for investments have allowed him to pay less tax as a percentage than the majority of his staff, including his secretary, Debbie Bosanek.¶ Earlier this year the White House proposed a "measures to ensure everyone making over a million dollars a year pays a minimum effective tax rate of at least 30%."¶ The report concludes: "The unequal tax treatment of income from different asset classes increases inequality in some cases and distorts the allocation of capital.¶ "Equalizing the effective tax rates on debt-financed corporate investment and on housing at the higher rate on equity financed corporate investment while simultaneously lowering the corporate tax rate would reduce income inequality."

## Internal Links

### General TI

#### Climate Change Effects ALL forms of transportation Infrastructure, which is key to the economy- LIST

Joanne R. Potter et al, March 2008, Michael J. Savonis, Virginia R. Burkett U.S. Climate Change Science Program Synthesis and Assessment Product 4.7 “Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: Gulf Coast Study, Phase I” <http://files.library.northwestern.edu.turing.library.northwestern.edu/transportation/online/restricted/200819/PB2008110533.pdf>

Transportation is such an integral part of daily life in the United States that few pause to consider its importance. Yet the Nation’s strong intermodal network of highways, public transit, rail, marine, and aviation is central to our ability to work, go to school, enjoy leisure time, maintain our homes, and stay in touch with friends and family. U.S. businesses depend on reliable transportation services to receive materials and transport products to their customers; a robust transportation network is essential to the economy. In short, a sound transportation system is vital to the Nation’s social and economic future. Transportation professionals – including planners, designers, engineers, financial specialists, ecologists, safety experts, and others – work hard to ensure that U.S. communities have access to safe and dependable transportation services. Given the ongoing importance of the Nation’s transportation system, it is appropriate to consider what effect climate change may have on this essential network. Through a regional case study of the central Gulf Coast, this report begins to examine the potential implications of climate change on transportation infrastructure, operations, and services. Investments in transportation are substantial and result in infrastructure that lasts for decades. Transportation plans and designs should, therefore, be carefully considered and well informed by a range of factors, including consideration of climate variability and change. Climate also affects the safety, operations, and maintenance of transportation infrastructure and systems. This research investigates the potential impacts of climate variability and change on transportation, and it assesses how planners and managers may incorporate this information into their decisions to ensure a reliable and robust future transportation network. This report does not contain recommendations about specific facilities or adaptation strategies, but rather seeks to contribute to the information available so that States and local communities can make more informed decisions when planning for the future.

The climate models used to estimate temperature changes agree that it will be warmer in the future. According to the IPCC report, global average warming is expected to be about 0.4°C (0.72°F) during the next 20 years. Even if the concentrations of all greenhouse gases and aerosols had been stabilized at 2000 levels, warming of 0.2°C (0.36°F) would be expected during this period (IPCC, 2007). Over the longer term, the IPCC models project average global temperature increases ranging from 1.1°C (1.98°F) to 6.4°C (11.5°F) by the end of the 21st century, although climate responses in specific regions will vary. These projections are the result of reviewing a robust set of global climate models under a variety of future scenarios – using a range of assumptions for future economic activity and energy use – for the Earth as a whole. The average increase in temperature may not be as important to the transportation community as the changes in extreme temperature, which also are expected to increase. Over the last 50 years, the frequency of cold days and nights has declined, while hot days, hot nights, and heat waves have become more frequent. The number of days with temperature above 32°C (90°F) and 38°C (100°F) has been increasing since 1970, as has the intensity and length of periods of drought. The IPCC report finds that it is virtually certain that the next century will witness warmer and more frequent hot days and nights over most land areas (IPCC, 2007).

Increasing temperatures have the potential to affect multiple modes of transportation, primarily impacting surface transportation. The transportation impacts mentioned most often in the literature included pavement damage; rail buckling; less lift and fuel efficiency for aircraft; and the implications of lower inland water levels, thawing permafrost, reduced ice cover on seaways, and an increase in vegetation. These are discussed in greater detail below:

• Pavement damage – The quality of highway pavement was identified as a potential issue for temperate climates, where more extreme summer temperatures and/or more frequent freeze/thaw cycles may be experienced. Extremely hot days, over an extended period of time, could lead to the rutting of highway pavement and the more rapid breakdown of asphalt seal binders, resulting in cracking, potholing, and bleeding. This, in turn, could damage the structural integrity of the road and/or cause the pavement to become more slippery when wet. Adaptation measures mentioned included more frequent maintenance, milling out ruts, and the laying of more heat resistant asphalt.

• Rail buckling – Railroads could encounter rail buckling more frequently in temperate climates that experience extremely hot temperatures. If unnoticed, rail buckling can result in derailment of trains. Peterson (2008) noted, “Lower speeds and shorter trains, to shorten braking distance, and lighter loads to reduce track stress are operational impacts.” Adaptation measures included better monitoring of rail temperatures and ultimately more maintenance of the track, replacing it when needed.

• Vegetation growth – The growing season for deciduous trees that shed their leaves may be extended, causing more slipperiness on railroads and roads and visual obstructions. Possible adaptation measures included better management of the leaf foliage and planting more low-maintenance vegetation along transportation corridors to act as buffers (Wooler, 2004).

• Reductions in aircraft lift and efficiency – Higher temperatures would reduce air density, decreasing both lift and the engine efficiency of aircraft. As a result, longer runways and/or more powerful airplanes would be required. However, one analyst projected that technical advances would minimize the need for runway redesign as aircraft become more powerful and efficient (Wooler, 2004).

• Reduced water levels – Changes in water levels were discussed in relation to marine transport. Inland waterways such as the Great Lakes and Mississippi River could experience lower water levels due to increased temperatures and evaporation; these lower water levels would mean that ships and barges would not be able to carry as much weight. Adaptation measures included reducing cargo loads, designing vessels to require less draft, or dredging the water body to make it deeper.

• Reduced ice cover – Reduced ice cover was generally considered a positive impact of increasing temperatures in the literature. For example, a study conducted by John D. Lindeberg and George M. Albercook, which was included in the Report of the Great Lakes Regional Assessment Group for the U.S. Global Change Research Program, stated, “the costs of additional dredging [due to lower water levels] could be partially mitigated by the benefits of additional shipping days on the [Great] Lakes caused by less persistent ice cover” (Sousounis, 2000, p. 41). Additionally, arctic sea passages could open; for example, the Arctic Climate Impact Assessment noted, “projected reductions in sea-ice extent are likely to improve access along the Northern Sea Route and the Northwest Passage” (Instanes et al., 2005, p. 934). However, negative environmental and security impacts also may result from reduced ice cover as well from as the increased level of shipping. These are discussed below in the subsection on indirect impacts (Section 1.3.6.).

• Thawing permafrost – The implications of thawing permafrost for Arctic infrastructure receive considerable attention in the literature. Permafrost is the foundation upon which much of the Arctic’s infrastructure is built. The literature consistently noted that as the permafrost thaws the infrastructure will become unstable – an effect being experienced today. Roads, railways, and airstrips are all vulnerable to the thawing of permafrost. Adaptation measures vary depending on the amount of permafrost that underlies any given piece of infrastructure. The literature suggested that some assets will only need rehabilitation, other assets will need to be relocated, and different construction methods will need to be used, including the possibility of installing cooling mechanisms. According to the Arctic Research Commission, “roads, railways, and airstrips placed on ice-rich continuous permafrost will generally require relocation to well-drained natural foundations or replacement with substantially different construction methods” (U.S. Arctic Research Commission Permafrost Task Force, 2003, p. 29).

• Other – Other impacts of increasing temperatures included a reduction in ice loads on structures (such as bridges and piers), which could eventually allow them to be designed for less stress, and a lengthening of construction seasons due to fewer colder days in traditionally cold climates.

#### Sea level rise tanks domestic economic activity as well as TI

National Research Council of The National Academies, 8

(NRC, Online Pubs, “Potential Impacts of Climate Change on U.S. Transportation”, 7/18/8,

<http://onlinepubs.trb.org/onlinepubs/sr/sr290.pdf>)

Sea level rise, which climate scientists now believe to be virtually certain, in combination with expected population growth, will aggravate the¶ situation, making housing and infrastructure in low-lying coastal areas¶ even more vulnerable to extensive flooding and higher storm surges. An¶ estimated 60,000 miles of coastal highways is already exposed to periodic¶ coastal storm flooding and wave action (Douglass et al. 2005).¶ 2¶ Those highways that currently serve as evacuation routes during hurricanes and other¶ coastal storms could be compromised in the future. Although coastal highway mileage is a small fraction of the nearly 4 million miles of public roads¶ in the United States, the vulnerability of these highways is concentrated in¶ a few states, and some of these routes also serve as barriers to sea intrusion¶ and as evacuation routes (Titus 2002).¶ Coastal areas are also major centers of economic activity. Six of the¶ nation’s top 10 U.S. freight gateways (by value of shipments) (BTS 2007)¶ will be at risk from sea level rise (see Table 3-1). Seven of the 10 largest¶ ports (by tons of traffic) (BTS 2007, 30) are located in the Gulf Coast,¶ whose vulnerability was amply demonstrated during the 2005 tropical¶ storm season.¶ 3¶ The Gulf Coast is also home to the U.S. oil and gas industries, providing nearly 30 percent of the nation’s crude oil production and approximately 20 percent of its natural gas production (Felmy 2005).¶ Several thousand off-shore drilling platforms, dozens of refineries, and¶ thousands of miles of pipelines are vulnerable to disruption and damage from storm surge and high winds of tropical storms, as was recently¶ demonstrated by Hurricanes Katrina and Rita. Those hurricanes halted all¶ oil and gas production from the Gulf, disrupted nearly 20 percent of the¶ nation’s refinery capacity, and closed oil and gas pipelines (CBO 2006).¶ 4¶ Climate scientists believe that global warming is likely to increase the intensity of strong hurricanes making landfall, increasing the risk of damage to¶ or lengthening the disruption in the operation of these vital facilities

#### Climate Change will negatively impact every $ector of transportation infrastructure costing us billions in the short and long term

NTPP ‘9 (National Transportation Policy Project, Bipartisan coalition of transportation policy experts, business and civic leaders, and is chaired by four distinguished former elected officials who served at the federal, state, and local levels, Published December 15 2009, Bipartisan Policy Center, <http://bipartisanpolicy.org/sites/default/files/Transportation%20Adaptation%20(3).pdf>)

Climate change will impact many sectors of the ¶ economy, and while required adaptations for some ¶ sectors already have been studied in depth, the same can not be said of transportation infrastructure. ¶ Executive Summary¶ Rising sea levels, greater weather variability, and more extreme weather ¶ events like hurricanes, permafrost thawing, and melting Arctic sea ice are ¶ just some of the important changes that will impact transportation networks ¶ and infrastructure. Coastal areas are particularly vul nerable. A large portion ¶ of the nation’s transportation infrastructure is in coastal zones: nearly half of ¶ the U.S. population lives within ﬁfty miles of the coast,¶ 1¶ and many roads, ¶ rail lines, and airports were built at or near water’s edge to take advantage ¶ of available right-of-way and land. Increasingly intense storm activity and ¶ surges, exacerbated by rising sea levels, are putting an ever-increasing range of ¶ this coastal infrastructure at risk. ¶ The costs of these climate impacts will most likely run into the billions of ¶ dollars. Costs will likely be highly variable — extreme events will incur ¶ large capital costs in very short periods of time, while other impacts (such as ¶ 1 sea level rise) will require investments spread out ¶ over long periods, integrated with capital replacement cycles. In a recent example of response to ¶ extreme events, the Mississippi Department of ¶ Transportation (DOT) spent an estimated $1 ¶ billion on debris removal, highway and bridge ¶ repair, and rebuilding the Biloxi and Bay St. Louis ¶ bridges in the four years following Hurricane ¶ Katrina, and CSX spent $250 million rebuilding ¶ thirty miles of destroyed rail line. Longer term, a ¶ study by Associated British Insurers estimated that ¶ climate change could increase the annual costs of ¶ ﬂooding in the United Kingdom almost 15-fold ¶ by the 2080s.

#### Transport is key to all economies.

UN ’06 [UNESCAP, “Transport Infrastructure”, 2006, UN, <http://www.unescap.org/pdd/publications/themestudy2006/9_ch3.pdf> AD]

**Transport is so essential in both developing and developed countries that it is often taken for granted.** Macroeconomic facts about transport are indeed impressive. **The value added by transport and storage accounts for 3 to 8 per cent of the GDP of countries** in Asia and the Pacific, according to ESCAP secretariat estimates.2 **Employment in transport, storage and communications ranges between 2.5 and 11.5 per cent of total paid employment**. Demand for freight and passenger transport, particularly by road, has typically grown 1.5 to 2 times faster than GDP in most developing and transition countries. Public investment in transport typically accounts for 2.0 to 2.5 per cent of GDP3 and may rise as high as 4 per cent or more in countries modernizing or building new transport infrastructure.4 Logistics costs are typically more than 20 per cent of sales, of which transport costs alone can be as much as 13 per cent.5

#### Investment in highway capital generates key macroeconomic benefits.

FHA 02 (Federal Highway Administration, part of the US Department of Transportation “2002 Status of the Nation's Highways, Bridges, and Transit: Conditions & Performance” 11/24/02. http://www.fhwa.dot.gov/policy/2002cpr/pdf/ch12.pdf)

The effects of highway investments on aggregate economic activity arise from the complex workings of a¶ market economy. Economic players translate the increased supply of highway capital (and the resulting¶ reductions in transportation costs) into reductions in firms’ cost of production and distribution. Firms may¶ also respond to the resulting increase in the level of service the highway system provides by changing their use¶ of other inputs or altering their production processes in ways that further reduce their production and¶ distribution costs. Furthermore, producer cost savings may be reflected in lower market prices and higher¶ output levels for the wide range of products and services that depend on transportation infrastructure.¶ Macroeconomic measures of highway investment benefits for the production sector capture the total savings¶ in firms’ production and distribution costs that result directly from an increased supply of highway capital.¶ One major advantage of measuring highway investment benefits from an economy-wide perspective is that it¶ may be possible to capture the total benefits from a continuing program of highway investments by all levels¶ of government, without requiring detailed evaluation of individual projects. Carefully conducted macroeconomic benefit studies offer a useful approach for estimating the aggregate value of an overall program of¶ highway investments, thus providing an important source of evidence on the total economic return these¶ investments generate.¶ Investments in highway capital may also generate important macroeconomic benefits in addition to direct¶ savings in transportation cost. Increases in the highway capital stock may also improve the productivity of¶ labor or increase the return on private capital investment, thus increasing the amount of goods and services¶ that can be produced using the resources that are available to the economy. By increasing the productivity of¶ labor and private capital, highway investment could allow overall economic activity to grow more rapidly than¶ demographic and technological progress alone would allow. If increases in the value of the Nation’s capital stock raise the productivity of private inputs, the aggregate or macroeconomic returns to investments¶ in highways may exceed those that would be captured using conventional measures of highway user and¶ related benefits, perhaps by a significant margin.

#### **America’s transportation is the lynchpin to our trade system and economy.**

FHA 02 (Federal Highway Administration, part of the US Department of Transportation “2002 Status of the Nation's Highways, Bridges, and Transit: Conditions & Performance” 11/24/02. http://www.fhwa.dot.gov/policy/2002cpr/pdf/ch12.pdf)

America’s transportation system is the essential element facilitating the movement of goods and people within¶ the country. It forms the backbone of local, regional, national, and international trade, making most economic¶ activity critically dependent upon this resource. The Nation’s urban transportation systems have enabled the¶ growth of America’s cities, linking workers with employers, wholesalers with retailers, markets with buyers,¶ and residents with recreational and cultural facilities. The intercity transportation system helps bring America’s¶ cities, States, and regions together, linking farmers and manufacturers to markets, raw material suppliers to¶ processors, businesses to clients, and tourists to destinations.¶ These transportation functions are served by a wide variety of modes. Airways and airports provide rapid,¶ long-distance transportation services for travelers, mail, and freight. On the surface, freight moves by water,¶ rail, highways, and pipelines, while people move by passenger rail, buses, ferries, and private vehicles.¶ The surface transportation system serving the United States today reflects investment and location decisions¶ made by both governments and private enterprise since the beginning of the Nation. Early settlement and¶ transportation patterns were determined primarily by geography, with waterborne and horse-drawn¶ transportation the dominant modes. Over the years, improvements in vehicle technology, including¶ steamships, locomotives, automobiles, and airplanes, have greatly expanded both the speed and flexibility of¶ transportation movements, allowing economic activity to concentrate in cities and spread across the country.¶ Harnessing the potential of these technologies has required large investments in guideways and facilities,¶ including ports and canals, railroads and terminals, highways and bridges, and airports and airways. The¶ development of these facilities has also been greatly aided by advancements in bridge, tunnel, pavement,¶ building, and communications technologies.¶ The Federal government has played a key role throughout the country’s history in shaping the transportation¶ system, both in regulating interstate commerce and in funding and facilitating transportation improvements.¶ Examples of the latter include the construction of the National Road in the early 19¶ th¶ Century; the Pacific¶ Railroad Act of 1862; inland waterways built by the Army Corps of Engineers; the Federal-Aid Highway¶ Program and the Interstate Highway System of the 20¶ th¶ Century; and Federal assistance for mass transit¶ operators beginning in the 1960’s

### Market Trade (General)

#### Transportation infrastructure makes markets trade together

Rodrigue and Notteboom 12, [ Dr. Jean-Paul Rodrigue, Professor at Hofstra University Department of Global Studies and Geography, Dr. Theo Notteboom, Professor at the Institute of Transport and Maritime Management in Antwerp, <http://people.hofstra.edu/geotrans/eng/ch7en/conc7en/ch7c1en.html>]

¶ Transportation links together the factors of production in a complex web of relationships between producers and consumers. The outcome is commonly a more efficient division of production by an exploitation of geographical comparative advantages, as well as the means to develop economies of scale and scope. The productivity of space, capital and labor is thus enhanced with the efficiency of distribution and personal mobility. It is acknowledged that economic growth is increasingly linked with transport developments, namely infrastructures but also managerial expertise is crucial for logistics. The following impacts can be assessed:¶ Networks. Setting of routes enabling new or existing interactions between economic entities.¶ Performance. Improvements in cost and time attributes for existing passenger and freight movements.¶ Reliability. Improvement in the time performance, notably in terms of punctuality, as well as reduced loss or damage.¶ Market size. Access to a wider market base where economies of scale in production, distribution and consumption can be improved.¶ Productivity. Increases in productivity from the access to a larger and more diverse base of inputs (raw materials, parts, energy or labor) and broader markets for diverse outputs (intermediate and finished goods).

#### Commute and goods delivery- strong expert support

Department of Treasury 3/23 [March 23,2012, Department of Treasury of the US, “A New Economic Analysis of Infrastructure Investment”, pg. 5 http://www.treasury.gov/resource-center/economic-policy/Documents/20120323InfrastructureReport.pdf]Public infrastructure is an essential part of the U.S. economy. This has been recognized since the founding of our nation. Albert Gallatin, who served as President Jefferson’s Treasury Secretary, wrote: “The early and efficient aid of the Federal Government is recommended by still more important considerations. The inconveniences, complaints, and perhaps dangers, which may result from a vast extent of territory, can no otherwise be radically removed or prevented than by opening speedy and easy communications through all its parts. Good roads and canals will shorten distances, facilitate commercial and personal intercourse, and unite, by a still more intimate community of interests, the most remote quarters of the United States. No other single operation, within the power of Government, can more effectually tend to strengthen and perpetuate that Union which secures external independence, domestic peace, and internal liberty.”1¶ Gallatin spoke in terms of infrastructure shortening distances and easing communications, even when the only means to do so were roads and canals. Every day, Americans use our nation’s transportation infrastructure to commute to work, visit their friends and family, and travel freely around the country. Businesses depend on a well-functioning infrastructure system to obtain their supplies, manage their inventories, and deliver their goods and services to market. This is true for companies whose businesses rely directly on the infrastructure system, such as shippers like UPS and BNSF, as well as others whose businesses indirectly rely on the infrastructure system, such as farmers who use publicly funded infrastructure to ship crops to buyers, and internet companies that send goods purchased online to customers across the world. A modern transportation infrastructure network is necessary for our economy to function, and is a prerequisite for future growth.

#### Trade and accessibility to markets- economic theory

Rodrigue and Notteboom 12, [ Dr. Jean-Paul Rodrigue, Professor at Hofstra University Department of Global Studies and Geography, Dr. Theo Notteboom, Professor at the Institute of Transport and Maritime Management in Antwerp, <http://people.hofstra.edu/geotrans/eng/ch7en/conc7en/ch7c1en.html>]

Like many economic activities that are intensive in infrastructures, the transport sector is an important component of the economy impacting on development and the welfare of populations. When transport systems are efficient, they provide economic and social opportunities and benefits that result in positive multipliers effects such as better accessibility to markets, employment and additional investments. When transport systems are deficient in terms of capacity or reliability, they can have an economic cost such as reduced or missed opportunities. Efficient transportation reduces costs, while inefficient transportation increases costs. The impacts of transportation are not always intended, and can have unforeseen or unintended consequences such as congestion. Transport also carries an important social and environmental load, which cannot be neglected.¶ The added value and employment effects of transport services usually extend beyond employment and added value generated by that activity; indirect effects are salient. For instance, transportation companies purchase a part of their inputs from local suppliers. The production of these inputs generates additional value-added and employment in the local economy. The suppliers in turn purchase goods and services from other local firms. There are further rounds of local re-spending which generate additional value-added and employment. Similarly, households that receive income from employment in transport activities spend some of their income on local goods and services. These purchases result in additional local jobs and added value. Some of the household income from these additional jobs is in turn spent on local goods and services, thereby creating further jobs and income for local households. As a result of these successive rounds of re-spending in the framework of local purchases, the overall impact on the economy exceeds the initial round of output, income and employment generated by passenger and freight transport activities. Thus, from a general standpoint the economic impacts of transportation can be direct, indirect and related:¶ Direct impacts (also known as induced) the outcome of accessibility changes where transport enables employment, added value, larger markets and enables to save time and costs.¶ Indirect impacts the outcome of the economic multiplier effects where the price of commodities, goods or services drop and/or their variety increases. Indirect value-added and jobs are the result of local purchases by companies directly dependent upon transport activity. Transport activities are responsible for a wide range of indirect value-added and employment effects, through the linkages of transport with other economic sectors (e.g. office supply firms, equipment and parts suppliers, maintenance and repair services, insurance companies, consulting and other business services).¶ Related impacts the outcome of economic activities and firms partly relying on efficient transport services for both passengers and freight. For instance, the steel industry requires cost efficient import of iron ore and coal for the blast furnaces and export activities for finished products such as steel booms and coils. Manufacturers and retail outlets and distribution centers handling imported containerized cargo rely on efficient transport and seaport operations.¶ Mobility is one of the most fundamental and important characteristics of economic activity as it satisfies the basic need of going from one location to the other, a need shared by passengers, freight and information. All economies and regions do not share the same level of mobility as most are in a different stage in their mobility transition. Economies that possess greater mobility are often those with better opportunities to develop than those suffering from scarce mobility. Reduced mobility impedes development while greater mobility is a catalyst for development. Mobility is thus a reliable indicator of development. Providing this mobility is an industry that offers services to its customers, employs people and pays wages, invests capital and generates income. The economic importance of the transportation industry can thus be assessed from a macroeconomic and microeconomic perspective:¶ At the macroeconomic level (the importance of transportation for a whole economy), transportation and the mobility it confers are linked to a level of output, employment and income within a national economy. In many developed countries, transportation accounts between 6% and 12% of the GDP.¶ At the microeconomic level (the importance of transportation for specific parts of the economy) transportation is linked to producer, consumer and production costs. The importance of specific transport activities and infrastructure can thus be assessed for each sector of the economy. Transportation accounts on average between 10% and 15% of household expenditures while it accounts around 4% of the costs of each unit of output in manufacturing, but this figure varies greatly according to sub sectors.

### Job Creation (General)

#### Investment in Transportation infrastructure is key to the economy- job creation, stimulus

Department of Treasury 3/23 [March 23,2012, Department of Treasury of the US, “A New Economic Analysis of Infrastructure Investment”, pg. 5 <http://www.treasury.gov/resource-center/economic-policy/Documents/20120323InfrastructureReport.pdf>]

President Eisenhower’s vision is even more relevant today than it was in 1955, when he said in his State of the Union Address, "A modern, efficient highway¶ 1 Williamson, John, “Federal Aid to Roads and Highways Since the 18th Century: A Legislative History” Congressional Research Service, January 6, 2012.¶ 5¶ system is essential to meet the needs of our growing population, our expanding economy, and our national security." Today, that vision would include making not only our highways, but our nation’s entire infrastructure system more efficient and effective.¶ Our analysis indicates that further infrastructure investments would be highly beneficial for the U.S. economy in both the short and long term. First, estimates of economically justifiable investment indicate that American transportation infrastructure is not keeping pace with the needs of our economy. Second, because of high unemployment in sectors such as construction that were especially hard hit by the bursting of the housing bubble, there are underutilized resources that can be used to build infrastructure. Moreover, states and municipalities typically fund a significant portion of infrastructure spending, but are currently strapped for cash; the Federal government has a constructive role to play by stepping up to address the anticipated shortfall and providing more efficient financing mechanisms, such as Build America Bonds. The third key finding is that investing in infrastructure benefits the middle class most of all. Finally, there is considerable support for greater infrastructure investment among American consumers and businesses.¶ The President’s plan addresses a significant and longstanding need for greater infrastructure investment in the United States. Targeted investments in America’s transportation infrastructure would generate both short-term and long-term economic benefits. However, transforming and rehabilitating our nation’s transportation infrastructure system will require not only greater investment but also a more efficient use of resources, because simply increasing funding does not guarantee economic benefits. This idea is embodied in the President’s proposal to reform our nation’s transportation policy, as well as to establish a National Infrastructure Bank, which would leverage private and other non-Federal government resources to make wise investments in projects of regional and national significance.¶ In this report, we begin by reviewing factors that should influence investment in infrastructure. We review the economic literature regarding returns to infrastructure investment. Next, we consider the specific condition of our economy and labor market, including the availability of workers with the requisite skills, which suggest that now is a particularly favorable time to initiate these investments. Then we analyze the benefits derived by American families and companies from well-functioning infrastructure systems and the costs associated with poor infrastructure systems. Finally, we review public and business sentiment regarding infrastructure investment.

#### Infrastructure Climate Adaptation creates new jobs in a green economy

RAENG, February 2011, The Royal Academy of Engineering, Britain’s national academy for engineering “Infrastructure, Engineering and Climate Change Adaptation- ensureing services in an uncertain future”

<http://www.raeng.org.uk/news/publications/list/reports/Engineering_the_future_2011.pdf>

Adapting to climate change is not just a matter of managing the risks - it is about taking the opportunities it presents to develop new, innovative infrastructure systems and services. Adaptation to, and mitigation of, climate change provides opportunities in the new Green Economy. New opportunities in engineering design and manufacturing will come from the development of renewable energy technologies and the supply chains that will serve them. Building of resilience into existing infrastructure and designing new systems that are robust and efficient will do the same. If managed correctly, investment in infrastructure adaptation will create quality jobs, increasing the demand for skilled technicians to install, upgrade and maintain the new resilient infrastructure.

#### Adaption to climate change is crucial to national economy

Winkleman et. al, ’12 [Steve Winkleman, Jan Muller, Erica Jue, associated with the CCAP and EESI, “CLIMATE ADAPTATION & TRANSPORTATION Identifying Information and Assistance Needs”, http://files.eesi.org/Climate\_Adaptation\_Transportation.pdf]

Extreme weather events, including coastal storm surges, flooding, heating and freezing, and severe rain, snow, ice, and wind events, as well as changing average conditions and seasonal weather patterns – including, sea level rise, precipitation totals, mean temperatures, evapotranspiration rates, and ecosystem changes, are projected to affect safety, cost-effectiveness, efficiency, and technical feasibility of transportation investment and asset management decisions. These impacts will vary from region to region and may even vary at the local and site scale. Anticipating the consequences of such disruptive changes and planning prudent responses before they become reality will help transportation agencies protect the transportation infrastructure upon which communities, regions, and the national economy depend for the movement of goods and people.

The general nature of potential climate change impacts on transportation has been reasonably well-defined. The specific operational implications for transportation agencies and the broader transportation community, however, are not well understood.

### Rail

#### Disruption of supply routes from climate change leads to economic instability

Rossetti, ’02[Micheal A. Rossetti, Michael Rossetti is a Strategic Planner and Economist at the DOT Volpe Center. He has served as Executive Agent for the DOT/NSTC initiative on Enhanced Transportation Weather Services. He is member of the User Advisory Group of the US Weather Research Program, and of the OFCM Joint Action Group on Weather Information for Surface Transportation. He is the author of many DOT publications on transportation statistics, and technology development. Previously, he was employed at the Federal Communications Commission and National Research Council. Mr. Rossetti holds a M.A. degree from the Pennsylvania State University and an A.B. from Boston College, “The Potential Impacts of Climate Change on Transportation”, 2002, http://climate.dot.gov/documents/workshop1002/rossetti.pdf]

Weather can lead to serious delays on the railroads and resulting loss of economic efficiency, as had happened¶ during the Midwestern floods of 1993. Damage to tracks due to weather, besides being a safety hazard as mentioned¶ earlier, also has serious economic consequences. Additionally, weather induced delays contribute to inefficient fuel¶ use and reduced air quality.¶ These impacts represent the potential benefits in saved lives and saved resources from enhanced weather¶ information to support railroad decision-making.

#### Rail transportation already has a negative affect on steel industry—shipping cost too high

Cooney, ‘07[Stephen Cooney, Congressional Research Service; Resources, Science, and Industry Division at IRL School at Cornell University, “Steel: Price and Policy Issues”, 10-31-2007, <http://digitalcommons.ilr.cornell.edu/cgi/viewcontent.cgi?article=1492&context=key_workplace>]

Rail transportation costs, seen as railways have consolidated and¶ created more “capitive shippers,” have had a negative effect on industry, particularly¶ in raising the costs and reducing the options for shipping inputs like scrap and¶ delivering finished product to customers. According to the Government¶ Accountability Office (GAO), while rail rates have declined over the long term, they¶ increased by 9% in 2005, basically for all products across the board.90 The steel¶ industry specifically reported increases of around a third in rail costs since 2003, and¶ in some cases as high as 60%. “Transportation costs have escalated to the point that¶ they now account for 15-20% of the total cost of producing steel.”91

#### Climate change will affect capitol within industries through their interaction with freight demand

Rossetti, ’02[Micheal A. Rossetti, Michael Rossetti is a Strategic Planner and Economist at the DOT Volpe Center. He has served as Executive Agent for the DOT/NSTC initiative on Enhanced Transportation Weather Services. He is member of the User Advisory Group of the US Weather Research Program, and of the OFCM Joint Action Group on Weather Information for Surface Transportation. He is the author of many DOT publications on transportation statistics, and technology development. Previously, he was employed at the Federal Communications Commission and National Research Council. Mr. Rossetti holds a M.A. degree from the Pennsylvania State University and an A.B. from Boston College, “The Potential Impacts of Climate Change on Transportation”, 2002, http://climate.dot.gov/documents/workshop1002/rossetti.pdf]

Climate models suggest a future warming of 0.2 - 0.3oC per decade.1 Sea levels are expected to rise at a rate of 4 to 10 cm per decade. Ancillary effects include changes in regional distributions of rainfall and soil moisture, and possibly more frequent and more intense storm systems. In recent years, the complexities of climate change and predictions of climate model outputs have introduced an additional measure of uncertainty for railroad operators. Weather events, climate oscillations, and climate trends hence affect railroad safety, including fatalities, injuries, and property damage. Through their interactions with maintenance, planning, operating efficiency, scheduling, and demand for freight and passenger services, weather and climate may also affect a firm’s balance sheet, and cash flow, capital investment decisions, and even competitive stance within the industry.

### Waterways

**The plan is also necessary to generating jobs**

**Toohey, 6/18-**

president and chief executive of Waterways Council Inc. (Michale, “JOC TENS: U.S. National Policy Should Include Capital Investment for Inland Waterways Infrastructure,” <http://www.joc.com/joc-tens/joc-tens-us-national-policy-should-include-capital-investment-inland-waterways-infrastructu>)

The United States needs a national policy that includes the waterways and its infrastructure, and helps put Americans back to work at the same time. Here are 10 ways why: 1. Jobs! Jobs! Jobs! The most important advantage our waterways can bring to America is family wage jobs. There are currently more than 20 navigation projects authorized by **Congress that could begin putting U.S. workers back on the job. Let us invest in our nation’s lock and dam system today for a more prosperous tomorrow.** 2. Exports for U.S. products: President Obama has called for the doubling of our nation’s exports over the next five years. A noble goal that will increase our country’s prosperity, yes, but without an efficient waterways infrastructure to move increased volumes of grain, for example, this will not be an achievable goal. 3. **Traffic congestion relief: One 15-barge tow of dry bulk cargo keeps 1,050 trucks off our nation’s already overly congested highways, or another 216 railcars rolling through our communities**. 4. Fresher air: The inland waterways transportation sector has a lower carbon footprint because it generates fewer carbon dioxide emissions than rail or truck for each ton of cargo compared to transporting that same cargo by these other modes. 5. Energy efficiency: Barges on our inland system can move one ton of cargo 576 miles on one gallon of fuel — more the 100 miles more than rail transport and 400 miles more than truck transport. **This matters now more than ever as we seek ways to be less dependent on foreign oil.** 6. Bolstering our economy**: 624 million tons of cargo moves annually on the inland waterways, equaling around $70 billion that goes back into the U.S. economy. And more than $9 is returned to the nation in transportation cost savings for every $1 that is invested in a navigation project.** 7. Multibeneficiaries: The inland waterways system benefits many Americans, including those who use it for recreation, municipal and industrial water supply, hydropower and flood control. **Many communities along our inland waterways benefit from economic development opportunities, and private property owners enjoy higher property values because of the steady pools of water created by locks and dams on our inland waterways.** 8. Safest mode: Our fundamental goal is to return our workers safely home to their families. Thus, inland waterways transportation boasts the lowest injury and fatality rates compared to rail or truck. Safety-related statistics for all modes of freight transportation show one injury in the inland marine sector for every 125.2 in the rail sector and 2,171.5 in the highway sector, and one fatality in the inland marine sector for every 22.7 in rail and 155 in highway. 9. Connecting the country: Our inland waterways system includes 12,000 miles of commercially navigable channels and around 240 lock sites. These inland marine highways transport commodities to and from 38 states throughout the nation’s heartland and the Pacific Northwest; they serve industrial and agricultural centers, and facilitate imports and exports at gateway ports along the Gulf Coast. Just like Lewis and Clark’s discovery expedition to find new trade routes for a young America, our waterways keep America moving today and will do so tomorrow as well. 10. Capacity to feed the world: Our capital development plan for the United States’ navigable waterways system is building for the future. Unlike the truck or rail industries, we can accommodate the Panama Canal expansion, containers on barge, and the increased exports that will help feed the world’s inhabitants, expected to grow to 9 billion by 2050.

**Shipping channels are a major source of income for urban areas- without the plan connectivity will be impaired by 25%**  
CIER 08 The Center for Integrative Environmental Research University of Maryland

[September 2008 A Review and Assessment <http://www.cier.umd.edu/climateadaptation/Pennsylvania%20Economic%20Impacts%20of%20Climate%20Change%20Full%20Report.pdf> “Economic Impacts of Climate Change on Pennsylvania”]

**Dredging in the Great Lakes-St. Lawrence shipping channels has an expected annual cost of $85-$142 million. The movement of goods along this shipping route is responsible for around 60,000 jobs and $3.5 billion annually**. As a result of **decreasing water levels we could expect to see an increase in freight cost**s for the area if higher priced railroad transportation becomes necessary as shipping channels became impaired. **System connectivity could be impaired by 25 percent, which would create an estimated annual cost of $995 million.**

**squo inland waterways lack resilience---deterioration kills the econ**

**American Society of Civil Engineers 8** \*2008 is the most recent citation, Infrastructure Report Card “Inland Waterways” http://www.infrastructurereportcard.org/fact-sheet/inland-waterways

Conditions

Because of their ability to move large amounts of cargo, **the nation’s inland waterways are a strategic economic and military resource**. A recent analysis by the U.S. Army War College concluded that "the strategic contributions of these inland waterways are not well understood. The lack of adequate understanding impacts decisions contributing to efficient management, adequate funding, and effective integration with other modes of transportation **at the national level.** Recommendations demonstrate that leveraging the strategic value of U.S. inland waterways will contribute to building an effective and reliable national transportation network for the 21st century." 1

Forty-one states, including all states east of the Mississippi River and 16 state capitals, are served by commercially navigable waterways. The U.S. inland waterway system consists of 12,000 miles of navigable waterways in four systems—the Mississippi River, the Ohio River Basin, the Gulf Intercoastal Waterway, and the Pacific Coast systems—that connect with most states in the U.S. The system comprises 257 locks, which raise and lower river traffic between stretches of water of different levels.

Three-quarters of the nation's inland waterways, or approximately 9,000 miles, are within the Mississippi River system. The next largest segment is the Ohio River system with 2,800 miles. The Gulf Coast Intercoastal Waterway system comprises 1,109 miles and the Columbia River system, the shortest of the four major systems, is only 596 miles long.

The nationwide network includes nearly 11,000 miles of federal user fees through an excise tax on fuel. Commercial waterway operators on these designated waterways pay a fuel tax of 20 cents per gallon, which is deposited in the Inland Waterways Trust Fund (IWTF). The IWTF, which was created in 1978, funds half the cost of new construction and major rehabilitation of the inland waterway infrastructure.

Forty-seven percent of all locks maintained by the U.S. Army Corps of Engineers were classified as functionally obsolete in 2006. Assuming that no new locks are built within the next 20 years, by 2020, another 93 existing locks will be obsolete—rendering more than 8 out of every 10 locks now in service outdated. 2 Currently, the Corps has $180 million per year available for lock repairs—half comes from the IWTF revenues and half comes from congressional appropriations. With an average rehabilitation cost of $50 million per lock, the current level allows the Corps to fully fund only two or three lock projects each year.

Due to a lack of adequate data, ASCE was unable to assess the condition of, or assign a grade to, the infrastructure of the nation’s more than 300 ports and harbors. Ports, which are owned and operated largely by state, local, and private entities, are not required to report on the condition of their infrastructure to the federal government. Nevertheless, U.S. ports connect to 1,000 federally maintained harbor channels and 12,000 miles of taxpayer-funded inland waterways, and their landside port infrastructure facilities include terminals, wharves, rail yards, and roadways within the harbor districts. 6 In 2007, the American Association of Port Authorities (AAPA), which represents ports in the U.S., Canada and Mexico, reported that public ports in the U.S. must invest $1.7 billion annually to update and modernize their facilities. The AAPA report contained no assessment of the physical condition of individual ports or of port infrastructure generally. 4 Resilience **The current system of inland waterways lacks resilience**. Waterway usage is increasing, but facilities are aging and many are well past their design life of 50 years. Recovery from any event of significance would be negatively impacted by the age and deteriorating condition of the system, **posing a direct threat to the American economy**.

#### Inland waterway repairs are crucial to the nation’s economy

NCGA, 4/2-

(National Corn Growers Association, “Improving inland waterways system remains crucial,” <http://www.agprofessional.com/news/Improvements-to-inland-waterways-system-remain-crucial-145162035.html>)

With a wide variety of pressing issues facing the federal government over the coming months, funding for desperately needed lock and dam improvements remains a high priority for the nation's corn farmers, according to the National Corn Growers Association. With the country's inland navigation system moving more than a billion bushels of grain per year, about 60 percent of all grain exports, farmers understand the importance of a functional waterways system. "Our inland waterway system plays a crucial role in the nation's economy, and we must act now to help our leaders understand that funding improvements is critical to maintaining our industry's viability," said NCGA President Garry Niemeyer. Achieving our goal is not only important for farmers and shippers, our nation as a whole will benefit from the job creation and shipping efficiencies this project would generate." The country's inland navigation system plays an even more visible role in the economy also, moving more than a billion tons of domestic commerce valued at more than $300 billion per year. Yet, investment in the Upper Mississippi and Illinois Waterways has not kept pace with the needs of the transportation sector. Designed to last only 50 years, much of the lock system is approaching 80 years old and signs of deterioration are readily apparent.

**Key to resource transport**

Martin, 10-

(Waterways Council’s new President and CEO. Prior to being named to this position he was Chairman and CEO of Direct Workforce, Inc., a contract labor company serving the shipbuilding, ship repair, and oil and gas industries based in Houma, Louisiana, President and CEO of the Canadian American Transportation System. Vice President - Corporate Affairs of American Classic Voyages Company, parent of the Delta Queen Steamboat Company (and other cruise line subsidiaries Vice President – Southern Region, for the American Waterways Operators. enior professional staff of the House of Representatives’ Coast Guard and Navigation Subcommittee and Legislative Assistant for Maritime Affairs for Congressman W.J. “Billy” Tauzin of Louisiana. Cornel, March 23, 2010, <http://www.waterwayscouncil.org/Media%20Center/articles/Page_%20from_Cornel_OPED_Marex.pdf>)

**Our inland waterways system transports about 20 percent of our nation’s coal to generate electricity in utility plants and around 22 percent of our domestic petroleum products. This system is the primary artery for more than half our grain and oilseed exports**. All told, more than 625 million tons of freight commodities valued at more than $70 billion move on America’s inland navigation system annually. **And with worldwide trade expected to double over the next decade and with our highways and railways facing serious capacity issues, our inland rivers may be even more critical tomorrow than they are today for transporting products efficiently.** There are other considerations as well. A new study by the National Waterways Foundation underscores the “green” value of this transport mode. Inland waterways relieve congestion on our already over-crowded highways and railways. One jumbo barge has the same capacity as 70 trucks or 16 rail cars. A typical 15-barge tow on our nation’s rivers is equal to 1,050 trucks – in other words, just one barge movement equals 1,050 truck movements! **To sustain these many benefits and stimulate economic recovery for our nation, investment in our inland navigation system of locks and dams is critic**al. **Many of our locks and dams are more than 50 years beyond their economic design life and are deteriorating rapidly, impacting efficiency, safety, and our world competitiveness.** **We must modernize our lock-and-dam system so that our farmers, coal miners, oil producers and stone/aggregate suppliers can transport their products cost-effectively and efficiently**, **allowing them to remain competitive in world markets.**

#### **Inland waterways creates jobs**

Devol and Wong, 10-

(Devol is Chief Research and the Miliken Institute, Wong is the director of Research at the Miliken Institute, January, “Jobs for America Investments and policies for economic growth and competitiveness,” <http://www.nam.org/~/media/58F813B0D1E643DC91E564FE4C3B3C2F.ashx>)

Inland Waterways Inland waterways are part of the nation’s infrastructure for moving goods, and they require federal assistance for maintainance and improvements. They encompass over 8,200 miles of major river systems 119 that connect the Gulf of Mexico with the agriculturally rich Midwest and manufacturing hubs in the Southeast and the Great Lakes. Current projects include development in the Pacific Northwest; however, the Mississippi River system and its tributaries are the busiest and most expansive network of lock-and-dam infrastructure. 120 Inland waterway projects under construction or almost ready to begin construction will require approximately $7 billion to complete. 121 The U.S. Army Corps of Engineers is responsible for constructing, modernizing, and maintaining these waterways. Construction and maintenance of dams and waterways for freight transportation have historically been neglected and underfunded. The Corps of Engineers has a $60 billion project backlog. 122 In addition to hampering trade by limiting cargo size and freight passage, 123 underinvestment in public works has had major public safety ramifications, often negatively amplifying natural disasters, as was the case with the levees that failed during Hurricane Katrina in 2005. The direct impacts of a $2.6 billion investment would consist of nearly 24,000 construction- and R&D-related jobs and $1.1 billion in earnings. Ripple effects increase the total impacts to more than 67,000 jobs, $2.7 billion in earnings, and $8.1 billion in output. In other words, every $1 billion invested in inland waterways creates more than 25,800 jobs across all sectors. Assuming that the impacts of the total proposed investment occur over three years, the average annual increase would be about 22,300 jobs.

#### Inland waterways creates jobs and a multiplier effect

Devol and Wong, 10-

(Devol is Chief Research and the Miliken Institute, Wong is the director of Research at the Miliken Institute, January, “Jobs for America Investments and policies for economic growth and competitiveness,” <http://www.nam.org/~/media/58F813B0D1E643DC91E564FE4C3B3C2F.ashx>)

Certain infrastructure projects, such as building a smart grid or constructing inland waterways, require an extensive production infrastructure and a large proportion of highly skilled and specialized labor. With this need comes demand for supply-related goods and services. The cumulative employment and earnings generated by all this tightly interconnected activity ripples throughout the economy. Spending by engineers, contractors, and researchers boosts the income of business professionals, restaurant workers, retail clerks, and real estate agents, who then plow that extra income back into the local economy. Through these greater purchases of goods and services, wealth is created and sustained.

### Road

#### Road transportation is the crucial key to the US economy—the nation’s economy is totally dependent on roads

Bragdon 08 (Clifford R. Vice President for Strategic Initiatives and Executive Director of the Florida Tech Research Park at Florida Institute of Technology. Former Associate Provost and Dean of the University of Florida. Former Distinguished Professor and Executive Director of the Center for Intermodal Transportation Safety and Security, CITSS, (a consortium of all public universities in Florida), established and funded by the U.S. Congress. Former Director and Vice-President of the National Aviation and Transportation Center and Dean for the School of Aviation and Transportation at Dowling College, Long Island, New York. Transportation Security. 2008 Published by Elsevier-Academic and Butterworth Press)

Note that AASHTO refers to the American Association of State Highway and Trans- portation Officials and that U.S. DOT refers to the U.S. Department of Transportation.¶ The road transportation system is a crucial component of the U.S. public infrastruc- ture and plays a vital role in maintaining the vigor of the nation's economy. In 2001. the Bureau of Transportation Statistics (BTS) reported that the SO states spent $104 billion to build and maintain highway infrastructure that supported some 2~ trillion vehicle miles of travel |TSA, 2006). The use of private automobile\* on America's extensive road transpor- tation network provides Americans with an unprecedented degree of personal mobility and freedom, continuing to allow people to travel where and with whom they want. In 2001, 87% of daily trips involved use of personal vehicles on the road transportation network.¶ The U.S. vehicle fleet includes 7.9 million trucks, 750.000 buses. 137 million cats, 4.9 million motorcycles, and 84 million other two-axle vehicles (TSA, 20061. Roads are also a key conduit for freight and cargo movement in the United States. Trucks carried 60% of total freight shipments by weight and "0% by value |not including shipments moved by truck in combination with another transportation mode). Trucks are playing an increasingly important role as businesses turn to just-in-time delivery systems to minimize logistics costs (e.g., warehousing and storage).¶ Road transportation has a central role to play in the continued health and growth of the nation's economy. Americans expect cars to travel and goods to he delivered door-to-door to all comers of the continental United States, quickly, economically, effi- ciently, and on time. Often road transportation is the only answer to the demand for such high levels of personal mobility and flexibility—a situation that will remain despite increasing investment in other modes, especially in the major urban areas. The road transportation sector itself already contributes significantly to the nation's economy.¶ Without an efficient, vibrant road transportation system, other modes cannot func- tion properly, as most freight and passenger journeys begin and end with a trip on the road. Only road transportation can provide door-to-door service. Road transportation, therefore, also plays a key role in development of America's integrated transportation networks and internodal transportation solutions.¶ The nation's economy is totally dependent on this critical infrastructure. It includes many historically and culturally significant structures that arc easily accessible to vehicles of all kinds without screening or inspection. Some of these structures also have high eco- nomic value and could easily be targeted for attack or sabotage. Trucks routinely carry hazardous materials that could be used to attack targets that are part of. or are adjacent to. the road transportation system. This was sadly demonstrated with a truck bomb at the Mumh Federal Building in Oklahoma Ciiv in April 1995 (TSA. 2006).¶

### Airports

#### Delays cost 40.7 billion dollars a year – and this number doesn’t even include the indirect impacts [such as late cargo, lost productivity, etc.].

The airline industry moves millions of passengers and tons of cargo annually. **The** Schumer **report estimated that in 2007, airport delays cost about 40.7 billion dollars to the economy** [1]. Disruptions in one part of the airspace impact the entire network as delays propagate. It is estimated that almost 50% of the entire airspace delays are caused by delays that originate at the New York/New Jersey/ Pennsylvania airports. **We begin this study by considering only the direct costs to the airlines of such delays.** Future work will examine the network impact as well as the resulting economics costs to the various regions and other industries. In general a flight can be delayed due to several reasons, mainly: - Mechanical problems with the aircraft. - **Schedule disruption due to bad weather or air traffic management initiatives** (Ground Delay Programs (GDPs) or Air Flow Programs (AFPs)). - Misaligned crew/ aircraft due to previous delayed flight **Weather is a major cause of delay as it reduces the capacity of both the airspace and the runways**. Based on weather forecasts, air traffic management estimates the resulting reduction in capacity within various segments of the airspace and at a variety of airports. It announces Ground Delay Programs (GDPs) that hold aircraft at the departing airport, in order to have the flying aircraft better match the capacity of the system. Holding at a gate is both cheaper and safer than airborne holds, and allows the system to be better managed. Finally, the delays already described induce future delays in the system, because the aircraft or crews may not arrive at their next assignment on time. Even when the crew does arrive, they may not be able to work another flight because they have exceeded their allowable working hours.

#### Air Freight is key to the economy – people move the most valuable items by air.

Caldwell et al [no date] – Harry Caldwell is the Chief of Freight Policy for the Federal Highway Administration, Kate H. Quinn is the Assistant Division Administrator of the Federal Highway Administration’s Indiana Division Office, Jacob Meunier, Ph.D. is an Analyst of Cambridge Systematics with experience in transportation planning and policy-making, John Suhrbier is a Principal of Cambridge Systematics, and Lance R. Grenzeback is a Principal and Senior Vice President of Cambridge Systematics [Department of Transport, “Potential Impacts of Climate Change on Freight Transport”, No Date, DOT, <http://climate.dot.gov/documents/workshop1002/caldwell.pdf> AD]

**The United States freight transport system comprises a vast network of** roads**, airports**, railroads, waterways, terminals, ports, and pipelines. **This network includes** 161,000 miles on the National Highway System, 46,000 miles of Interstate Highways, 3.8 million miles of other roads, **800 major airports,** 170,000 miles of freight railroads, 26,000 miles of navigable waterways, 10,000 commercial waterway terminals, and 1.4 million miles of oil and gas pipelines. Many of these facilities, especially intermodal ports, are sited in low-lying coastal areas, reflecting the historical importance of water access to the movement of freight. In the future, however**, their location may prove as much a liability as an asset, since many global climate change models forecast an increase in flood frequencies and elevations. The nation’s freight system moved 14 billion tons of domestic freight valued at $11 trillion over 4.5 trillion ton-miles** in the 2 Potential Impacts of Climate Change on Freight Transport The Potential Impacts of Climate Change on Transportation year 2000. Figure 1 shows the share of tons, ton-miles, and revenue dollars for each mode. Trucks moved 78 percent of the nation’s domestic freight tonnage, generated 60 percent of its ton-mileage, and accounted for 88 percent of its dollar value, the highest percentage in each category. Trucks moved 11 billion tons valued at $9.5 trillion over 2.6 trillion ton-miles in 2000. Rail moved 16 percent of total domestic freight tonnage, second to truck. Rail moves tended to be longer in distance than truck moves and therefore accounted for a proportionately higher share (28 percent) of ton-miles. Rail moves also tended to involve lower-value commodities than truck, so rail represented a proportionately lower share (six percent) of total domestic freight value. Rail moved two billion tons valued at $600 billion over 1.2 trillion ton-miles in 2000. **Air represented a negligible share of tonnage and ton-miles, but a disproportionately high share of value, five percent. Airfreight tends to be very light and valuable.**

#### High value goods tend to be shipped by air and the sector is growing.

World Trade Organization and United Nations Environment Programme ’09 [WTO and UNEP, “Trade and Climate Change”, 2009, WTO and UNEP, <http://www.wto.org/english/res_e/booksp_e/trade_climate_change_e.pdf>, AD]

One important issue concerning trade’s role in greenhouse gas emissions is its link to transportation services. International trade involves countries specializing in the production and export of goods where they have a comparative advantage and importing other goods from their trade partners where they have no such advantage. This process of international exchange requires that goods be transported from the country of production to the country of consumption, and consequently an expansion in international trade is likely to lead to increased use of transportation services. Merchandise trade can be transported by air, road, rail and water, or via pipelines in the case of oil. In most instances, international trade in merchandise will involve more than one mode of transport, since even goods that are carried by air or by water must often make an overland journey to the seaport or airport, and are generally transported by land on the final stretch of their journey to the ultimate consumer. At a global level, maritime transport accounts for the bulk of international trade transport by volume, and for a signifi cant share by value. Excluding intra-EU trade, the United Nations Conference on Trade and Development (UNCTAD) (2007b) reported that, in 2006, seaborne cargo accounted for 89.6 per cent of world trade transport by volume; overland and other Part II: Trade and Climate Change: Theory and Evidence 59 Part IV Part III Part II Part I modes of transport (including pipelines) accounted for another 10.2 per cent; while airborne cargo accounted for the remaining 0.27 per cent (see Figure 2). By value, seaborne trade made up 70.1 per cent of global trade transport, airborne cargo accounted for 14.1 per cent, and land and other modes of transport for the remaining 15.8 per cent.28 Since 2000, the share by volume of each of these modes of transport appears to have changed very little, with the share of maritime transport remaining almost invariable at 89 per cent. Th e share by value, however, has been more subject to change, with maritime transport’s share varying between 64 and 70 per cent. Th e inclusion of trade within the EU changes the picture somewhat. Lloyd’s Maritime Intelligence Unit (MIU) estimated that seaborne trade accounted for 76.5 per cent of international trade transport by volume and air transport for 0.3 per cent, while the share of overland transport was 15.9 per cent and that of pipelines was 7.3 per cent. By value, the share of seaborne cargo represented 58 per cent of the total, air cargo [was] 11 per cent, overland cargo 39 per cent and transport via pipelines accounted for 2 per cent.29 Th e apparent reduction in the share of maritime transport can be explained by the fact that only a small proportion – 18.1 per cent (by volume) – of trade within the EU is transported by sea although 71.7 per cent of its trade with the rest of the world is by sea (OECD, 2006a). At the regional level, there is of course considerable variation in the importance of the various modes of transport. Countries that share a land border will have a greater share of trade being transported by land. Hummels (2007) estimates that in North America, nearly 25 to 35 per cent of trade by value is transported by land. Th e OECD (2006a) estimates that, in 2004, 31.1 per cent of trade within the EU was transported by road, another 6.1 per cent by rail and 7.7 per cent by pipeline. Th e role of international trade in increasing greenhouse gas emissions caused by road transport has been highlighted in a number of environmental assessments of regional trade agreements such as NAFTA (these assessments were reviewed in the previous subsection). By contrast, for countries in Africa, the Middle East and Asia, only between 1 and 5 per cent of trade by value is with neighbouring countries, and thus the bulk of trade is carried by sea or by air. While the greater part of international trade is transported by sea, the volume of goods shipped by air (tonnes/kilometre) has been growing rapidly: between 1951 and 2004, it grew at 11.7 per cent annually – about twice the rate of other modes of world trade transport.30 This comparatively faster increase in the use of air transport for the shipment of goods can be explained by technological improvements (e.g. the invention and widespread use of the jet engine) which have resulted in a sharp decline in the cost of air shipping; by a fall in the value-to-weight ratio of manufactured goods; and by the growing importance of speed in international trade (Hummels, 2007).

#### Cargo flights are key to freight trade.

The World Bank ’06 [World Bank, “Transport for development”, 2006, The World Bank, <http://siteresources.worldbank.org/INTTRANSPORT/Resources/ECD_Draft1_final.pdf> AD]

**Aviation is becoming increasingly important to development in all regions. Air freight services carry a significant proportion of trade by value, and they are vital for the export of perishable commodities** (flowers, seafood, etc.) produced by many developing countries **for international markets**. **Safe and secure air passenger services underpin the international tourism industry. Reliable air transport links also influence the investment location decisions made by international companies, particularly technology companies with high value-added products.** Strong international growth in aviation is straining the physical and management capacities of many developing country airports**. Over the ten years to 2005, both passenger travel and air freight have increased by about 55 percent** (ICAO 2006). In 2005 some 4,020 billion revenue passenger–kilometers were flown, with a projected annual average growth of 4.9 percent a year for the next 20 years. **Cargo flights worldwide involved 178.1 billion revenue tonne–kilometers (29 million tonnes), with a projected average annual growth of 6.1 percent a year.** 23 The Bank Group’s transport business strategy will give increasing support to the development of safe air transport services in client countries. The key issues being addressed by Bank operations and advice in the subsector are regulatory oversight, safety and security, air traffic infrastructure and facilities, provision of essential air services, the liberalization of air transport in regions and subregions, and environmental impact. Fatalities are very low in air transport worldwide, compared with other modes of passenger transport and, unlike road accidents, cannot be classified as a major public health issue. But safety is critical to the development of aviation services and hence to the industries that depend on it. Safety varies widely: for example, West Africa has an aviation accident rate 30 times that of the United States. High accident rates have become the prime hurdle for development of air services in many developing countries because of the impact of blacklists (in Europe), certification requirements (in the United States), and related difficulties in raising finance and procuring insurance. Regular aircraft crashes in a region also inevitably affect the confidence of investors. The fixed infrastructure for air transport includes airports and runways, navigation technology for flights en route or landing (installations on the ground or satellites in orbit), and air traffic control facilities. The Bank Group has financed airports, both with IBRD/IDA lending instruments and IFC financing. The Bank is currently supporting the preparation of a major air transport infrastructure project to provide the East African Community with a satellite-based air traffic control system, as well as several runway projects. The liberalization of air transport services (in terms of rights of service and access to airport capacity) is particularly topical in Sub-Saharan Africa and East Asia. The Bank has provided research and been involved in the policy dialogue in both regions, generally in support of increased economic liberalization coupled with higher regulatory standards for safety and environment.

#### In Virginia alone, airports are responsible for 728 million dollars in economic activity while they sustain about 259,000 jobs.

Daily Press ’11 – The Daily Press is the newspaper of Hampton, Virginia [Daily Press, “Study: Airports are key economic drivers”, September 19, 2011, Daily Press, <http://articles.dailypress.com/2011-09-19/news/dp-nws-cp-airport-economics-20110919_1_general-aviation-airports-smallest-airports-williamsburg-jamestown-airport> AD]

WILLIAMSBURG — On a recent late summer morning, the Williamsburg-Jamestown Airport appeared quite unremarkable. Four single-engine airplanes were parked on the tarmac — their pilots no where in sight. The hazy air was still and the familiar buzz of small plane engines absent. The famous Charly's Airport Restaurant — that draws diners from well beyond the horizon — had yet to open for the day. Few people were observed milling about the airport property. Nothing about the scene belied the fact that this small airstrip, nestled between the Williamsburg Winery and Route 199, is itself an engine that generates more than $4 million in economic activity each year. The airport also supports 62 (direct and indirect) jobs with a payroll of more than $1.2 million. That was the finding of a recent economic impact study conducted by the Virginia Department of Aviation on the state's nine commercial and 57 general aviation airports. The report found Virginia's public-use airports contribute $28.8 billion in economic activity to the state economy — about 4.4 percent of total output. And they are credited with creating and sustaining approximately 259,000 jobs — about 5.5 percent of the state total — with $11.1 billion in payroll. The report drew from data collected through a "comprehensive survey" of airport managers, on-airport tenants, off-airport businesses, visitors and data collected from U.S. government agencies. It concluded more than 69,000 people board commercial planes and more than 6,000 aircraft take-off or land at state airports each day. Further, each job at a Virginia airport supports seven additional positions and every $1 spent at a Virginia airport contributes an additional $3.48 in economic activity, the report concluded. The report showed: •Newport News-Williamsburg International Airport contributes $373.5 million to the local economy, including 3,382 jobs with a payroll of more than $114 million. •Norfolk International Airport generates more than $1 billion in economic activity and supports more than 10,000 jobs with payroll of more than $341 million. •Richmond International Airport supports more than 10,900 jobs, with $350 million in payroll, and generates more than $1 billion in economic activity. Ken Spirito, executive director of the Newport News-Williamsburg International Airport, noted a portion of the study that indicated the Peninsula facility is the smallest of the three regional airports, but is second in terms of visitor spending. "With AirTran leaving, the economic impact of the airport is more important now than it's ever been," he said. "There is significant value to understanding how important access to the Peninsula is for business, military and tourism." Small but mighty Perhaps most surprising in the report is the economic thrust of the state's smallest airports. According to the report, Virginia's general aviation airports contributed $728 million in economic activity in 2010 and were responsible for nearly 5,200 jobs with an annual payroll of more than $213 million. By late morning, this becomes clearer as the Williamsburg-Jamestown Airport's bustle breaks the country quiet. A number of planes take-off and land. Several pilots and passengers (from Holland of all places) prepare their planes to continue flights that were paused for an overnight stay. A local pilot shows up for his regular morning coffee. A corporate helicopter lands and several men dressed in business casual scurry across the tarmac. The flight school down the runway stirs awake. Charly's restaurant was still yet to open, but the airport's owner Larry Waltrip assured there would be more activity later. "A lot of people fly in for lunch," he said. "It's a good stop if someone is traveling down the coast." In fact, Charly's is widely known as one of the best "fly-in" restaurants in the country — as voted by pilots on 100dollarhamburger.com, a subscription-based website with more than 54,000 readers, most of whom are pilots who own their own aircraft, according to publisher John Purner. "Charly's has been one of the Best of the Best since 2006, except for 2008 when it received a runner-up award," Purner wrote, in an email. "Only three other restaurants in the United States have matched Charly's accomplishment." Disclaimer: Charly's doesn't sell a $100 hamburger, or hamburgers at all for that matter. The aviation term apparently references an excuse to go flying. 'Social center' Waltrip says the Williamsburg airport handled 15,084 take-offs and landings in 2010. The 43-year-old family-owned business — and "dying breed," in Waltrip's words — serves College of William & Mary parents and students, corporate travelers, tourists, entertainers performing at Busch Gardens and golfers. Waltrip says the airport makes significant contributions (directly and indirectly) to local taxes and businesses like restaurants, hotels and tourist attractions. Despite periodic construction of new hangars, the airport has, for years, maintained a waiting list of pilots who want to store planes, the owner continued. "In a 24-hour day, a lot goes on that the public is not aware of at all," Waltrip said. "The airport is doing more than people think. We're pleased they did the study, it proved what we've been talking about." Pilot Alan Melton calls the Williamsburg airport his "social center." "In every community there are these airplane guys. The general aviation airport is the center to which all these guys gravitate," Melton said. "I'm sure Larry could build another 20 hangars and fill them. It's a very handily located place."

#### America’s airports generate 10.5 million jobs and 1.2 trillion in economic impact.

Airports Council International – North America ’12 [AIC-NA, “New Study: America’s Airports Are Vital Economic Hubs”, 2012, AIC-NA, http://aci-na.org/newsroom/press-releases/new-study-america%E2%80%99s-airports-are-vital-economic-hubs]

**America’s commercial airports are a powerful economic engine, generating 10.5 million jobs and $1.2 trillion in total economic impact**, according to a new study released today by the Airports Council International-North America. The Economic Impact of Commercial Airports in 2010 quantifies the contributions of 490 commercial airports in the United States, dubbed “Airports, Inc.” The analysis, prepared by CDM Smith, concludes that in addition to the broader impacts, airports also are powerful economic multipliers in communities and states nationwide. **U.S. airports have generated 56 percent more jobs in America’s communities since ACI-NA last studied airports’ total economic impact in 2001**. More information about the contributions of airports at the national and state levels can be found at www.airportsforthefuture.org**. In 2010, airports were responsible for about 8 percent of U.S. gross domestic product (GDP), and an estimated 7 percent of jobs.** And with domestic passenger travel projected to grow from 713 million to 1 billion enplanements in the next decade, the industry is poised to expand rapidly. “This analysis confirms that America’s airports are economic hubs that drive our local, state and national economies, both inside and outside the airport fenceline,” said Greg Principato, president of ACI-NA. “Airports are bright spots in a time of economic uncertainty, especially for the 10.5 million American workers who depend on airports for good jobs across the USA.” Using data from 2010, the report shows: When you consider direct employment, “**Airports, Inc.” is the nation’s second largest employer**, after Wal-Mart. The effect of airports on U.S. GDP ― $1.2 trillion ― is greater than the total value of all goods and services produced in countries like Mexico, Switzerland or South Korea, according to 2010 World Bank data. The annual payroll associated with airports ― $365 billion ― is comparable to the economy of Michigan. “Airports will be as vital to job creation over the next 10 years as they have been over the last decade,” Principato said. “In fact, our biggest challenges are improving local empowerment so our airports can make the infrastructure investments needed to sustain this level of economic contribution well into the 2020s.” ACI-NA has identified over $80 billion in documented infrastructure projects, including runways, terminals and other facilities, needed to meet a surge in domestic passenger travel over the next decade, not counting federal projections for growth in cargo and other aviation-related services. At the state level, the study shows that workers in five states benefit the most from commercial airports: California: 1.4 million jobs Florida: 1.2 million jobs New York: 974,000 jobs Texas: 970,000 jobs Georgia: 637,000 jobs Commercial airports are funded with user fees and receive almost no taxpayer funds from state or local governments. The federal grants that help pay for airport construction projects come from a portion of taxes paid on airline tickets, air cargo shipments, and aviation fuel purchases. The study examined the direct on-airport economy, including visitor spending, operations, and the impact of the airports’ capital improvement projects. The FAA-approved methodology used also measured the commercial airports’ multiplier economic impacts, including employment and payroll, both on- and off-airport property.

### US key Global Economy

#### Financial crises in the US spills over - all markets are reliant on the US

Harris and Burrows 9 [PhD in European History @ Cambridge and Counselor of the US National Intelligence Council AND Member of the National Intelligence Council’s Long Range Analysis Unit (Mathew J. and Jennifer, “Revisiting the Future: Geopolitical Effects of the Financial Crisis,” April, Washington Quarterly, <http://www.twq.com/09april/docs/09apr_Burrows.pdf>]

Such was the world the NIC foresaw as the crisis unfolded. Now, emerging markets the world over have lost more than half of their value since September 2008 alone. Banks that have never reported a net loss earnings quarter were dissolved in a matter of days. Even with the one year anniversary of the Bear Stearns collapse approaching in March, markets may have yet to find a floor. The proportions of the current crisis hardly need familiarizing. As the panic has not yet given way to a lucid picture of the impacts, most economists and political forecasters are smart enough to shy away from sweeping predictions amid the fog of crisis. Yet, in the post-crisis world, it seems conceivable that global growth will most likely be muted, deflation will remain a risk while any decoupling of the industrialized from developing countries is unlikely, the state will be the relative winner while authoritarianism may not, and U.S. consumption as the engine for global growth will slowly fade. Whether U.S. political and market clout will follow, and whether U.S. political leadership will come equipped with knowledge of the strategic forces affecting the United States remains to be seen. How Much of a Geopolitical ‘‘Game Changer’’ is the Financial Crisis? Mapping the NIC’s predictions against early facts, one of the most interesting observations is less about any particular shock generated by the financial crisis and more about its global reach. If anything , the crisis has underscored the importance of globalization as the overriding force or ‘‘mega-driver’’ as it was characterized in both the NIC’s 2020 and 2025 Global Trends works. Developing countries have been hurt as decoupling theories, assertions that the emerging markets have appreciably weaned themselves from the U.S. economy, have been dispelled. This second epicenter of the crisis in emerging markets could also continue to exacerbate and prolong the crisis. Alongside foreseeable exposures, such as Pakistan with its large current account deficit, are less predictable panics like Dubai, whose debt was financed on suddenly expensive dollars. Even those with cash reserves, such as Russia and South Korea, have been severely buffeted.

#### The United States economy still has a huge effect on the world

Deés and Saint-Guilhem 9 (Central Bank, “The role of The United States in The global economy and its evolution over Time,” 2009, p.25-26 http://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1034.pdf)

The current economic recession in the United States has questioned the ability of¶ the global economy to "decouple"' from US. cyclical developments. While there¶ were some signs of decoupling in the first quarters following the US. downturn,¶ they disappeared rapidly towards the end of 2008, when the crisis became more¶ global and the economic cycles turned out to be more synchronous across the¶ world.¶ ‘While the increasing Economic integration at the world level and the resulting¶ emergence of large economic players, like China, is likely to have weakened the¶ role of the U .S. economy as a driver of global growth, the influence of the United¶ Stats on other economic remains however larger than direct trade ties would¶ suggest. Third-market effects together with increased financial integration tends¶ to foster the international transmission of cyclical developments.¶ This paper attempts to provide some answers by analyzing how' a change in¶ U.S. GDP is transmitted to the rest of the world and to what extent such a transmission has changed over time. The empirical analysis shows various results.¶ First, the economies differ as regards their sensitivity to U .S. developments. The¶ US. economy is for most economic their first trading partner and has remained¶ so during the last 25 years. Even for countries that do not trade so much with ¶ the U .S., they are influenced by its dominance through other partners’ trade.¶ Of course, the economies that trade a lot with the U.S. are most likely affected¶ by UR economic shocks. At the regional level, however, such effects tend to¶ be diluted and the transition of U .S. cyclical developments seem to be some-¶ what dampened by regional integration. Moreover, while no clear trend seems¶ to emerge, it seems that the role of the US. in the global economy has changed¶ over time. Although, we are not able to identify any structural break in the¶ sample, we can see that a time-varying estimation shows some noticeable differences in the transmission of U.S. shocks over time. Overall, it seems that for¶ most countries, a change in U .S. GDP has weaker impacts during most recent¶ periods than for earlier periods. However, the persistence of such shocks seem¶ to have increased in the most recent periods. The increase in persistence of¶ the U.S. shocks together with the increase in the impact elasticities of non-US.¶ foreign activity for some regions [emerging in particular) emphasizes the role¶ of second-round and third partners” effects, making U .S. cyclical developments¶ more global.¶

## Impacts

### War

Global economic crisis causes war---strong statistical support   
Royal 10 (Jedediah, Director of Cooperative Threat Reduction at the U.S. Department of Defense, 2010, “Economic Integration, Economic Signaling and the Problem of Economic Crises,” in Economics of War and Peace: Economic, Legal and Political Perspectives, ed. Goldsmith and Brauer, p. 213-215)

Less intuitive is how periods of **economic decline may increase** the likelihood of **external conflict**. Political science literature has contributed a moderate degree of attention to the impact of economic decline and the security and defence behaviour of interdependent states. Research in this vein has been considered at systemic, dyadic and national levels. Several notable contributions follow. First, on the systemic level, Pollins (2008) advances Modelski and Thompson's (1996) work on leadership cycle theory, finding that **rhythms in the global economy are associated with the** rise and fall of a pre-eminent power and the often **bloody transition from one** pre-eminent **leader to the next**. As such, exogenous shocks such as economic crises could usher in a redistribution of relative power (see also Gilpin. 1981) that leads to uncertainty about power balances, **increasing the risk of miscalculation** (Feaver, 1995). Alternatively, **even a** relatively **certain redistribution** of **power could lead to a permissive environment for conflict** as a rising power may seek to challenge a declining power (Werner. 1999). Separately, Pollins (1996) also shows that global economic cycles combined with parallel leadership cycles impact the likelihood of conflict among major, medium and small powers, although he suggests that the causes and connections between global economic conditions and security conditions remain unknown. Second, on a dyadic level, Copeland's (1996, 2000) theory **of trade expectations suggests that 'future expectation of trade' is a significant variable in understanding economic conditions and security behaviour of states**. He argues that interdependent states are likely to gain pacific benefits from trade so long as they have an optimistic view of future trade relations. However, if the expectations of future trade decline, particularly for difficult to replace items such as energy resources, the likelihood for conflict increases, as states will be inclined to use force to gain access to those resources. Crises could potentially be the trigger for decreased trade expectations either on its own or because it triggers protectionist moves by interdependent states.4 Third, others have considered the link between economic decline and external armed conflict at a national level. Blomberg and Hess (2002) find a strong correlation between internal conflict and external conflict, particularly during periods of economic downturn. They write: The linkages between internal and external conflict and prosperity are strong and mutually reinforcing. Economic conflict tends to spawn internal conflict, which in turn returns the favour. Moreover, the presence of a recession tends to amplify the extent to which international and external conflicts self-reinforce each other. (Blomberg & Hess, 2002. p. 89) **Economic decline has also been linked with an increase in** the likelihood of **terrorism** (Blomberg, Hess, & Weerapana, 2004), which has the capacity to spill across borders and lead to external tensions. Furthermore, crises generally reduce the popularity of a sitting government. "Diversionary theory" suggests that, when facing unpopularity arising from economic decline, sitting governments have increased incentives to fabricate external military conflicts to create a 'rally around the flag' effect. Wang (1996), DeRouen (1995). and Blomberg, Hess, and Thacker (2006) find supporting evidence showing that economic decline and use of force are at least indirectly correlated. Gelpi (1997), Miller (1999), and Kisangani and Pickering (2009) suggest that the tendency towards diversionary tactics are greater for democratic states than autocratic states, due to the fact that democratic leaders are generally more susceptible to being removed from office due to lack of domestic support. DeRouen (2000) has provided evidence showing that **periods of weak economic performance in the U**nited **S**tates, and thus weak Presidential popularity, **are statistically linked to an increase in** the **use of force**.

# Trade-Advantage

## Internals

### Climate threatens Trade

#### Climate change messes up international trade.

NCCR [no date] –Swiss National Centre of Competence in Research [NCCR, “Impact of global climate change on international trade”, no date, NCCR, <http://www.nccr-trade.org/wps/wp5/51/>, AD]

**Global climate change affects a region integrated in international trade** in two ways. Changes in the regional climate conditions might affect production, which causes direct losses or benefits for the exposed region and since regions are linked to each other through trade, changes in other regions’ climate conditions may affect their own welfare as well. If agricultural production in sub-Saharan Africa declines, prices for such commodities will also increase in northern economies and worsen their terms of trade – the indirect effects of CC. Most climate scenarios predict a higher exposure to CC impacts of regions in more southerly latitudes. And since most southern economies are also developing countries, the lack of adaptive capacity makes them even more vulnerable. This suggests that in developed economies of the North indirect effect dominate, whereas in the South the opposite is observed. The starting point will be an analytically static trade model with two different regions. The regions are distinguished by their factor endowments, their regional climate and adaptive capacity. Regional climate quality depends on the atmospheric carbon concentration which is a public bad, as well as the region’s investment in adaptation, which must be considered as private to the region**. Since adaptation can reduce the negative impacts of global climate change and climate variability, regional climate quality is viewed as the difference between the atmospheric stock of carbon and regional adaptation.** With this analytical framework we want to examine whether the consideration of international trade and the subsequent indirect effects can provide an incentive to the North to fund adaptationn in the South.

#### Climate change directly affects freight movement by air – it’s a threat to world trade.

World Trade Organization and United Nations Environment Programme ’09 [WTO and UNEP, “Trade and Climate Change”, 2009, WTO and UNEP, <http://www.wto.org/english/res_e/booksp_e/trade_climate_change_e.pdf>, AD]

As greenhouse gas emissions and temperatures increase, the impacts from climate change are expected to become more widespread and to intensify. For example, even with small increases in average temperature, the type, frequency and intensity of extreme weather – such as hurricanes, typhoons, fl oods, droughts, and storms – are projected to increase. Th e distribution of these weather events, however, is expected to vary considerably among regions and countries, and impacts will depend to a large extent on the vulnerability of populations or ecosystems. Developing countries, and particularly the poorest and most marginalized populations within these countries, will generally be both the most adversely aff ected by the impacts of future climate change and the most vulnerable to its eff ects, because they are less able to adapt than developed countries and populations. In addition, climate change risks compound the other challenges which are already faced by these countries, including tackling poverty, improving health care, increasing food security and improving access to sources of energy. For instance, climate change is projected to lead to hundreds of millions of people having limited access to water supplies or facing inadequate water quality, which will, in turn, lead to greater health problems. Although the impacts of climate change are specifi c to location and to the level of development, most sectors of the global economy are expected to be aff ected and these impacts will often have implications for trade. For example, three trade-related areas are considered to be particularly vulnerable to climate change. Agriculture is considered to be one of the sectors most vulnerable to climate change, and also represents a key sector for international trade. In low-latitude regions, where most developing countries are located, reductions of about 5 to 10 per cent in the yields of major cereal crops are projected even in the case of small temperature increases of around 1° C. Although it is expected that local temperature increases of between 1° C and 3° C would have benefi cial impacts on agricultural outputs in mid- to high-latitude regions, warming beyond this range will most likely result in increasingly negative impacts for these regions also. According to some studies, crop yields in some African countries could fall by up to 50 per cent by 2020, with net revenues from crops falling by as much as 90 per cent by 2100. Depending on the location, agriculture will also be prone to water scarcity due to loss of glacial meltwater and reduced rainfall or droughts. Tourism is another industry that may be particularly vulnerable to climate change, for example, through changes in snow cover, coastal degradation and extreme weather. Both the fi sheries and forestry sectors also risk being adversely impacted by climate change. Likewise, ix Part IV Part III Part II Part I there are expected to be major impacts on coastal ecosystems, including the disappearance of coral and the loss of marine biodiversity. Finally, one of the clearest impacts will be on trade infrastructure and routes. Th e IPCC has identified port facilities, as well as buildings, roads, railways, airports and bridges, as being dangerously at risk of damage from rising sea levels and the increased occurrence of instances of extreme weather, such as fl ooding and hurricanes. Moreover, it is projected that changes in sea ice, particularly in the Arctic, will lead to the availability of new shipping routes.

#### Climate change raises the cost of international shipping – tanks trade.

WTO [no date] [World Trade Organization, “Trade and the Environment in the WTO”, no date, WTO, <http://www.wto.org/english/tratop_e/envir_e/bkgrnd_climate_e.pdf>, AD]

**Climate change has an impact on various sectors of the economy**. Agriculture, forestry, fisheries and tourism are affected by climate change through temperature increases, droughts, water scarcity, coastal degradation, and changes in snow cover. These are key sectors in international trade especially for developing countries which have a comparative advantage on the international trading scene. **Extreme weather can also affect** ports, roads, **airports** and railways. **Climate change can disturb supply and distribution chains, potentially raising the cost of international trade.**

### IL-Airports

#### Airports are key to international trade.

OECD ’11 [OECD, “Strategic Transport Infrastructure Needs to 2030”, 2011, OECD, <http://www.oecd.org/dataoecd/19/49/49094448.pdf> AD]

**Major international gateway and corridor infrastructures such as** ports**, airports** and key rail **routes are crucially important to the exports and imports of all the products and resources of modern-day economies.** These infrastructures will become even more important in the future. Following a brief recovery in economic growth rates at OECD and world level, global activity has slowed again and the near-term economic outlook is for quite weak growth. However, over the longer term to 2030, modest but sustained growth is expected in developed countries, and significantly higher growth in the major developing countries. International passenger and trade demand are likely to see strong long-term growth as well. **As a result, rapidly increasing volumes can be expected, particularly along major trade and transport corridors between the largest regions**, i.e. Asia (China, India), Europe and North America. **Aviation** and maritime services **will carry most of the long distance traffic**, with ground handling likely to remain heavily concentrated at the major international gateway airports and ports.

#### Airports are key to international trade and require policy action and transportation infrastructure investment.

OECD ’02 [ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, “Impact of Transport Infrastructure Investment on Regional Development”, 2002, Internationaltransportforum.org, <http://www.internationaltransportforum.org/pub/pdf/02RTRinvestE.pdf> AD]

**In order to develop a useful definition of “regions” in the context of analysing transport, it is crucial to identify the policy goals to which transport infrastructure investment is meant to contribute**, so that an appropriate type of region with appropriate indicators can be developed. **For example, some policy goals specifically for transport infrastructure investment may be:** • To improve the global competitiveness of regions, for example by improving the provision and/or quality of urban transport systems (for travel-to-work purposes), enabling the available pools of skilled labour to expand. • **To stimulate international trade by improving strategic links in the freight transport networks, including** ports and **cargo-handling airports as well as road and rail infrastructure**. • Social objectives, i.e. to redistribute economic activity between spatial areas, countries or sectors, in order to reduce income disparities and promote social cohesion. Each of these definitions, and others not listed, may suggest a different type of definition of a region. For example, one definition might suggest a nodal region or a national or planning region perspective, while another definition might suggest a series of homogeneous regions based on policy relevant variables such as income per capita. **At the policy level, actions and initiatives are usually taken for a mixture of social, economic and political motives**. Further, there is a wide range of possible areas for which such objectives are relevant. These depend both on the nature of the item of infrastructure being assessed and on the context into which it is being placed. Thus the Group arrived at the conclusion that no one definition is feasible and that in order to ensure the maximum benefit from its analysis and recommendations, it should consider the whole range of possible areas, provided they represented an appropriate policy context. In some situations, these will be areas contained entirely within one country, in others they will coincide with national territories while in others they will transcend national boundaries.

### IL-Waterways

**The current system makes US products uncompetitive – lack of investment is putting the US behind**

**Gibbs, 4/18-**

(Bob, Chairman of house committee on transportation and infrastructure, subcommittee on water resources and environment, Committee Hearing, Lexis)

In this Committee hearing, **we're dealing with how Reliability of Inland Waterway Systems Impacts Economic Competitiveness.** And I'll start here with my opening statement and we'll turn it over to our Ranking Member official. Again, welcome. **Transportation savings are key factor in economic growth**. As fuel prices continue to escalate, **waterway transportation becomes an even more viable alternative for shippers**. **But an unreliable transportation system will inject uncertainty in the decisions made by U.S. farmers and manufacturers, making U.S. products more uncompetitive in world markets.** **While the Nation's ports are rightfully called the Nation's gateways, the inland navigation system provides access to foreign export markets for manufacturers and commodity producers**. Water transportation is most fuel efficient, least polluting, safest, and least expensive means of moving cargo. In addition, waterways provide freight mobility for products that are too large to move by any other means. There are also some industries located on the river that are completely dependent on the inland waterway system to bring in raw materials to their facilities. **Trade, especially global trade, is increasing**. That means the need for transportation services will continue to grow and grow rapidly. The question is not whether it will be by the rail or truck or boats that will be of most benefit. The question is whether or not we can produce an efficient and integrated network of airports, railroads, highways, waterways, and ports that can respond to a changing world economy. **We are trying to run this bill for a Nationally integrated transportation system with an infrastructure that was largely built before the World War II.** We don't do that for roads, railroad, or aviation while there is room for improvement in those sectors as well. In general, we have modernized in most areas and our economy has benefitted from those investments. **But when it comes to inland waterway system, we have been investing too slowly for too long.** Fifty seven percent of our inland system is more than 50 years' old and 37 percent of that system is more than 70 years old. **It is literally falling apart and we're falling behind**. Navigation outages along the system are increasing. For instance, the Ohio River outages have increased from 25,000 hours in 2000 to 80,000 hours today. This trend of increasing outages is expected to continue. **While it affects the reliability of the system, it also foretells the likelihood of a major physical failure at one of the structures. Without some rehabilitation and rebuilding, we can expect to pay more each year for increasingly unreliable system.** The corps engineers are charged with maintaining and improving inland waterway system with the authorities and the funding provided by Congress each year. For decades, the Corps has made to do with constraint funding, leaving the commanders with no choice but to defer some maintenance projects and reduce operations at some of the locks (ph). I'm concerned that the Corps reduces the efficiency of some parts of the system. Our sailors (ph) are adversely affected. **If this cycle is not broken, we are going to lose water transport as a viable part of our inland water transportation system, completely diverting cargo from water** to rail that would require hundreds of thousands or additional railroad cars and additional 25,000 locomotives. If a cargo that is currently moved by the waterway have to move by truck, it would require an additional 58 million trucks, moving in already on congested highways annually. After Hurricane Katrina, it became obvious that the warning signs were there all along that many experts had been telling us for years that conditions were ripe in the New Orleans area for a disaster. Today, **we are getting a similar warning on the Nation's inland waterway system of transportation. Finding alternative ways to move cargo will be expensive if not impossible**. **And if transportation costs go up, the competitiveness of American products in the world market goes down.** So addressing, and I just would add, I think some of **our competitors in the world markets are making those investments and that puts us in a disadvantage and uncompetitiveness that will cost us in the long run.** So addressing the infrastructure needs of the inland waterway system is not about economic benefits to a few barge companies. **It's about keeping American farms and manufacturers and businesses competitive and growing American jobs.** Letting the inland waterway system decline further would be an economic disaster to add to the Nation's already significant fiscal problems. **Having an inland waterways system that is a viable alternative will keep costs down among all modes of transportation**. If you take inland waterways out of the mix in terms of transportation options, costs would go up, **American products become less competitive in the global marketplace, and that means lost jobs.** That's why I can say I am a fiscal conservative, and I support investing in America where those expenditures stoke the fires of our economic engines and create jobs throughout our economy. For a tiny percentage of the $1 trillion failed stimulus program in 2009 or the $450 billion jobs program recently suggested by the Administration, we could spend the $8 billion necessary to recapitalize the inland waterway system -- that is to finish the projects under construction and begin and finish the slate of authorized projects. Given our economic conditions, I know that coming with additional public money is going to be a huge challenge. So I think it makes sense to explore financing options. The Administration has suggested a new lockage fee and Inland Waterways User Board has developed a comprehensive plan of increased user fees and changes to the current cost-sharing arrangement. **By these ideas to deserve more consideration, I think it is time to think further outside of the box and consider enhanced public-private partnerships.** **A significant part of project delays has come from project funds being partialed out to Corps engineers in small amounts that drag the project out over many years than necessary**. Perhaps a private investor can supply other funds needed upfront and paid back over the extended period of time. I think this is a possible paradigm worth exploring. I welcome our witnesses today and I look forward to hearing from you, and at this time, I will yield to my Ranking Member, Mr. Bishop, for any comments you may have.

**The United States inland waterway infrastructure is eroding – that threatens competitiveness – all current investments fail and our lock systems are functionally obsolete**

**Scott, 12-**

(ASCE New Source, “ASCE Tells Congress More Must Be Invested in Inland Waterways,” <http://www.asce.org/ascenews/shorttakes.aspx?id=25769808619>)

Testifying on April 18 before the U.S. House Transportation and Infrastructure Committee’s Subcommittee on Water Resources and Environment, James A. Rossberg, P.E., M.ASCE, the Society’s managing director of engineering programs, said that **efforts by the administration and Congress to address the growing investment deficit in waterways infrastructure have largely been ineffectual because of political considerations** that give precedence to deficit reduction **and tax cuts over the badly needed restoration of critical infrastructure.** “We can sum up the present situation concisely,” Rossberg said before the subcommittee chair, Bob Gibbs (R-Ohio), and the ranking minority member, Tim Bishop (D–New York**). “These policy failures at the White House and in Congress threaten the nation’s economic competitiveness in a global economy.** “**ASCE’s 2009 Report Card for America’s Infrastructure gave the nation’s inland waterways a grade of D–, an indication that the system is near failure. Neither [the] president nor Congress has done anything in the years since to improve upon that extremely dismal assessmen**t by adopting a long-term, systematic approach to improve the performance and condition of our national waterways.” The Subcommittee on Water Resources and Environment deals with water resources development, water pollution control, water infrastructure, conservation and management, and hazardous waste cleanup. It held the April 18 hearing to receive expert testimony on how the reliability of inland waterways systems will affect the country’s economic competitiveness. Rossberg began by citing the U.S. Army Corps of Engineers’ Great Lakes and Ohio River Navigation Systems Commerce Report, 2008 in telling the subcommittee that the United States has more than 25,000 mi of inland, intracoastal, and coastal waterways. **The federal government improves and maintains almost 11,000 mi, or about 45 percent, of the total channel length**. **This includes dredging and the installation and maintenance of such navigation structures as locks, dams, dikes, revetments, and groins**. The federal and state governments, along with port authorities and carriers, he said, share responsibility for the nation’s waterway transportation system. The inland waterway transportation industry, he explained, is characterized by extensive cooperation and coordination on the part of the public and private sectors, and the waterway navigation projects that facilitate safe passage for vessels are maintained by the Corps of Engineers. “Because of their ability to move large amounts of cargo, **the nation’s inland waterways are a strategic economic and military resource**,” stressed Rossberg. “An analysis by the U.S. Army War College concluded that ‘the strategic contributions of these inland waterways are not well understood**. The lack of adequate understanding impacts decisions contributing to efficient management, adequate funding, and effective integration with other modes of transportation at the national level**. Recommendations demonstrate that leveraging the strategic value of U.S. inland waterways will contribute to building an effective and reliable national transportation network for the 21st century.’” The administration’s budget proposal for fiscal year (FY) 2013 for the Corps of Engineers would provide $4.7 billion, a decrease of more than 5 percent from the $5 billion approved for the current fiscal year. Rossberg said that ASCE believes this level of spending is insufficient to meet the country’s national security, economic, and environmental needs in the 21st century. “**The president’s budget for FY 2013 is inadequate to meet the needs of an aging waterways infrastructure and must be increased,”** said Rossberg. “Congress must increase funding for the Corps in the coming fiscal year in order to protect an essential economic asset and ensure American competitiveness in the 21st century. “The administration’s proposal for FY 2013 would reduce construction funding from $1.694 billion to $1.471 billion, a reduction of 13 percent. Operations and maintenance funding would be down slightly, from $2.412 billion to $2.398 billion. The Mississippi River and tributaries account would decline from $252 million to $234 million, or seven percent. Investigations—the money used to complete project feasibility studies—would go from $125 million to $102 million, a decline of 18 percent. In all, the [Corps of Engineers] civil works program budget for FY 2013 would be cut from $5.002 billion in FY 2012 to $4.731 billion in FY 2013, an overall reduction of 5.4 percent.” Rossberg told the subcommittee that ASCE recommends $5.2 billion in new budget authority for the Corps of Engineers in FY 2013 to account for inflation and to halt the continuing decline in funding for the Corps’s work. **This level of funding is necessary to ensure safe infrastructure and a sound economy. Pubic investment in inland waterways, he said, is needed throughout the country to reverse the present course of declining infrastructure**. **“Forty-seven percent of all locks maintained by the U.S. Army Corps of Engineers were classified as functionally obsolete in 2006**,” he told the subcommittee. “Assuming that no new locks are built within the next 20 years, **by 2020 another 93 existing locks will be obsolete, rendering more than 8 out of every 10 locks now in service outdated**. Most locks now are anywhere from 50 to 70 years old. “The current system of inland waterways lacks resilience. Waterway usage is increasing, but facilities are aging and many are well past their design life of 50 years. **Recovery from any event of significance would be negatively impacted by the age and deteriorating condition of the system, posing a direct threat to the American economy.”**

### Waterways

#### Maintaining the waterway systems is necessary to reverse this and increase US competitiveness

Mica, 11-

(John L., Chairman of the Transportation and Infrastructure Committee, September 19, “HEARING TO FOCUS ON INLAND WATERWAYS TRANSPORTATION SYSTEM,” http://transportation.house.gov/news/PRArticle.aspx?NewsID=1396)

Washington, DC – **A Congressional hearing on Wednesday will focus on the importance of the nation’s system of inland waterways, and the challenges in maintaining this aging but economically important transportation system.**

The U.S. **Inland Waterways Transportation System is the nation’s most cost-effective and energy efficient means for transporting commercial goods, especially major bulk commodities like grain, coal, and petroleum products. This transportation system is also a key component of state and local economies and job creation efforts and is essential in maintaining economic competitiveness and national security.**

Benefits of the system are numerous. Barges moving on waterways are safer, more fuel efficient, and less polluting than other means of transportation. One 15-barge tow on a river can carry as much cargo as 216 rail cars or 1,050 large trucks. Thirty-eight states are directly served by the Inland Waterways Transportation System, constituting 630 million tons of cargo valued at more than $180 billion annually, at an average annual savings of $9.2 billion.

**Many of the facilities on the system are 50 years old or more, and delays and congestion on the aging system can cause transportation cost increases. Keeping these costs low benefits U.S. consumers and makes U.S. products more competitive on the world market.**

#### Inland waterways are key to competitiveness---solves econ and hunger---lack of funding now ensures inevitable collapse

Steenhoek 4/18Mike Steenhoek, Executive Director of the Soy Transportation Coalition House Transportation and Infrastructure Subcommittee on Water Resources and Environment Hearing; "How Reliability of the Inland Waterway System Impacts Economic Competitiveness."; Testimony by Mike Steenhoek, Executive Director, Soy Transportation Coalition, Congressional Documents and Publications, 2012, lexis

Over the past few years, much of U.S. agriculture, in general, and the soybean industry, in particular, **has been a silver lining in an overall cloudy economy**. American farmers are increasingly productive in growing quality, abundant food. Customers, both domestic and, increasingly, overseas, are demanding this production. For the soybean industry, **over half of what American farmers produce is destined to the international marketplace -** one quarter of total production will be delivered to China alone. Not only do these transactions **enhance the U.S. economy** - particularly in rural America - it also serves the higher purpose of feeding **millions of people** who, for the first time in their family's history, are able to incorporate more protein into their diets. This pastoral, traditional industry has truly become one of the world's most dynamic and compelling. One of the primary reasons U.S. agriculture is so viable and competitive is our expansive and efficient transportation network of roads, bridges, railroads, inland waterways, and ports. Figure 1 below provides an efficient snapshot of the role of transportation - particularly inland waterways-in ensuring the competitiveness of the U.S. soybean industry. The chart provides a cost comparison of producing and delivering a metric ton of soybeans from both the U.S. and Brazil - our primary competitor - to a customer in Shanghai. Both of the origination points - Davenport, Iowa, and North Mato Grosso, Brazil - are approximately 950 miles from their respective port regions. While the movement from North Mato Grosso to the port relies on trucking, the movement from Davenport to the export terminals in Southern Louisiana enjoys the efficiency America's inland waterway system provides. As the chart validates, **the main reason the U.S. soybean industry and many other agricultural products are the most economical choice for our customers on the international marketplace is due to our superior transportation system**. Other countries can produce quality products at a lower price. However, it has been and continues to be our ability to deliver those products to our customers in a cost-effective manner that **allows our industry to be so competitive**. Transportation - **particularly the inland waterway system** - **is not simply a contributing factor of agriculture's success, it is a predominant one.** Figure 1: Costs of transporting soybeans: U.S. vs. Brazil (per metric ton; 4th quarter, 2011) Davenport, Iowa to Shanghai North Mato Grosso, Brazil to Shanghai Truck-$10.22 Truck-$115.05 Barge-$28.91 Ocean - $55.33 Ocean-$49.65 Total Transportation - $94.46 Total Transportation - $164.70 Farm Value - $425.00 Farm Value - $358.24 Cost to Customer - $519.46 Cost to Customer - $522.94 Transportation as % of Customer Cost 18.18% Transportation as % of Customer Cost - 31.50% Source: USDA Unfortunately, while Brazil and other countries are aggressively investing in their infrastructure, **we remain anemic in investing in ours**. It can be accurately stated that the U.S. is more a spending nation, not an investing nation. A high percentage of taxpayer dollars are used to meet immediate wants and needs, rather than providing dividends to future generations. According to our recent analysis funded by the soybean check off, the Upper Mississippi, Ohio, and Illinois Rivers accommodated the following volumes of grain and oilseeds in 2010: \* Upper Mississippi River: 236 million tons \* Ohio River: 49 million tons \* Illinois River: 24 million tons

The plan necessitates Agriculture Competitiveness ASA, 11**-**

(June 27, American Soybean Association, “ASA: more funds for inland waterways,” <http://m.deltafarmpress.com/soybeans/asa-more-funds-inland-waterways-maintenance>

maintenance

The American Soybean Association (ASA) has joined with the National Grain and Feed Association, other producer groups, processors, and **input suppliers, alerting the Congressional Appropriations Committees about the urgent need for additional resources to dredge and repair inland waterways that have been damaged** by historic high water levels. "**Agricultural producers**, processors and exporters rely on the entire Mississippi River system and **share concern about the impact recent floods** in the Midwest will have on the river system," said Steve Wellman, ASA First Vice President and a soybean producer from Syracuse, Neb. "**More than 60 percent of U.S. soybean exports moved to world markets through the Port of South Louisiana via the Mississippi River and its tributaries."** A **modern and efficient inland waterways transportation system is vital to maintaining U.S. agricultural competitiveness in the world market**. **As the U.S. system continues to face delays and closures attributable to low drafts and crumbling locks and dams, competitors are increasing expenditures on their own transport infarstructures,** thereby eroding the competitive advantage long enjoyed by the United States

#### Waterways are uniquely key to grain production

Witsanu Attavanich et. al 11Attavanich\* Ph.D. Candidate Bruce A. McCarl Distinguished and Regents Professor Stephen W. Fuller Regents Professor Dmitry V. Vedenov Associate Professor Zafarbek Ahmedov Ph.D. Candidate Department of Agricultural Economics, Texas A&M University, College Station Selected Paper prepared for presentation at the Agricultural & Applied Economics Association’s 2011 AAEA & NAREA Joint Annual Meeting

July 24-26, “The Effect of Climate Change on Transportation Flows and Inland Waterways Due to Climate-Induced Shifts in Crop Production Patterns” http://ageconsearch.umn.edu/bitstream/109241/2/AAEASelectedPaper\_The%20Effect%20of%20Climate%20Change%20on%20Transportation%20Flows\_13247.pdf

**Grain production plays a crucial role in response to the world’s growing demand for food, feed, and biofuels**. Corn, soybeans, and wheat are major grains crops that are most widely planted in the world and also in the US. From the past to the present, the US is a major country that plays a dominant role as a world grain producer and exporter. In crop year 2009/2010, total US supply of corn, soybean and wheat accounted for about 39, 31, and 9 percent of the world supply of corn, soybean and wheat, respectively. For the aspect of international trade, the US market shares for export of corn, soybean and wheat to the world’s total export were about 52, 44, and 18 percent, respectively (USDA World Agricultural Outlook Board 2011). **A highly efficient, low-cost system of transportation is one of the major factors determining the competitiveness of US grains**, which are low-valued bulky products, in the world market. Grains produced in the US move to domestic and foreign markets through a well-developed transportation system. Barges, railroads, and trucks facilitate a highly competitive market that bridges the gap between US grain producers, domestic and foreign consumers. Not only is agriculture the largest user of the transportation system accounting for 22 percent of all tons and 31 percent of all ton-miles transported via all modes in 2007, but grains also are the largest users of freight transportation in agriculture (Denicoff et al. 2010). From 1978 to 2007 total US grain shipments significantly increased 92 percent from about 242 million tonnes to 464 million tonnes with corn movements accounted for 63 percent of all grain movements followed by movements of soybeans and wheat, which were equal to 19 percent and 14 percent, respectively in 2007. During 2002-2007, inland grain transportation via truck and rail is the principal channel for overall grain movements accounting for about 85 percent, while inland water transportation via barge represents only about 15 percent of all grain tonnages. **Although inland water transportation has a small share for overall tonnage movements, it plays a significant role as a major route to export market accounting for about 48 percent of all grain** tonnages **for export** over the same period (Marathon and Denicoff 2011). Mississippi River and its tributaries on the Mississippi river basin are the largest inland water way system shipping grains especially corn and soybeans from the US inland to the Lower Mississippi ports for export market accounting for on average 55 and 47 percent of all US corn and soybean export, respectively during 2005-2009 (U.S. Army Corps of Engineers 2010).

#### Waterways are key to grain production

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**Grain production plays a crucial role in response to the world’s growing demand for food, feed, and biofuels**. Corn, soybeans, and wheat are major grains crops that are most widely planted in the world and also in the US. From the past to the present, the US is a major country that plays a dominant role as a world grain producer and exporter. In crop year 2009/2010, total US supply of corn, soybean and wheat accounted for about 39, 31, and 9 percent of the world supply of corn, soybean and wheat, respectively. For the aspect of international trade, the US market shares for export of corn, soybean and wheat to the world’s total export were about 52, 44, and 18 percent, respectively (USDA World Agricultural Outlook Board 2011). **A highly efficient, low-cost system of transportation is one of the major factors determining the competitiveness of US grains**, which are low-valued bulky products, in the world market. Grains produced in the US move to domestic and foreign markets through a well-developed transportation system. Barges, railroads, and trucks facilitate a highly competitive market that bridges the gap between US grain producers, domestic and foreign consumers. Not only is agriculture the largest user of the transportation system accounting for 22 percent of all tons and 31 percent of all ton-miles transported via all modes in 2007, but grains also are the largest users of freight transportation in agriculture (Denicoff et al. 2010). From 1978 to 2007 total US grain shipments significantly increased 92 percent from about 242 million tonnes to 464 million tonnes with corn movements accounted for 63 percent of all grain movements followed by movements of soybeans and wheat, which were equal to 19 percent and 14 percent, respectively in 2007. During 2002-2007, inland grain transportation via truck and rail is the principal channel for overall grain movements accounting for about 85 percent, while inland water transportation via barge represents only about 15 percent of all grain tonnages. **Although inland water transportation has a small share for overall tonnage movements, it plays a significant role as a major route to export market accounting for about 48 percent of all grain** tonnages **for export** over the same period (Marathon and Denicoff 2011). Mississippi River and its tributaries on the Mississippi river basin are the largest inland water way system shipping grains especially corn and soybeans from the US inland to the Lower Mississippi ports for export market accounting for on average 55 and 47 percent of all US corn and soybean export, respectively during 2005-2009 (U.S. Army Corps of Engineers 2010).

Adaptation key to preserve trade routes IWAC 09 Inland Waterways Advisory Council in England and Whales [<http://www.iwac.org.uk/downloads/reports/IWAC_Climate_Change_Inland_Waterways_Apr09.pdf> “Climate change mitigation and adaptation – implications for inland waterways in England and Wales” April 2009]

Navigation and recreational use of the England and Wales inland waterways networkthat has been experienced over the last twenty years. Most older reservoirs now have a lower capacity than when originally constructed because of changes in reservoir safety requirements. The West Midland canal network is also heavily dependant upon groundwater**, with** **supplies being distributed outwards** especially to the south east. Many of the **rivers currently used for navigation have formed historic trade routes and, as a consequence, major urban developments are typically found along their length. This has three potentially important implications relevant to climate change adaptation: water is abstracted in large quantities for drinking** purposes, **development has created vast areas of impervious surfacing** and hence contributes rapid run-off to rivers (and canals) in times of heavy rain **and waterways tend to be used for the disposal of treated effluent**. Throughout the network, use of the towpaths is becoming an increasingly important facility. **Opportunities to develop towpath use and to exploit the benefits or changes bought about by climate change will therefore need to be taken forward by** the navigation **authorities**, stakeholders, partners and local communities. The English and Welsh inland waterways network is approximately 4500km long and lies mostly within a ‘box ‘the corners of which are defined by the Humber, Thames, Severn and Mersey estuaries (see Figure 4.1). Approximately 60% of its overall length is river based, the remainder being canals. The waterways network is owned and managed by some twenty navigation authorities comprising a mixture of public corporations, agencies or national parks, voluntary organisations and trusts, and some are private sector companies. The scale of operation is significant - ranging from ship canals down to the narrow canal network predominately of the Midlands and the North West. Some areas are heavily used and are in fact over subscribed by boating users at peak seasons, whereas others are underutilised. Several restoration projects are currently in hand and many more are in the pipeline. The canal network is heavily dependant on surface water run off, especially during the summer, given the highly seasonal demand Inland navigation authorities are collectively represented by the Association of Inland Navigation Authorities (AINA). AINA is currently assisting in the revision of ‘Waterways for Tomorrow’, which sets out the Government’s policies for inland waters in England and Wales. AINA has been responsible for the publication of much industry good practice

## Impacts

### China Relations

#### Trade is key to China Relations – the other option is war

**Since the end of the Cold War, there have been enormous changes in the configuration of international relations.** During the Cold War, the Soviet Union was the main concern for U.S. security and political interests in global politics. Superpower rivalry was mainly concentrated in Europe. But, after the end of the Cold War, the strategic focus of the U.S. has shifted from Europe to Asia and especially in East Asia because of its growing economic importance. **The fall of the former Soviet Union also took away the geo-strategic reasons to sustain cooperation between the United States and China** (Suettinger, 2003; Wang, 2000). U**.S. security perception has also changed due to the ideological victory of liberal democracy over communism, the decline of Russian economic and military strength, and the possibility of China’s emergence as a global economic and military power**. Since the collapse of the former Soviet Union, **more attention has been paid to China and its relations with the United States** (Shambaugh, 1996). The United States is suspicious and worried about China due to its authoritarian political system, lack of transparency on military affairs, and uncertainty about future intentions and capabilities. The emergence of China has changed Asian security perceptions, trade, and the global balance of power (Shambaugh, 1996). A robust debate is underway in the U.S. about how to tackle the growing China (Shambaugh, 1996**). Both liberals and conservative groups consider China as a potential threat to US interests in Asia. But liberals want “peaceful evolution” and “cooperative engagement” by trade, investment, and interdependence,** **while neo-conservatives want to prevent China by “pre-emptive confrontation” through diplomatic means, alliance formation, and military conflicts** (Henry and Liu, 2002). Three major views have emerged in response to China’s economic growth in the last two and half decades: first, “The China threat” perspective argues that China’s growing economic power and military modernization efforts will eventually weaken the preponderant power of the United States relatively and absolutely in Asia and especially North Asia (Shambaugh, 1996). The scholars of this group (Huntington, 1996; Bernstein and Munro, 1997; Bernstein and Munro, 1998; Meirshimer, 2001) argue that a growing China will upset the world status quo and destabilize Asia as well as the whole world. Policy prescription of this group of scholars is to ‘contain’ China as quickly as possible and by any means.

# Hegemony-Advantage

### IL-Roads

Roads are the key link to our military readiness and mobilization

FHA 02 (Federal Highway Administration, part of the US Department of Transportation “2002 Status of the Nation's Highways, Bridges, and Transit: Conditions & Performance” 11/24/02. http://www.fhwa.dot.gov/policy/2002cpr/pdf/ch12.pdf)

MTMC executes the Highways for National Defense program on behalf of USTRANSCOM. This program¶ is designed to ensure that the American road network can support military deployments. This program¶ recognizes that, first and foremost, highways are a key part of the strategic military transportation system.¶ One of the original purposes of the Interstate System was to improve the Nation’s readiness during the Cold¶ War, and highways still provide that same function.¶ The Strategic Highway Network (STRAHNET) is critical to the Defense Department’s domestic operations.¶ STRAHNET is a 61,044-mile system of roads deemed necessary for emergency mobilization and peacetime¶ movement. Even though the U.S. Department of Defense primarily deploys heavy equipment by rail,¶ highways play a critical role.¶ Additionally, there were 102,859 bridges on the Strategic Highway Network in 2000. The next section of¶ this chapter describes bridge quality using indicators from Chapter 3 and performance measures from the FY¶ 2003 FHWA Performance Plan.¶ Exhibit 12-4 describes the condition of STRAHNET by the percent of deficient bridges on STRAHNET¶ routes. About 21.5 percent of STRAHNET bridges were deficient in 2000. About 6 percent were¶ structurally deficient, and 15.5 percent were functionally obsolete. By comparison, about 28.5 percent of all¶ bridges nationwide were deficient in¶ 2000, while roughly 14.8 percent¶ were structurally deficient and 13.8¶ percent were functionally obsolete.¶ Exhibit 12-5 shows how the percent¶ of deficient STRAHNET bridges has¶ dropped since 1995. This is a¶ performance measure in the FY 2003¶ FHWA Performance Plan. Exhibit 12-6 describes the percent of¶ deficient deck area for STRAHNET¶ bridges. In 2000, 26.7 percent of the¶ deck area on STRAHNET bridges was¶ deficient. By comparison, about 27.9¶ percent of bridge deck area nationwide¶ was considered deficient.¶ Finally, Exhibit 12-7 describes the percent¶ of STRAHNET routes under bridges with¶ vertical clearance greater than 16 feet.¶ This is a performance measure from the¶ FY 2003 FHWA Performance Plan. In¶ 2000, about 70.8 percent of STRAHNET¶ routes under bridges met this threshold, an¶ indicator that has steadily improved since 1995. This is an important measure because military convoys and¶ emergency response vehicles need to be able to clear structures on the STRAHNET system.¶ Another important element of the STRAHNET¶ system is the network of STRAHNET connectors.¶ There are 1,700 miles of STRAHNET connectors¶ that link over 200 military installations and ports to¶ the network. There are 17 key power projection¶ platforms (PPPs) in the continental United States¶ that are essential to rapid military deployment, and¶ the condition of STRAHNET connectors is as¶ important as the quality of the main STRAHNET¶ routes.

#### STRAHNET is key to national defense- key to military readiness

NCHRP 2006 (National Cooperative Highway Research Program, part of the Administration of Highway and Transportation Agencies “The Interstate and National Highway System- A Brief History and Lessons” June 13 2006 <http://www.interstate50th.org/docs/techmemo1.pdf>)

The concept of STRAHNET, a system of roads important to national defense, goes back to ¶ World War I when trucks of newly standardized designs destined for France were driven ¶ overland from Ohio to New York City and Baltimore because of congestion on the railroads. ¶ Over 30,000 trucks traveled east via designated truck routes, each loaded with 3 tons or more ¶ of spare parts and munitions, releasing over 17,000 railcars for other work. During the WW I ¶ transportation crisis the federal government had seized the railroads and the newly formed ¶ state highway departments cooperated with the War Department to bring road resources to ¶ bear on the problem. ¶ Following the war the “Pershing Map” of 1922 defining military needs was produced in ¶ anticipation of the defining of first 7 percent highway system required by the Federal Highway ¶ Act of 1921. All of the routes on the Pershing map were incorporated into the first Federal-aid ¶ system. In 1935 BPR and the War Department restudied military highway needs working with ¶ the states. These updated needs were important in the selection of the 26,700 mile system ¶ recommended in the 1939 report Toll Roads and Free Roads. ¶ At the start of WW II the War Department brought the total mileage it considered important up ¶ to 74,600 miles of which 29,000 were considered critical. Bridges unable to support heavy ¶ military loads were of particular concern. The Defense Highway Act of 1941 provided some ¶ funds for military related highway needs and work on the 1400 mile Alaska Highway was ¶ begun. The war efforts resulted in serious deterioration of the nation’s highways. At the same ¶ time normal road programs ground to a halt with gas rationing drying up revenues and war ¶ efforts getting priorities for cement, steel and related materials. ¶ The same 1941 Defense Act provided $10 million for post war planning and it was this money ¶ that led to the Interregional Highways report of 1944 which recommended an “optimum” ¶ system of 33,920 miles or about 1 percent of the then total road and street mileage. (Note the ¶ precision!) The postwar highway bill that was enacted after 9 months of debate authorized a ¶ 40,000 mile National System of Interstate Highways. ¶ Military requirements have changed over the years. They have moved from the need for a ¶ paved load bearing system that accessed military facilities and ports, to a system that would ¶ transport the missiles of the Cold War era to finally today to the rapid deployment needs of the ¶ Iraq wars which stress high volume movements between bases, equipment and munitions ¶ manufacturers, and ports and airports.

#### Highways are k2 national defense- links military bases and allows defense mobilization

Cocker 02 ( Janine, Marketing Coordinator for McMachon in Motion, a transportation newsletter, “Defense Mobilization: Ensured¶ through the Strategic Highway¶ Network” Vol 6 No 2. Winter/Spring 2002 <<http://www.mcmtrans.com/newsletters/2002/MIMwinterSp02.pdf>>

Our nation's highways link U.S. military¶ bases with rail, seaports, and airports, making the 161,000-mile National Highway¶ System (NHS) a key component in national¶ defense mobility. The Federal Highway¶ Administration (FHWA), in association¶ with the U.S. Department of Defense,¶ Homeland Security Council, and the states,¶ is committed to ensuring defense mobilization by improving the condition of the¶ Strategic Highway Network (STRAHNET)¶ and its connectors, a 61,000-mile subset of¶ the NHS.¶ The Federal Highway¶ Administration leads the way¶ When the federal government needs to¶ respond to a threat or a natural disaster, our¶ highways must be ready. The FHWA coordinates emergency preparedness meetings¶ with military and state officials to address¶ issues associated with military deployment¶ during national emergencies. The FHWA¶ also coordinates with the Federal Emergency¶ Management Agency (FEMA) and the¶ Office of Emergency Transportation in ¶ planning and implementing the hurricane¶ evacuation liaison program, which provides¶ traffic information during major ¶ evacuations.

#### **Transporation is key to civilian military mobility.**

Cocker 02 ( Janine, Marketing Coordinator for McMachon in Motion, a transportation newsletter, “Defense Mobilization: Ensured¶ through the Strategic Highway¶ Network” Vol 6 No 2. Winter/Spring 2002 <<http://www.mcmtrans.com/newsletters/2002/MIMwinterSp02.pdf>>

Surface transportation continues¶ to be an important service facility¶ for civilian and militar y use.¶ During a threat or a natural disaster, commercial bus carriers and¶ rail lines can move military personnel using the highway and rail¶ transportation system. The FHWA¶ takes the lead by inviting all¶ involved agencies to coordinate¶ with the military base personnel to¶ develop strategic plans and procedures to ensure prompt and¶ efficient military responses.

# Rail-Advantage

### Climate Threatens Rail

#### Climate change can seriously hinder railroad safety, efficiency, and property

Rossetti, ’02[Micheal A. Rossetti, Michael Rossetti is a Strategic Planner and Economist at the DOT Volpe Center. He has served as Executive Agent for the DOT/NSTC initiative on Enhanced Transportation Weather Services. He is member of the User Advisory Group of the US Weather Research Program, and of the OFCM Joint Action Group on Weather Information for Surface Transportation. He is the author of many DOT publications on transportation statistics, and technology development. Previously, he was employed at the Federal Communications Commission and National Research Council. Mr. Rossetti holds a M.A. degree from the Pennsylvania State University and an A.B. from Boston College, “The Potential Impacts of Climate Change on Transportation”, 2002, http://climate.dot.gov/documents/workshop1002/rossetti.pdf]

Weather is a major influence on many aspects of the transportation system: particularly safety, mobility,¶ accessibility, economic efficiency, and infrastructure. While the nature and extent of this influence may vary¶ between modes, all modes are affected. Railroads are no exception, and in fact suffer from a variety of atmospheric and environmental factors, many of which are unique to this particular mode and deserving of special focus by the¶ transportation and meteorological communities.¶ Weather adversely affects railroad safety, efficiency, and property in many ways. Intermodal crossing points, such¶ as grade crossings and waterway/railroad trestle intersections are vulnerable, as are remote stretches far removed¶ from observational networks. Railroads may also be subject to sudden weatherinduced¶ mode shifts, such as occurred during the East Coast blizzard of January 1996.¶ Precipitation and fog lead to decreased visibility of signals to locomotive engineers. Flash floods can lead to¶ washout of tracks and consequent derailment. Seasonal floods from rivers may make some track segments¶ impassable. Warping of tracks due to uneven thermal expansion in the summer, or buildup of snow and ice on the¶ tracks in the winter, can lead to decreased speeds and derailment. Extreme cold causes brittle track and track¶ separation. Since railroad locomotives and cars are high-profile vehicles, high-speed crosswinds can influence their¶ stability.¶

#### Floods and flash floods will cause eventual devastation to railroad infrastructure

Rossetti, ’02[Micheal A. Rossetti, Michael Rossetti is a Strategic Planner and Economist at the DOT Volpe Center. He has served as Executive Agent for the DOT/NSTC initiative on Enhanced Transportation Weather Services. He is member of the User Advisory Group of the US Weather Research Program, and of the OFCM Joint Action Group on Weather Information for Surface Transportation. He is the author of many DOT publications on transportation statistics, and technology development. Previously, he was employed at the Federal Communications Commission and National Research Council. Mr. Rossetti holds a M.A. degree from the Pennsylvania State University and an A.B. from Boston College, “The Potential Impacts of Climate Change on Transportation”, 2002, http://climate.dot.gov/documents/workshop1002/rossetti.pdf]

Problems posed¶ by high waters from flash floods, river floods,¶ persistent heavy rains, and hurricanes have¶ historically been one of the most prominent¶ weather-related concerns facing the railroad¶ industry, as well as the nation as a whole. Some¶ climate models predict increased precipitation in¶ specific regions. This, along with faster melting¶ of mountain snow and seasonally high spring¶ water levels, may significantly impact railroad¶ operations in the next century.¶ Among weather events, floods annually¶ produce some of the largest amounts of¶ economic damage and fatalities. The¶ Midwestern river floods of 1993 devastated¶ railways, with over 4,000 miles of track either¶ flooded or idled and over $200 million in¶ estimated losses. A flash flood that weakened¶ an existing wooden trestle led to the 1997¶ Kingman, Arizona derailment of an Amtrak¶ passenger train that injured 183 and produced¶ damages of $7.2 million. The Kingman incident¶ generated a special FRA safety advisory,¶ concerning the use by railroads of official¶ weather watches and warnings.

#### Climate change causes increase in avalanches which poses threat to rails

Rossetti, ’02[Micheal A. Rossetti, Michael Rossetti is a Strategic Planner and Economist at the DOT Volpe Center. He has served as Executive Agent for the DOT/NSTC initiative on Enhanced Transportation Weather Services. He is member of the User Advisory Group of the US Weather Research Program, and of the OFCM Joint Action Group on Weather Information for Surface Transportation. He is the author of many DOT publications on transportation statistics, and technology development. Previously, he was employed at the Federal Communications Commission and National Research Council. Mr. Rossetti holds a M.A. degree from the Pennsylvania State University and an A.B. from Boston College, “The Potential Impacts of Climate Change on Transportation”, 2002, http://climate.dot.gov/documents/workshop1002/rossetti.pdf]

Aside from possible increases in the number of¶ floods, hurricanes, tornadoes, and other violent¶ storms, climatic fluctuations that produce¶ increased precipitation and greater temperature¶ swings are likely to trigger more earth, rock, and¶ snow slides in mountain areas. Because of the¶ mitigation efforts that the railroad industry has¶ 0taken, serious accidents, injuries, and fatalities¶ due to these natural hazards are relatively few,¶ but they still result in a considerable number of¶ disruptions and delays. As with any surface¶ transportation, slides can threaten the safety of¶ railroad operations, but slide mitigation planning¶ and implementation for railroads must consider¶ the following characteristics of railroad¶ operations and of the U. S. railroad network.¶ First, warnings must allow for trains to safely¶ stop in advance of a hazard. For heavy freight¶ trains or faster passenger trains on descending¶ grades, stopping distances are often between one¶ and two miles. Second, trains cannot steer¶ around even the smallest slides or obstructions.¶ And third, especially in the western U. S., there¶ are relatively few alternative railroad routes, and¶ the detour distances for accessing these may be¶ hundreds of miles long.¶

#### Temperature Extremes can pose numerous dangers to railroad infrastructure including uneven thermal expansion

Rossetti, ’02[Micheal A. Rossetti, Michael Rossetti is a Strategic Planner and Economist at the DOT Volpe Center. He has served as Executive Agent for the DOT/NSTC initiative on Enhanced Transportation Weather Services. He is member of the User Advisory Group of the US Weather Research Program, and of the OFCM Joint Action Group on Weather Information for Surface Transportation. He is the author of many DOT publications on transportation statistics, and technology development. Previously, he was employed at the Federal Communications Commission and National Research Council. Mr. Rossetti holds a M.A. degree from the Pennsylvania State University and an A.B. from Boston College, “The Potential Impacts of Climate Change on Transportation”, 2002, http://climate.dot.gov/documents/workshop1002/rossetti.pdf]

When exposed to the summer sun, railroad¶ tracks occasionally develop heat kinks that may¶ in turn create a hazardous condition for¶ oncoming traffic. Track misalignments caused¶ by sun kinks have often been identified as a¶ cause of train derailments with the potential for¶ injuries, fatalities, property damage, and toxic¶ release of hazardous materials. In addition to¶ the direct effect of solar radiation, railroad tracks¶ may also be exposed to uneven thermal¶ expansion when shade covers nearby sections,¶ thereby posing the risk of warp and¶ misalignment to freight traffic. A similar¶ condition may occur in winter, when extreme¶ cold results in brittle track, thus increasing the¶ risk of breakage. Cold temperatures are also the¶ cause of frozen air lines, when moisture present¶ in the distal part of the line cannot be dislodged¶ by heat from the locomotive.¶

#### Thunderstorms and Tornadoes create various problems for railroad infrastructure including efficiency and rail operations

Rossetti, ’02[Micheal A. Rossetti, Michael Rossetti is a Strategic Planner and Economist at the DOT Volpe Center. He has served as Executive Agent for the DOT/NSTC initiative on Enhanced Transportation Weather Services. He is member of the User Advisory Group of the US Weather Research Program, and of the OFCM Joint Action Group on Weather Information for Surface Transportation. He is the author of many DOT publications on transportation statistics, and technology development. Previously, he was employed at the Federal Communications Commission and National Research Council. Mr. Rossetti holds a M.A. degree from the Pennsylvania State University and an A.B. from Boston College, “The Potential Impacts of Climate Change on Transportation”, 2002, http://climate.dot.gov/documents/workshop1002/rossetti.pdf]

Exposed to weather in nearly all directions in¶ parts of the Midwest and western U.S., train¶ operators are often direct, in-line targets of¶ large-scale convection and supercells that¶ generate tornadoes. The FRA database reports¶ four tornadoes causing accidents during the¶ 1993-2002 period, but the actual effects are¶ likely much higher when slow orders or halts are¶ dispatched to train conductors, thus impeding¶ efficiency and cost-effectiveness. Similarly,¶ thunderstorm activity may harm rail operations¶ through various means, including lightning¶ strikes to switching equipment, flash floods of¶ poor drainage areas, and high winds associated¶ with microbursts and squall lines. Although a¶ separate meteorological phenomenon, intense¶ crosswinds that often set-up in the front range of¶ the Rocky Mountains may disrupt, halt, or even¶ force the rerouting of downwind rail traffic.¶

#### Tropical Cyclones pose serious concern for future railroad infrastructure

Rossetti, ’02[Micheal A. Rossetti, Michael Rossetti is a Strategic Planner and Economist at the DOT Volpe Center. He has served as Executive Agent for the DOT/NSTC initiative on Enhanced Transportation Weather Services. He is member of the User Advisory Group of the US Weather Research Program, and of the OFCM Joint Action Group on Weather Information for Surface Transportation. He is the author of many DOT publications on transportation statistics, and technology development. Previously, he was employed at the Federal Communications Commission and National Research Council. Mr. Rossetti holds a M.A. degree from the Pennsylvania State University and an A.B. from Boston College, “The Potential Impacts of Climate Change on Transportation”, 2002, http://climate.dot.gov/documents/workshop1002/rossetti.pdf]

Landfalling hurricanes along the Gulf and¶ Atlantic seaboards adversely affect¶ transportation interests and sometimes inflict¶ heavy damage to the infrastructure and assets of¶ the system. Railroads often sustain damage¶ from flooding, washouts, storm surges, and¶ debris flows associated with the passage of these¶ storms. Many notable examples appear in¶ historical records.¶ The effects of Hurricane Floyd on inland¶ North Carolina showed the importance of preexisting¶ soil moisture as a critical indicator of¶ flood potential in areas previously saturated by¶ heavy rains. Unable to absorb typical 10+ inch¶ rainfalls produced by landfalling storms, such¶ areas are especially vulnerable to rapid rises in¶ local streams and rivers. Flood amplification is¶ a real concern. Rain runoffs quickly undermine¶ structures such as dams, railroad beds, bridges,¶ and buildings. Outputs of land-surface models¶ help by providing risk estimates of land surface¶ temperatures, soil moisture, and surface wetness,¶ where wetness depends on precipitation and soil¶ texture. Land surface temperatures fall during¶ the passage of a hurricane. This decrease in¶ temperature also then decreases evaporation¶ levels.¶

#### Winter Storms disrupt entire transportation infrastructure

Rossetti, ’02[Micheal A. Rossetti, Michael Rossetti is a Strategic Planner and Economist at the DOT Volpe Center. He has served as Executive Agent for the DOT/NSTC initiative on Enhanced Transportation Weather Services. He is member of the User Advisory Group of the US Weather Research Program, and of the OFCM Joint Action Group on Weather Information for Surface Transportation. He is the author of many DOT publications on transportation statistics, and technology development. Previously, he was employed at the Federal Communications Commission and National Research Council. Mr. Rossetti holds a M.A. degree from the Pennsylvania State University and an A.B. from Boston College, “The Potential Impacts of Climate Change on Transportation”, 2002, http://climate.dot.gov/documents/workshop1002/rossetti.pdf]

Across the eastern seaboard, the intermountain¶ states and northern tier of the U.S., severe winter¶ storms sometimes disrupt the entire¶ transportation system. Railroad operations¶ degrade in such conditions, due to lowered¶ visibility, icing, snowdrifts, and cold¶ temperatures. Railroad segments dependent on¶ overhead electrical cattenaries may fare¶ especially poorly since their exposure tends to¶ allow ice build-up. Winter storms also¶ adversely affect rail in an indirect way – by¶ preventing producers of goods from shipping to¶ intermodal terminals or delivering goods to rail¶ sidings, freight traffic becomes backlogged and¶ trains may not run at full economic efficiency.¶

#### Rising Sea Levels and global warming pose future risks to transportation infrastructure

Rossetti, ’02[Micheal A. Rossetti, Michael Rossetti is a Strategic Planner and Economist at the DOT Volpe Center. He has served as Executive Agent for the DOT/NSTC initiative on Enhanced Transportation Weather Services. He is member of the User Advisory Group of the US Weather Research Program, and of the OFCM Joint Action Group on Weather Information for Surface Transportation. He is the author of many DOT publications on transportation statistics, and technology development. Previously, he was employed at the Federal Communications Commission and National Research Council. Mr. Rossetti holds a M.A. degree from the Pennsylvania State University and an A.B. from Boston College, “The Potential Impacts of Climate Change on Transportation”, 2002, http://climate.dot.gov/documents/workshop1002/rossetti.pdf]

Although slight rises in ocean levels have now¶ been observed, the increase is likely not yet high¶ enough to force changes in coastal rail¶ infrastructure or capital planning decisions. The¶ future effects of storm tides and wave battering¶ from large storms may amplify the risks posed¶ by changes in sea levels.¶ It is probably still not too early for railroads¶ to begin thinking about vulnerabilities in the¶ location of rail infrastructure. Consideration¶ should be given to limiting construction in¶ highly vulnerable areas (e.g., floodplains, coastal¶ areas). The industry may also want to begin¶ thinking about infrastructure design, framing¶ specifications determined by a new set of¶ (uncertain) environmental constraints (e.g.,¶ number of 100-year storms the element is¶ expected to face and survive). Another related¶ concern is the adequacy of existing insurance¶ policies against natural disasters and extreme¶ weather events, and the likelihood that¶ premiums – for bridges, tunnels, vehicles, and¶ other structures – will begin rising in line with¶ the higher risks posed by global warming and¶ rising sea levels.

# Airports-Advantage

### Climate Threatens Airports

#### Warmer summers would require infrastructure change for airports – or aircraft would have to carry lighter cargo.

Caldwell et al [no date] – Harry Caldwell is the Chief of Freight Policy for the Federal Highway Administration, Kate H. Quinn is the Assistant Division Administrator of the Federal Highway Administration’s Indiana Division Office, Jacob Meunier, Ph.D. is an Analyst of Cambridge Systematics with experience in transportation planning and policy-making, John Suhrbier is a Principal of Cambridge Systematics, and Lance R. Grenzeback is a Principal and Senior Vice President of Cambridge Systematics [Department of Transport, “Potential Impacts of Climate Change on Freight Transport”, No Date, DOT, <http://climate.dot.gov/documents/workshop1002/caldwell.pdf> AD]

**Warmer summer weather will also have important implications for safety, operations, and maintenance**. First, it will make the need to refrigerate perishable goods all the more critical. **Second, it will reduce engine combustion efficiency. This will place a particular burden on air carriers because aircraft will require longer runways or lighter loads.** **Third, on extremely hot days it will preclude certain maintenance efforts that require prolonged outdoor exposure.**

#### Hotter temperatures result in reduced airplane efficiency.

Union of Concerned Scientists ’09 [UCS, “Climate Change in the United States”, August 2009, <http://www.ucsusa.org/assets/documents/global_warming/climate-costs-of-inaction.pdf> AD]

Air travel. Flooding at airports in coastal areas will affect air travel, and aircraft will need higher takeoff speeds and longer runways to obtain the extra lift required at higher temperatures. Recent hot summers have forced companies to cancel flights, especially at high-altitude locations. One analysis projects a 17 percent reduction in the freight-carrying capacity of a Boeing 747 at the Denver airport by 2030, and a 9 percent reduction for such an aircraft at the Phoenix airport, because of higher temperatures and more water vapor (NRC 2008)

#### Airports are needed, and their construction must take into account environmental changes.

UN Economic and Security Council ’10 [UN, “Policy options and actions for expediting progress in implementation: transport”, December 17, 2010, United Nations, <http://www.un.org/esa/dsd/csd/csd_pdfs/csd-19/sg-reports/CSD-19-SG-report-transport-final-single-spaced.pdf> AD]

Many are being implemented or are being planned, including roads and highways, railways, bridges and tunnels, sea and dry ports, airports, canals, waterways and pipelines. **Comprehensive and inclusive technical** and financial **planning, including** detailed social and **environmental impact assessment studies, remain critical to ensure the long-term sustainability of such investments**. 54. **Planning sustainable transport systems, including long-distance cross-border transport corridors, requires well-coordinated multi-modal integration. The construction or expansion of new** ports or **airports needs to be accompanied by the appropriate up-grading of transport infrastructure and services in the associated hinterland**. 55. Transport technologies and trade flows change over time. **With the rapid growth in air traffic, the capacities of inner-city airports are quickly becoming inadequate.** With growing containerization, many inner-city harbours also do not have the space needed for expansion. However, the relocation of transport activities can offer attractive opportunities for urban re-development, for example by converting former piers and warehouses into residential, commercial or recreational zones and facilities. 56. **Planning and construction of transport infrastructures need to anticipate potential long-term future changes.** River transport, waterways, canals and harbours can be affected by changes in precipitation, droughts or floods, or sea level rise. Appropriate and environmentally sustainable water management is thus essential.

#### Airport hazards laundry list.

Transportation Research Board of the National Academies ’11 [Transportation Research Board, “ Adapting Transportation to the Impacts of Climate Change”, June 2011, Transportation Research Circular, E-C152, <http://www.trb.org/Publications/Blurbs/165529.aspx> AD]

**The potential serious physical damage to the facilities and infrastructure of an airport mainly result from the changes in precipitation, temperature, sea level, storm surge, and winds**. The risks include flooding, heat buckle and other forms of expansion stress, permafrost thaw buckle in northern regions, perimeter security breaches, and fuel contamination or spills from pipe ruptures. As noted in the previous section, **secondary effects of climate change may also cause new risks**, such as extreme erosion, soil depletion, wild land fires, and facility damage from new species of animals and plants. Addressing potential physical damage from future climate change can generally be done • Rebuilding, relocating, or abandoning shoreline facilities (e.g., seawalls, sewage treatment outfalls, and building and runway foundations) to accommodate expected future higher sea levels It would be unusual for these types of physical improvements to be carried out in isolation from the regular process of continuous planning, design, development, and maintenance that typically goes on at any airport. Climate change adaptation actions for the physical plant can be seen as one of many objectives to be incorporated into the master planning and asset management process. This approach ensures that solutions are thought through in an integrated and comprehensive manner, to minimize the costs of the improvements and maximize the efficiency of the development process over time. The goal is to adapt to this new consideration of climate change in a way that still maximizes the utility of the often very long lived components of the airport infrastructure.

#### With climate change, weather is even going to be worse – this will hinder airports even more.

Morello ’11 – Lauren Morello is a writer for Scientific American [Scientific American, “NOAA Makes It Official: 2011 Among Most Extreme Weather Years in History”, June 17, 2011, Scientific American, <http://www.scientificamerican.com/article.cfm?id=noaa-makes-2011-most-extreme-weather-year>, AD]

The devastating string of tornadoes, droughts, wildfires and floods that hit the United States this spring marks 2011 as one of the most extreme years on record, according to a new federal analysis. Just shy of the halfway mark, 2011 has seen eight $1-billion-plus disasters, with total damages from wild weather at more than $32 billion, according to the National Oceanic and Atmospheric Administration. Agency officials said that total could grow significantly, since they expect this year's North Atlantic hurricane season, which began June 1, will be an active one. Overall, NOAA experts said extreme weather events have grown more frequent in the United States since 1980. Part of that shift is due to climate change, said Tom Karl, director of the agency's National Climatic Data Center.

### Floods

#### Airports are particularly vulnerable to flooding.

Transportation Research Board of the National Academies ’11 [Transportation Research Board, “ Adapting Transportation to the Impacts of Climate Change”, June 2011, Transportation Research Circular, E-C152, <http://www.trb.org/Publications/Blurbs/165529.aspx> AD]

The committee noted the need for "a more strategic, risk-based approach to investment decisions that trades off the costs of making the infrastructure more robust against the economic costs of failure." **In the future, climate changes in some areas may necessitate permanent alterations. For example**, roads, rail lines, and **airport runways** in low-lying coastal areas **may become casualties of sea-level rise, requiring relocations or expensive protective measures, such as sea walls and levees.**

#### Floods threaten to destroy the Gulf Coast’s airports – but the damage caused by climate change won’t end there.

United States Global Research Program , no date[United States Research Program, “  
Transportation”, No date, USGRP, <http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts/climate-change-impacts-by-sector/transportatoin> AD]

**More frequent interruptions in air service and airport closures can be expected. Airport facilities including terminals, navigational equipment, perimeter fencing, and signs are likely to sustain increased wind damage. Airports are frequently located in low-lying areas and can be expected to flood with more intense storms.** As a response to this vulnerability, some airports, such as LaGuardia in New York City, are already protected by levees**. Eight airports in the Gulf Coast region of Louisiana and Texas are located in historical 100- year flood plains; the 100-year flood events will be more frequent in the future, creating the likelihood of serious costs and disruption**.217

#### San Francisco International Airport is located only 13 feet above sea level – it would be prone to flooding if sea levels rose.

Airport-Data ’12 citing the FAA [Airport Data, “San Francisco International Airport (SFO) Information”, 7/10/12, Airport Data.com, <http://www.airport-data.com/airport/SFO/>]

**San Francisco International Airport (SFO) Information** San Francisco, CA All Airports in California All Airports in United States Home FAA Information Maps Statistics Nearby Airports Hotels Weather Photos Aircraft Photos San Francisco International Airport (SFO) Airport Location & QuickFacts Owner & Manager Airport Operations and Facilities Airport Communications Airport Services Runway Information Radio Navigation Aids Remarks SFO Total 24 photos. View all photos Latest photos of San Francisco International Airport (SFO) by Bill Larkins by Bill Larkins by Bill Larkins by Bill Larkins Have a photo of this airport? Share with others. Location & QuickFacts FAA Information Effective: 2011-08-25 Airport Identifier: SFO Airport Status: Operational Longitude/Latitude: 122-22-29.6000W/37-37-08.3000N -122.374889/37.618972 (Estimated) **Elevation: 13 ft** / 3.96 m (Surveyed) Land: 5207 acres From nearest city: 8 nautical miles SE of San Francisco, CA Location: San Mateo County, CA Magnetic Variation: 17E (1975)

#### Two of the most important airports – JFK and Newark are only 10 feet above sea level.

Caldwell et al [no date] – Harry Caldwell is the Chief of Freight Policy for the Federal Highway Administration, Kate H. Quinn is the Assistant Division Administrator of the Federal Highway Administration’s Indiana Division Office, Jacob Meunier, Ph.D. is an Analyst of Cambridge Systematics with experience in transportation planning and policy-making, John Suhrbier is a Principal of Cambridge Systematics, and Lance R. Grenzeback is a Principal and Senior Vice President of Cambridge Systematics [Department of Transport, “Potential Impacts of Climate Change on Freight Transport”, No Date, DOT, <http://climate.dot.gov/documents/workshop1002/caldwell.pdf> AD]

The transport infrastructure of low-lying port cites, such as New York, Boston, Charleston, Miami, New Orleans, Texas City, San Jose, and Long Beach, could be particularly at risk. For example, New York’s La Guardia Airport, which is less than seven feet above sea level, already maintains a dike and pumps for floodwaters. **Newark International and John F. Kennedy International Airports are about 10 feet above sea level. In 2000, JFK was the country’s largest foreign trade gateway measured by value. Building higher retaining walls around floodprone airports is generally not a viable option, as these would interfere with aircraft takeoff and landing.**

#### Airports would be vulnerable to floods – especially those in New York.

#### **US Climate Action Report ’10** [State.gov “Vulnerability Assessment, Climate Change Impacts, and Adaptation Measures”, 2010, <http://www.state.gov/documents/organization/140006.pdf>AD]

**The U.S. transportation network is vital to the nation’s economy, safety, and quality of life.** Transportation accounts for approximately one-third of total U.S. GHG emissions. While it is widely recognized that emissions from transportation have impacts on climate change, **climate will also likely have significant impacts on transportation infrastructure and operations** (Karl et al. 2009; U.S. DOT 2006). Examples of specific types of impacts include softening of asphalt roads and warping of railroad rails; damage to roads and opening of shipping routes in polar regions (McCarthy et al. 2001); flooding of roadways, rail routes, and airports from extreme events and sea level rise; and interruptions to flight plans due to severe weather (Karl et al. 2009). Along the Gulf Coast alone, it is estimated that 3,864 kilometers (2,400 miles) of major roadways and 396 kilometers (246 miles) of freight rail lines are at risk of permanent flooding within 50–100 years as climate change and land subsidence combine to produce an anticipated relative sea level rise in the range of 1.2 meters (4 feet). In Alaska, the cost of maintaining the state’s public infrastructure is projected to rise 10–20 percent by 2030 due to warming, costing the state an additional $4–$6 billion, with roads and airports accounting for about half this cost (Karl et al. 2009**). In New York City, what is now a 100-year storm is projected to occur as often as every 10 years by late this century. Portions of lower Manhattan and coastal areas of Brooklyn, Queens, Staten Island, and Long Island’s Nassau County would experience a marked increase in flooding frequency. Much of the critical transportation infrastructure**, **including** tunnels, subways, and **airports, lies well within the range of projected storm surge and would be flooded during such events** (Karl et al. 2009).

### Storms

#### Weather causes 70 percent of aircraft delays, cost 3 billion dollars, and sometimes, lives. With climate change, more severe weather will affect more people.

Kulesa [no date] - Gloria Kulesa is the Team Leader for the FAA’s Aviation Weather Research Program [Department of Transportation, “Weather and Aviation: How Does Weather Affect the Safety and Operations of Airports and Aviation, and How Does FAA Work to Manage Weather-related Effects?”, No Date, DOT, <http://climate.dot.gov/documents/workshop1002/kulesa.pdf>, AD]

According to FAA statistics, weather is the cause of approximately 70 percent of the delays in the National Airspace System (NAS). Figure 1 illustrates that while weather delays declined with overall NAS delays after September 11th, 2001, delays have since returned to near-record levels. In addition, weather continues to play a significant role in a number of aviation accidents and incidents. While National Transportation Safety Board (NTSB) reports most commonly find human error to be the direct accident cause, weather is a primary contributing factor in 23 percent of all aviation accidents. The total weather impact is an estimated national cost of $3 billion for accident damage and injuries, delays, and unexpected operating costs. Thunderstorms and Other Convective Weather. Hazards associated with convective weather include thunderstorms with severe turbulence, intense up- and downdrafts, lightning, hail, heavy precipitation, icing, wind shear, microbursts, strong low-level winds, and tornadoes. According to National Aviation Safety Data Analysis Center (NASDAC) analysis, between 1989 and early 1997, thunderstorms were listed as a contributing factor in 2-4 percent of weather-related accidents, depending on the category of aircraft involved. Precipitation was listed as a factor in 6 percent of commercial air carrier accidents, roughly 10 percent of general aviation accidents, and nearly 19 percent of commuter/air taxi accidents. American Airlines has estimated that 55 percent of turbulence incidents are caused by convective weather. In addition to safety, convective weather poses a problem for the efficient operation of the NAS. Thunderstorms and related phenomena can close airports, degrade airport capacities for acceptance and departure, and hinder or stop ground operations. Convective hazards en route lead to rerouting and diversions that result in excess operating costs and lost passenger time. Lightning and hail damage can remove aircraft from operations and result in both lost revenues and excess maintenance costs. In Figure 1, the vast majority of the warm season delays are due to convective weather. In-Flight Icing. In the period 1989-early 1997, the NTSB indicated that in-flight icing was a contributing or causal factor in approximately 11 percent of all weather-related accidents among general aviation aircraft. Icing was cited in roughly 6 percent of all weather-related accidents among air taxi/commuter and agricultural aircraft. The percentage was 3 percent for commercial air carrier accidents. The 1994 crash of an ATR-72 near Roselawn, Indiana, which claimed 68 lives, took place during icing conditions. In-flight icing is not only dangerous, but also has a major impact on the efficiency of flight operations. Rerouting and delays of commercial carriers, especially regional carriers and commuter airlines, to avoid icing conditions lead to late arrivals and result in a ripple effect throughout the NAS. Diversions en route cause additional fuel and other costs for all classes of aircraft. Icing poses a danger to aircraft in several ways: · Structural icing on wings and control surfaces increases aircraft weight, degrades lift, generates false instrument readings, and compromises control of the aircraft. See Figure 2. · Mechanical icing in carburetors, engine air intakes, and fuel cells impairs engine performance, leading to reduction of power.

### IL-Emergency Response

#### Airports are key to emergency response but are extremely prone to climate damage: the repairs will be expensive but are necessary. This means that only the fed has the resources to undertake an upgrade such as the one we propose.

Transportation Research Board of the National Academies ’11 [Transportation Research Board, “ Adapting Transportation to the Impacts of Climate Change”, June 2011, Transportation Research Circular, E-C152, <http://www.trb.org/Publications/Blurbs/165529.aspx> AD]

**• Aircraft, airport, and airspace operations are weather dependent.** Aircraft assets are extremely expensive precision machines that must be protected from salt water, excessive windborne dust, etc. Adapting to climate change is as much about protecting aircraft as it is about protecting airport infrastructure, and as the climate evolves, this may lead to completely new facility requirements and operating procedures. • **Airports often host emergency city or regional command center operations during times of crisis, and are a focal point for rescue, evacuation, and emergency supply chains.** These expected roles are both an opportunity for the airport to play a critical role in facilitating regional climate change adaptation and preparedness, as well as a **potential vulnerability if the airport were severely damaged by storms or sea-level rise in ways that compromised its** commandcenter and distribution hub **role.**

## Solvency

#### Airports are needed, and their construction must take into account environmental changes.

**UN Economic and Security Council ’10** [UN, “Policy options and actions for expediting progress in implementation: transport”, December 17, 2010, United Nations, <http://www.un.org/esa/dsd/csd/csd_pdfs/csd-19/sg-reports/CSD-19-SG-report-transport-final-single-spaced.pdf> AD]

Many are being implemented or are being planned, including roads and highways, railways, bridges and tunnels, sea and dry ports, airports, canals, waterways and pipelines. **Comprehensive and inclusive technical** and financial **planning, including** detailed social and **environmental impact assessment studies, remain critical to ensure the long-term sustainability of such investments**. 54. **Planning sustainable transport systems, including long-distance cross-border transport corridors, requires well-coordinated multi-modal integration. The construction or expansion of new** ports or **airports needs to be accompanied by the appropriate up-grading of transport infrastructure and services in the associated hinterland**. 55. Transport technologies and trade flows change over time. **With the rapid growth in air traffic, the capacities of inner-city airports are quickly becoming inadequate.** With growing containerization, many inner-city harbours also do not have the space needed for expansion. However, the relocation of transport activities can offer attractive opportunities for urban re-development, for example by converting former piers and warehouses into residential, commercial or recreational zones and facilities. 56. **Planning and construction of transport infrastructures need to anticipate potential long-term future changes.** River transport, waterways, canals and harbours can be affected by changes in precipitation, droughts or floods, or sea level rise. Appropriate and environmentally sustainable water management is thus essential.

# Waterways-Advantage

## Uniqueness

**Waterways will fail by 2020**

**IRC, 5/31-**

(Infrastructure Report Card, “Inland Waterways,” <http://www.infrastructurereportcard.org/fact-sheet/inland-waterways>)

Because of their ability to move large amounts of cargo, **the nation’s inland waterways are a strategic economic and military resource**. A recent analysis by the U.S. Army War College concluded that "**the strategic contributions of these inland waterways are not well understood.** **The lack of adequate understanding impacts decisions contributing to efficient management, adequate funding, and effective integration with other modes of transportation at the national level**. Recommendations demonstrate that **leveraging the strategic value of U.S. inland waterways will contribute to building an effective and reliable national transportation network for the 21st century**." 1 Forty-one states, including all states east of the Mississippi River and 16 state capitals, are served by commercially navigable waterways. The U.S. inland waterway system consists of 12,000 miles of navigable waterways in four systems—the Mississippi River, the Ohio River Basin, the Gulf Intercoastal Waterway, and the Pacific Coast systems—that connect with most states in the U.S. The system comprises 257 locks, which raise and lower river traffic between stretches of water of different levels. Three-quarters of the nation's inland waterways, or approximately 9,000 miles, are within the Mississippi River system. The next largest segment is the Ohio River system with 2,800 miles. The Gulf Coast Intercoastal Waterway system comprises 1,109 miles and the Columbia River system, the shortest of the four major systems, is only 596 miles long. The nationwide network includes nearly 11,000 miles of federal user fees through an excise tax on fuel. Commercial waterway operators on these designated waterways pay a fuel tax of 20 cents per gallon, which is deposited in the Inland Waterways Trust Fund (IWTF). The IWTF, which was created in 1978, funds half the cost of new construction and major rehabilitation of the inland waterway infrastructure. **Forty-seven percent of all locks maintained by the U.S. Army Corps of Engineers were classified as functionally obsolete** in 2006. **Assuming that no new locks are built within the next 20 years, by 2020, another 93 existing locks will be obsolete**—rendering more than 8 out of every 10 locks now in service outdated. 2 Currently, the Corps has $180 million per year available for lock repairs—half comes from the IWTF revenues and half comes from congressional appropriations. With an average rehabilitation cost of $50 million per lock, **the current level allows the Corps to fully fund only two or three lock projects each year.**

**By 2020, 80% of lock systems will fail**

**Heintz et al. 9** James Heintz Associate Research Professor & Associate Director Robert Pollin Professor of Economics & Co-Director Heidi Garrett-Peltier Research Assistant Political Economy Research Institute“How Infrastructure Investments Support the U.S. Economy: Employment, Productivity and Growth,” http://americanmanufacturing.org/files/peri\_aam\_finaljan16\_new.pdf

Approximately 2.6 billion short tons of commodities are transported on U.S. navigable waterways each year—an extremely cost-efficient transportation system (Army Corps of Engineers, 2005). The Army Corps of Engineers maintains and operates the inland waterway system which includes 257 lock systems nationwide, the average age of which is 55 years. According to the American Society of Civil Engineers, **by 2020 80 percent of the lock systems will be functionally obsolete** **without new infrastructure investments** (ASCE, 2005). The estimated cost of updating all the lock systems is $125 billion.

## Internal Links

#### Low flow leads to concentration, increases environmental pollution

IWAC 09 Inland Waterways Advisory Council in England and Whales [<http://www.iwac.org.uk/downloads/reports/IWAC_Climate_Change_Inland_Waterways_Apr09.pdf> “Climate change mitigation and adaptation – implications for inland waterways in England and Wales” April 2009]

As indicated above, the **reduced capacity for** flushing or **dilution during periods of low flow could lead to** additional **water quality problems associated with inputs from sewage treatment works, run-off from agricultural land, discharges, etc**. As a consequence, problems with oxygen depletion, algae or weed growth and/or increased concentrations of contaminants in sediments (which can act as a ‘sink’ for pollutants) might be anticipated (for example, see BMVBS, 2007). Lock gate replacement at Braunston – prevention of leakage at locks will become increasingly important Whilst such issues may arise largely irrespective of navigation use of the waterway, **care will be required to ensure that the environmental problems are not exacerbated by** either **vessel movemen**t or navigation related activities such as dredging. To this end, navigation authorities will need to remain appraised of the outcomes of (routine) monitoring undertaken by the Environment Agency and others. Indeed, in certain situations, it may be prudent for navigation authorities to carry out their own monitoring of relevant parameters (e.g. water level, turbidity, dissolved oxygen, certain chemical parameters) in order to inform decision- making on operations and activities (e.g. dredging, sluice or lock operation) which could affect water status.

## Impacts

#### Climate change concentrates waste; leads to pollution CIER 08 The Center for Integrative Environmental Research University of Maryland

[September 2008 A Review and Assessment <http://www.cier.umd.edu/climateadaptation/Pennsylvania%20Economic%20Impacts%20of%20Climate%20Change%20Full%20Report.pdf> “Economic Impacts of Climate Change on Pennsylvania”]

Projected **climate change** impacts **may cause disruptions to** Pennsylvania’s municipal **water supply networks**. More **intense precipitation events may create conditions that concentrate pollution in waterways and exacerbate water treatment needs, as heavy runoff washes contaminants into surface waters**. In addition, **higher temperatures** combined **with more pollutants can increase the amount of harmful bacteria** and algae **that occur in surface waters,** increasing water treatment needs and increasing the risk of illness for swimmers and others that use the water for recreation (Frumkin 2008).

#### Inland waterway pollution factors directly into the water we drink and use every day

Dawn No date Demand Media [<http://greenliving.nationalgeographic.com/can-water-pollution-affect-animals-homes-health-2921.html> How Can Water Pollution Affect Animals, Homes and Health?Dawn Walls-Thumma, Demand Media]

**Drinking water comes from surface water, such as lakes and rivers**, and from groundwater (see References 5). **Pollution** in these sources **affects the quality and safety of water available in your home and, if the problem is not detected, it can affect your health**. Pollution of drinking water occurs because of contamination by human and animal waste, mining activities, fertilizer and pesticides from homes and farms, industrial wastes, hazardous wastes generated by dry cleaners and gas stations, landfills and improperly disposed-of household wastes. (See References 5)

#### The impact is chronic heath effects including birth defects, cancer, and death

Zaslow and Herman 96 Extension Housing Specialists [Sandra A. Zaslow and Glenda M. Herman http://www.bae.ncsu.edu/programs/extension/publicat/wqwm/he393.html “Health Effects of Drinking Water Contaminants”]

The levels of contaminants in drinking water are seldom high enough to cause acute (immediate) health effects. Examples of acute health effects are nausea, lung irritation, skin rash, vomiting, dizziness, and even death. **Contaminants** are more likely to **cause chronic health effects** - effects **that occur long after repeated exposure to small amounts of a chemical**. Examples of **chronic health effects include cancer, liver and kidney damage, disorders of the nervous system, damage to the immune system, and birth defects**. Evidence relating chronic health effects to specific drinking water contaminants is limited. In the absence of exact scientific information, scientists predict the likely adverse effects of chemicals in drinking water using human data from clinical reports and epidemiological studies, and laboratory animal studies.

#### River flows will change resulting in flow changes and habitat destruction.

IWAC 09 Inland Waterways Advisory Council in England and Whales [<http://www.iwac.org.uk/downloads/reports/IWAC_Climate_Change_Inland_Waterways_Apr09.pdf> “Climate change mitigation and adaptation – implications for inland waterways in England and Wales” April 2009]

The report Climate Impacts on Inland Waterways (US Dept. of Transportation, 2005) concludes that **climate change is likely to affect the inland navigation on the Mississippi River in two ways: i) changing river flows including an increased frequency of floods and low flow events, and ii) changing the amount of commodity traffic, its origins and its destinations**. **The report also documents a number of potential adaptations to such climate change** and variability:

reviewing water-use master plans to balance multiple uses of water, including navigation; **ensuring habitat protection and enhancement**; **increasing dredging**; and climate change feasibility studies to future-proof navigation projects.

They conclude, however, that with the current state of knowledge, it does not now make sense to build expensive infrastructure *in anticipation* of potential climate change. Rather, water resources and transportation managers should continue to monitor climate conditions and their effects on hydrology and adapt policies and operating procedures if significant changes are detected. **Plans should then be evaluated based on their resiliency, robustness and reliability under a range of uncertain scenarios.**

**Biodiversity is key to preventing extinction**

**Madgoluis 96** (Richard Margoluis director of the Analysis and Adaptive Management and the Latin America and Caribbean Programs of the Biodiversity Support Program. He holds a Master’s of Public Health (MPH) in International Health and a Ph.D. in Epidemiology. Biodiversity Support Program, 1996, http://www.bsponline.org/publications/showhtml.php3?10)

**Biodiversity not only provides direct benefits like food, medicine, and energy; it also affords us a "life support system." Biodiversity is required for** the recycling of essential elements, such as **carbon, oxygen, and nitrogen**. It is also responsible for **mitigating pollution, protecting watersheds, and combating soil erosion**. Because biodiversity acts as a buffer against excessive variations in weather and climate, it protects us from catastrophic events beyond human control. **The importance of biodiversity to a healthy environment has become increasingly clear. We have learned that the future well-being of all humanity depends on** our stewardship of **the Earth. When we overexploit living resources, we threaten our own survival.**

### Locks

#### Lower water levels damage lock cells- become vulnerable to damage

IWAC 09 Inland Waterways Advisory Council in England and Whales [<http://www.iwac.org.uk/downloads/reports/IWAC_Climate_Change_Inland_Waterways_Apr09.pdf> “Climate change mitigation and adaptation – implications for inland waterways in England and Wales” April 2009]

Navigation authorities will need to ensure that their routine asset monitoring and maintenance activities identify any structures which could potentially be vulnerable if low flow/drought conditions reduce or remove hydraulic support from the waterside face. Structures which could be vulnerable in the event of rapid drawdown should similarly be identified and monitored. In both cases, if significant risks are identified the **structures will need to be strengthened or modified accordingly** (or rapid drawdown avoided where possible). **Lower water levels may occasionally result in damage to lock cills** (e.g. if deeper drafted craft impact upon them). Steps should therefore be taken to ensure that a minimum under-keel clearance is maintained. Alternatively it may be necessary to close the navigation until water levels recover sufficiently to remove the risk. **Lock and bridge approaches may** similarly **become more vulnerable to damage as craft attempt to sail in shallower conditions**. However, **long term dredging should be used to address this issue** as good practice would require such approaches to be cleared. Finally, as discussed in Section 6.7, whenever significant modifications or made to existing infrastructure, or when new assets are being planned, care should be taken to future-proof such activities. This will help to ensure that such infrastructure will be able to withstand the projected future effects of climate change over its design life.

#### Lock climate change adaption key to prevent breakage- ensures bank stability

IWAC 09 Inland Waterways Advisory Council in England and Whales [<http://www.iwac.org.uk/downloads/reports/IWAC_Climate_Change_Inland_Waterways_Apr09.pdf> “Climate change mitigation and adaptation – implications for inland waterways in England and Wales” April 2009]

Other players in inland waterways management organisation. When measures to address the potential effects of climate change and their consequences for inland waterways and inland navigation are being considered, a number of important inter-relationships therefore need to be taken into account. Some such inter-relationships are related to The characteristics of many inland waterways in England and Wales are such that infrastructure may have a dual function or its operation may involve more than one planning and/or policy, whilst others have more practical implications. **Of** particular **importance in this respect are flood risk management and water resources**. The **embankments of many navigable waterways are also flood defences. Locks, weirs, sluices and other structures may similarly have a flood risk management role, and the compatibility of flood risk management and navigation requirements needs to be taken into account**, particularly in times of extreme events. Whereas **high flows can sometimes make it difficult or indeed dangerous to operate locks**, there may be a specific requirement for locks to be held open to facilitate flood conveyance downstream. Active management of weir structures may similarly be used to modulate storm pulses. According to Environment Agency (2007), **channel maintenance for flood risk management purposes and/or for navigation is** likely **to become a key part of the response to climate change** - in particular **to ensure bank stability** and to keep rivers open during low flow. There is a great deal of ongoing research into flood risk management requirements under a scenario of climate change and this report does not attempt to repeat or duplicate such work. Rather, it aims to highlight the need for close cooperation between flood risk and navigation personnel, both in the operation and maintenance of existing assets and in the planning and design of future new or modified infrastructure. In particular, such activities need to take into account the sometimes differing requirements and to endeavour to identify ‘win-win’ solutions which meet the needs of both activities. In addition to increased precipitation and flood risk management considerations, low flow and drought conditions are relevant to this report, as the operation of locks may need to be restricted in order to reduce drainage and maintain water in the network - not only to conserve ecological interests but also to help maintain the structural integrity of flood embankments, etc. The use of back-pumping to continue to allow boat passage through locks also needs to be undertaken in a way that takes account of other interests. A number of navigations also form part of large low-level drainage systems which are managed by Internal Drainage Boards (IDB), for example the Middle Level Commissioners in the Fens. IDBs often discharge their drainage systems via pumping stations to main rivers which may be part of a navigation system - such as the River Witham in Lincolnshire. Such discharges typically increase when there is already sufficient water in the river to support navigation. However other, potential mutually beneficial water management opportunities might be explored under a scenario of climate change.and is likely to play a leading role in developing and coordinating strategies to deal with the impacts of climate change.

#### Lock breakage leads to water loss, and causes species to go extinct, largely affecting habitat in the area

IWAC 09 Inland Waterways Advisory Council in England and Whales [<http://www.iwac.org.uk/downloads/reports/IWAC_Climate_Change_Inland_Waterways_Apr09.pdf> “Climate change mitigation and adaptation – implications for inland waterways in England and Wales” April 2009]

**Reduced precipitation and** associated **low flow** conditions **have the potential to affect aquatic habitats** detrimentally, including marginal areas **and adjacent wetlands**. If water levels drop, **water-dependent species of flora and fauna are vulnerable** and their Restoration and use of historic side ponds at locks could save water. This principle is also used in ‘economiser’ locks on major modern waterways in continental Europe.**survival may be compromised**. Depending on the duration of the event, certain **plant species may die-back or be lost and associated insects, fish and birds might be threatened as a result** - **through losing a source of food, through exposure to predators or due to an interruption in up- and down-stream connectivity.** In addition to marginal or bankside habitats, nearby wetland areas may depend on navigable rivers and canals for their water supply, whether directly through side channels, via infrastructure such as sluices or, occasionally, through seepage. As a result of the historic loss of wetland habitats over many years (due to land drainage, infilling for development, etc.), many remaining wetland areas are protected under international, national or local initiatives. Depending on the nature of the protection, either the conservation agencies or the Environment Agency (e.g. through the designation of water protection zones, see Section 7.7) could require measures to be taken - which could, in turn, have implications for navigation. In some situations, **maintaining water levels to support wildlife will also be beneficial for navigation.**

**Similarly, where water loss is a result of drying out, fissuring or malfunction of navigation infrastructure such as** sluices or **locks**, it will be in the navigation authority’s interest to remedy the problem. In other cases, however, making water available to protect wildlife interests might further reduce the amount available for lock and sluice operations, etc. There is thus the potential for conflict, and careful management will be needed to ensure that a balance is achieved between the requirements of navigation and those of nature. As it seems likely that **low flow conditions will occur much more frequently due to climate change** (see Section 7.1), navigation authorities would benefit from an improved understanding of site-specific ecology-water interdependencies.Such an understanding would enable them to anticipate any problems, to explore potential ‘win-win’ opportunities to store excess winter rainfall (e.g. as discussed in Section 6.8) and to develop a contingency plan including measures such as releasing fresh water from storage where available or using lock, sluice and weir operation to aerate the water.Finally, in extreme low flow conditions, as water resources diminish during the summer season it will become increasingly important to retain sufficient water within the river reach or canal pound to protect the ecology. As a consequence, there may be situations in which the use of locks has to be temporarily suspended.

# Ports-Advantage

### Climate Threatens Ports

#### Climate change will force ports to shut down

Becker et al, 11 (Austin Becker, PhD Student at Stanford University, Emmett Interdisciplinary Program for Environment and Resources; Satoshi Inoue, Visiting Professor at Stanford, National Graduate Institute for Policy Studies, Tokyo, Japan; Martin Fischer, Director, Center for Integrated Facility Engineering; Professor, Civil and Environmental Engineering, Stanford University; Ben Schwegler, Chief Scientist of Walt Disney Imagineering R&D and Consulting Professor at Stanford

University; “Considering Climate Change: a Survey of Global Seaport Administrators; http://cife.stanford.edu/sites/default/files/WP128.pdf)

In a 2007 study, Nicholls et al. analyzed 136 port cities around the world to quantify ¶ current and future exposure to a 1-in-100 year flooding event. Their findings suggest that many ¶ of these areas have significant percentages of their GDP in areas that are at high risk today and ¶ climate change will increase that risk significantly. By 2070, for example, the combined effect of ¶ climate change, urbanization, increased population, and land subsidence could put 150-million ¶ people and US $35,000 billion (9% of projected global GDP) of assets at direct risk (Nicholls ¶ 2007). Though their study focused on “port cities,” as opposed to the ports themselves, the ¶ results serve as a useful indicator to the urgency of climate-change adaptation for the ports that ¶ are economic engines for these regions. Even outside of catastrophic damages, ports can expect ¶ “downtime” to increase with climate change. Larger storms in Japan, for example, could lead to ¶ more port shutdowns. Esteban (2009) shows that without taking proactive steps toward ¶ adaptation, the increased frequency of wind events could reduce the potential Japanese GDP by ¶ between 1.5 and 3.4% by 2085. Hallegate (2007) looked more specifically at the impact of ¶ hurricane intensity and found that just a 10% increase in storm intensity would increase annual ¶ hurricane damages in the US by 54%, from $8 billion to $12 billion per year. Another recent ¶ study found that surrounding port lands at 35 of 44 Caribbean ports will be inundated by 1m of ¶ SLR, unless protected by new coastal structures (Simpson et al. 2010).

#### Changes in precipitation will damage all infrastructure – Waterways are the greatest risk of catastrophe.

NTPP ‘9 (National Transportation Policy Project, Bipartisan coalition of transportation policy experts, business and civic leaders, and is chaired by four distinguished former elected officials who served at the federal, state, and local levels, Published December 15 2009, Bipartisan Policy Center, <http://bipartisanpolicy.org/sites/default/files/Transportation%20Adaptation%20(3).pdf>)

Projected changes in annual precipitation are ¶ not consistent across the United States, with ¶ regional models showing increases in some areas ¶ and decreases in others. Increasing rates of annual average precipitation can render stormwater ¶ facilities inadequate, lead to deteriorating water ¶ quality due to run-off and sedimentation, degrade ¶ infrastructure, and change soil conditions (with ¶ impacts such as subsidence and heave, landslides, ¶ and structural instability). Decreasing precipitation rates also can create problems, particularly in ¶ drying and shrinking of soils, affecting the base ¶ under pavements and other structures. Warming ¶ temperatures also will likely result in a shift from ¶ snowfall to rainfall, potentially relieving areas that ¶ typically see large amounts of snow from some of ¶ the cost of maintaining winter roads.¶ A potentially more signiﬁcant concern across the ¶ nation is a projected increase in the intensity of¶ precipitation events. Extreme rainfall events can ¶ overwhelm stormwater management systems, ¶ lead to more ﬂooding, and increase run-off issues throughout the nation. For instance, Tropical ¶ Storm Allison caused widespread ﬂooding of ¶ Houston’s freeway system in 2001 due not to ¶ storm surge, but rather to the intensity, and duration of the rainfall. ¶ Changes in precipitation, coupled with increasing ¶ temperatures, also will have important effects on ¶ the nation’s inland waterway system. The Great ¶ Lakes are projected to experience declining water ¶ levels that will impair shipping; for each inch of ¶ lost draft a 1,000-foot bulk carrier loses 270 tons ¶ of capacity.¶ 13¶ If lower water levels occur on a regular basis, Great Lakes shippers will be less competitive with other competing modes such as rail or ¶ truck.¶ 14¶ Declining water levels would also result in ¶ increased costs and environmental impacts from ¶ increased dredging. Projections are less certain for ¶ the Mississippi River system, but both drought ¶ and ﬂood conditions can stop barge trafﬁc on the ¶ river system, greatly affecting the ability to move ¶ agricultural products from the interior to market.

\*Note to reader: My home town will go broke if this happens

#### Warming would make shipping more difficult: lower lake and river levels mean that larger ships could not pass through existing lanes.

**Department of Transportation - DOT Center for Climate Change and Environmental Forecasting ‘2** [DOT, “The Potential Impacts of Climate Change on Transportation”, October 2002, Federal Research Workshop, <http://climate.dot.gov/documents/workshop1002/workshop.pdf>, AD]

**What are some** other **aspects of this¶ Assessment that are directly relevant to¶ transportation**? First, future conditions were¶ evaluated by using results from state of the art¶ climate model simulations in impacts studies,¶ and by using results from the current scientific¶ literature. Some of the relevant results include:¶ • Some **climate models show a reduction in¶ soil moisture** in many areas resulting in¶ decreases in ground and surface water¶ supplies. This **could result in a decrease in¶ the levels of the Great Lakes by as much as¶ a meter or more.** However, other model¶ results suggest little change in lake levels.¶ **Reductions in base stream flow could cause¶ problems with transportation such as barge¶ shipping, infrastructure, and reductions in¶ water supply**. However, warmer winter¶ temperatures could result in a longer ice-free¶ season thereby extending the shipping¶ season on the Great Lakes.¶ • A possible reduction in Western U.S.¶ snowpack that would impact water supply¶ and streamflow. This could result in a¶ seasonal redistribution of water availability.¶ • In Alaska, permafrost has already undergone¶ extensive melting and if future projections¶ of high-latitude warming hold, then melting¶ would continue.¶ • Heavy precipitation events in the U.S. have¶ increased over the 20th century, and could continue with a more vigorous hydrologic¶ cycle as projected by model scenarios.¶ • Increasing summer temperatures, coupled¶ with increasing water vapor, would likely¶ result in increases in the summer-time heat¶ index in many parts of the country.

#### New weather patterns will create permanent damage.

**Transportation Research Board of the National Academies ’11** [Transportation Research Board, “ Adapting Transportation to the Impacts of Climate Change”, June 2011, Transportation Research Circular, E-C152, <http://www.trb.org/Publications/Blurbs/165529.aspx> AD]

**Changing weather patterns**, increasing storm intensities and flooding, rising sea levels, and¶ increasing temperatures **are presenting a “new normal” under which transportation agencies** ¶ across the **country are starting to weigh the potential vulnerability of their transportation ¶ infrastructure** and come up with plans to adapt. ¶ **Many coastal states,** while experienced with severe weather and effects of storm surge,¶ **are now preparing for more permanent effects**—including disinvestment and abandonment of¶ some transportation infrastructure, and in some cases, relocation of entire communities. For some non-coastal states, increased frequency and intensity of storm events—and the¶ associated flooding and wind damage—have become critical issues.

### Dirty Bombs

#### **The chaos caused by a dirty bomb could cost billions in economic damage.**

Curry 11( Andrew, Writer for Wired, Discover, National Geographic and Smithsonian, contributing editor for Archaeology magazine. Winner of Arthur F. Burns Journalism Prize. “Why Is This Cargo Container Emitting So Much Radiation?” October 21, 2011 Wired Magazine http://www.wired.com/magazine/2011/10/ff\_radioactivecargo/all/1)

Unloading a pre-container “breakbulk” cargo ship could take a week. Today, a crew of six Genoese longshoremen can move almost two dozen containers per hour using a crane to unload the ship, a stacker to move the boxes, and a few semi trucks; a ship with 3,000 boxes aboard can be turned around in 48 hours. The efficiency has proven to be an irresistible economic force. In 2010, the world’s container ports processed the equivalent of 560 million 20-foot containers. If you set aside bulk commodities like crude oil and grain, that’s more than 90 percent of the planet’s maritime cargo. By driving the cost of shipping way down and the speed of international commerce way up, containers helped make manufacturing global.¶ But those millions of identical containers are, essentially, mystery boxes. Stevedores used to lay hands on each piece of cargo that went into a ship’s hold. Today, a container may be loaded, or “stuffed,” thousands of miles from the port. Once the doors are closed and sealed, “no one knows what’s inside,” says Philip Spayd, a supply-chain security consultant who spent 25 years working for the federal government. “We know what’s represented on their documents,” but those documents are easily faked, he says. “The only people who really know what’s inside are the ones who were there when the container was packed.” Containerized cargo is used to smuggle every imaginable form of contraband, from narcotics and small arms to counterfeit purses and illegal immigrants. Since the terrorist attacks of 9/11, security experts and politicians have zeroed in on containers as a major risk. At the top of their list is the possibility that containers could be used to smuggle a nuclear weapon, in pieces or whole. But nuclear bombs are tremendously complicated, and the key components aren’t exactly commonplace. In security circles, nukes are what’s known as a “high consequence, low probability” threat.¶ But that’s not true for the next danger on the list: a radiological dispersion device, also known as a dirty bomb. A payload of radioactive material — from inside a hospital’s teletherapy machine or instrument sterilizer, for example — sits atop a pile of conventional explosives. When the bomb detonates, it blows a cloud of radioactive dust into the air. The wind does the rest: Under the right conditions, just 20 milligrams of cesium-137 — roughly the amount found in gadgets that hospitals use to calibrate their radiation therapy equipment — could contaminate 40 city blocks.¶ Compared to a nuclear explosion, a dirty bomb would be a hiccup in terms of destructive force. The real problem would be panic. A light coating of radioactive dust raining down on Manhattan might cause only a minor increase in cancer rates, but it would definitely result in a major national freak-out. Set off at a major port, a dirty bomb would cause a chain reaction of precautionary closures and painstaking inspections that could bring the entire U.S. economy to a crawl within weeks. “The idea that dirty bombs could cause major destruction is complete bullshit. What they could do is cause billions and billions in economic damage,” says James Acton, an analyst at the Carnegie Endowment for International Peace. “Dirty bombs are weapons of mass disruption.”

# Roads-Advantage

### Climate Threatens Roads

#### We are not prepared for the impacts of climate change.

Highways Agency 11 (British(government) Highways Agency, “Climate Change Risk Assessment” August 2011 http://www.highways.gov.uk/aboutus/documents/HA\_Climate\_Change\_Risk\_Assessment\_August\_2011\_v2.pdf)

“We are not prepared for climate changes which occur, ¶ threatening both highway asset integrity and availability; and we ¶ fail to adequately manage the carbon emissions that lie within the ¶ Highways Agency’s sphere of inl uence, leading to loss of reputation ¶ and i nancial impacts from Carbon Reduction Commitment (CRC) ¶ penalties and higher energy consumption”¶ The cause of the risk can be identified as not targeting management ¶ actions nor timely and demonstrably reducing climate change risks ¶ defined by the organisation. Unmanaged, the consequence would ¶ be a deterioration in network integrity; increased maintenance ¶ liability; increased disruption to service from events such as flooding; ¶ increased risks to road users and operational staff from extremes in ¶ weather and risk to the ability of staff to access their place of work ¶ when extreme weather events occur.¶ The Agency has already experienced problems on the network due to ¶ extremes in rainfall and temperature. These occurrences are only likely ¶ to increase in their frequency and severity over time as the impacts ¶ of climate change increase. The majority of the network remains ¶ susceptible to weather events, with detrimental changes in asset ¶ integrity adversely affecting journey reliability and safety. In treating ¶ the risks posed, some changes to technical standards have already ¶ been made to increase resilience to climate changes including HD33 ¶ drainage standard and the Enrobé à Module Élevé 2 (EME2) revised ¶ pavement specification.

#### Rising sea levels pose a threat to low-lying roads

Austroads, 4 (Austroads, road transport and traffic authorities of Australia and New Zealand, “Impact of Climate Change on Road Infrastructure, http://www.bitre.gov.au/publications/2004/files/cr\_001\_climate\_change.pdf)

Sea level rise could be a concern for low-lying roads in coastal areas, particularly if the rise by 2100 is¶ towards the upper end of the projected range of 9 to 88 cm. The problem may be worse in northern Australia¶ if wind speeds become higher during storm surges. Planners and designers of roads and causeways in lowlying coastal areas can take account of projected rises in sea level over the lives of assets. The impact on¶ existing roads and causeways can be taken into account at the time they require rehabilitation or ¶ improvement. Clearances for new bridges over tidal water should take into account the potential rise in sea ¶ level over the life of the bridge, usually 100 years.

#### Climate change poses a host of risks to the highway network.

Walters 09 (Caroline, Researcher for URS Scott Wilson, a leading engineering and environmental consultant firm. “The Effect of Climate Change on 3CAP’s ¶ Highway Network Policies and Standards” The 3 Counties Alliance Partnership (3CAP) February 2009 http://www.leics.gov.uk/climate\_change\_adaptations.pdf)

A Risk and Probability Assessment of the effects of climate change on the highway network has ¶ identified the ten effects posing the biggest risks from climate change to the highway network ¶ (extracted from Table 9). • Pavement failure from prolonged high temperatures;¶ • Increased length of the growing season leading to prolonged and/or more rapid growth of the ¶ soft estate; ¶ • Lack of capacity in the drainage system and flooding of the network; ¶ • Surface damage to structures from hotter and drier summers; ¶ • Scour to structures from more intense rainfall; ¶ • Damage to pavement surface layers from more intense rainfall; ¶ • Subsidence and heave on the highway from more intense rainfall; ¶ • Scour and damage to structures as a result of stronger winds and more storminess; ¶ • Severe damage to light-weight structures from stronger winds and more storminess; and ¶ • Less disruption by snow and ice due to warmer winters.

#### Climate change accelerates the deterioration of highway systems.

Walters 09 (Caroline, Researcher for URS Scott Wilson, a leading engineering and environmental consultant firm. “The Effect of Climate Change on 3CAP’s ¶ Highway Network Policies and Standards” The 3 Counties Alliance Partnership (3CAP) February 2009 http://www.leics.gov.uk/climate\_change\_adaptations.pdf)

There have been an increasing number of very hot days (i.e. with temperatures over 25°C) in ¶ the East Midlands over the last 40 years. Extremely hotter summers have been experienced in ¶ 1976, 1983, 1990, 1995 and 2003, where high temperatures were sustained over a number of ¶ days ¶ regions such as Cambridgeshire and Hampshire reported significant problems with cracking ¶ and deformation of the highway as a result of a prolonged hot and dry period leading to a ¶ severe reduction in soil moisture content and soil shrinkage. Incidences similar to this are ¶ expected to increase in frequency and severity as climate change develops. ¶ However, hotter and drier summers do have the potential to provide some benefits for highway ¶ construction and maintenance. Although prolonged high temperatures can cause asphalt roads ¶ to soften and deform and concrete roads to crack, it also means that roads can be resurfaced ¶ rapidly and grass growth is reduced during the very hot periods, thus producing a short-term ¶ reduction in the need for grass cutting [Capps and Lugg, 2005]. These effects will help to ¶ reduce the costs and disruption associated with these particular maintenance activities during ¶ these particular periods of hot and dry weather. ¶ Wetter winters and more extreme rainfall events will lead to increased occurrences of flooding, ¶ as seen in the summer of 2007. This will particularly be a problem in low-lying areas as well as ¶ floodplains, and will increase the risk of landslips and embankment erosion. Flooding will also ¶ have implications on pavement maintenance as water ingress and binder stripping can lead to ¶ premature deterioration and failure of the pavement structure. More intense rainfall, increased ¶ storminess and more severe winds will have impacts on pavement resilience, drainage capacity ¶ and condition, utilities and highways structures (such as; bridges, culverts, road signs, street ¶ lighting). ¶ Warmer winters will lead to less snow and ice which should reduce the need for winter ¶ maintenance activities (salting etc). However, this will not necessarily reduce the need for winter ¶ maintenance resources and capabilities that are available for utilisation – conservative ¶ forecasting and an increase in the number of ‘marginal’ nights may in fact mean that the number ¶ of ‘turn-outs’ in winter is likely to remain the same or may even increase. ¶ Warmer winters and more intense rainfall events will also lead to a lengthened growing season. ¶ This will result in an increased demand and need for maintenance of the soft estate and new ¶ plant species may begin to thrive. This in turn will have additional potential impacts such as; ¶ drainage blockages, impaired ‘sight-line’ vision of road signs, and vegetation ingress onto the ¶ highway leading to pavement damage and deterioration.

### Extreme Heat

#### **Extreme Heat damages roads and reduces life spans**

Meyer et. al. 09, (Michael Frederick R. Dickerson Professor, School of Civil and Environmental Engineering, Georgia Institute of Technology, PhD Michael Flood Senior Planner at Parsons Brinckerhoff ¶ Chris Dorney Transportation/Land Use Planner at Parsons Brinckerhoff ¶ Ken Leonard Principal of Cambridge Systematics, ¶ Robert Hyman Associate at Cambride Systematics ¶ Joel Smith expert on climate change policy, lead author of the Intergovernmental Panel on Climate Change 2001 and 2007 assessment report; the latter shared the Noble Peace Prize with former Vice President Al Gore. Vice-President of Stratus Consulting, Boulder, CO. “Climate Change and the Highway System: Impacts and Adaptation Approaches”. National Cooperative Highway Research Program. 5/6/2009 http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-83%2805%29\_Task2-3SynthesisReport.pdf)

The literature points to a likely increase in very hot days and heat waves. As discussed in section ¶ 3.2, heat extremes and heat waves will continue to become more intense, longer lasting, and more ¶ frequent in most regions during the 21st century (NRC, 2008). Increasing periods of extreme heat ¶ will place additional stress on infrastructure, reducing service life and increasing maintenance ¶ needs. ¶ Extreme maximum temperature and prolonged duration of heat waves are expected to lead to ¶ premature deterioration of infrastructure. Temperature increases have the potential to affect and ¶ reduce the life of asphalt road pavements through softening and traffic-related rutting (Karl et al., ¶ 2009; CNRA, 2009; Field et al., 2007; CSIRO, 2007; Maine DOT, 2009). Extreme heat can also stress ¶ the steel in bridges through thermal expansion and movement of bridge joints and paved surfaces ¶ (Karl et al., 2009; CSIRO, 2007; New York City Panel on Climate Change, 2009). ¶ The increase in very hot days and extended heat waves are expected to impact highway operations ¶ and maintenance in several ways. The first is the probable limit on construction activities and the ¶ number of hours road crews can work due to health and safety concerns for highway workers (Karl ¶ et al., 2009; Peterson et al., 2008). The increase in extreme heat could also lead to load restrictions ¶ on roads. Pavement damage and buckling will disrupt vehicle movements (Karl et al., 2009). ¶ Extreme heat could disrupt vehicle operations because of overheating and increased risk of tire ¶ blow-outs in heavily loaded vehicles (Karl et al., 2009; Peterson et al., 2008). Higher temperatures ¶ could lead to an increased need for refrigerated freight movement, and thus result indirectly in ¶ higher transportation costs (Karl et al., 2009; CNRA, 2009). ¶ A secondary impact of extreme and extended periods of heat, when combined with reduced ¶ precipitation, is the projected increased risk of wildfires, especially in the Southwest region. Fire ¶ poses a risk to infrastructure and travelers, and can necessitate road closures (Karl et al., 2009).

### Permafrost

#### Increased temperature causes permafrost thaws which will cause landslides and destroy roads.

Meyer et. al. 09, (Michael Frederick R. Dickerson Professor, School of Civil and Environmental Engineering, Georgia Institute of Technology, PhD Michael Flood Senior Planner at Parsons Brinckerhoff ¶ Chris Dorney Transportation/Land Use Planner at Parsons Brinckerhoff ¶ Ken Leonard Principal of Cambridge Systematics, ¶ Robert Hyman Associate at Cambride Systematics ¶ Joel Smith expert on climate change policy, lead author of the Intergovernmental Panel on Climate Change 2001 and 2007 assessment report; the latter shared the Noble Peace Prize with former Vice President Al Gore. Vice-President of Stratus Consulting, Boulder, CO. “Climate Change and the Highway System: Impacts and Adaptation Approaches”. National Cooperative Highway Research Program. 5/6/2009 http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-83%2805%29\_Task2-3SynthesisReport.pdf)

Changes in the projected range of temperatures, including seasonal changes in average ¶ temperatures, can also impact highway systems. The increase in range of temperatures will likely ¶ benefit highways in some ways, while increasing risks in others. ¶ Warmer winters will likely lead to less snow and ice on roadways, and incidence of frost heave and ¶ road damage caused by snow and ice in southern locations is likely to decline. However, in some ¶ regions warmer winters could also increase the freeze-thaw conditions that create frost heaves and ¶ potholes on road and bridge surfaces; particularly in northern locations that previously ¶ experienced below-freezing temperatures throughout much of the winter. They may lead to an ¶ increase in freeze-thaw conditions in northern states, creating frost heaves and potholes on road ¶ and bridge surfaces that increase maintenance costs: repairing such damage is already estimated to ¶ cost hundreds of millions of dollars in the U.S. annually (Peterson et al., 2008). ¶ In Alaska, warmer temperatures will likely adversely affect infrastructure for surface ¶ transportation. Permafrost thaw in Alaska will damage road infrastructure due to foundation ¶ settlement and is the most widespread impact (Larsen et al., 2008). Permafrost thaw will also ¶ reduce surface load-bearing capacity and potentially trigger landslides that could block highways. NCHRP 20-83 (5) Task 2.3 Synthesis Report ¶ Review of Key Climate Impacts to the Highway System ¶ and Current Adaptation Practices and Methodologies ¶ 27 ¶ Roadways built on permafrost already have been damaged as the permafrost has begun to melt and ¶ ground settlement has occurred leading to costly repairs for damaged roads. Dealing with thaw ¶ settlement problems already claims a significant portion of highway maintenance dollars in Alaska ¶ (Karl et al., 2009). A study in Manitoba, Canada, projects the degradation of permafrost beneath ¶ road embankments will accelerate because of warmer air temperatures. The symptoms of ¶ permafrost degradation on road embankments are lateral spreading and settlement of road ¶ embankments. This can create sharp dips in road surfaces which require extensive patching every ¶ year and lead to dangerous conditions for motorists (Alfaro et al., 2009). ¶ In Southern Canada, studies suggest that rutting and cracking of pavement will be exacerbated by ¶ climate change and that maintenance, rehabilitation, or reconstruction of roadways will be required ¶ earlier in the design life (Mills et al., 2009). Similarly, simulations for pavement in Alberta and ¶ Ontario show that temperature increases will have a negative impact on the pavement performance ¶ in the Canadian environment. As temperature increases, accelerated pavement deterioration due to ¶ traffic loads on a warmer pavement was expected and observed. An increase in temperature would ¶ facilitate rutting because the pavement is softer. Pavement movement due to loads on a softer ¶ pavement would also result in increased cracking. Overall temperature changes significantly ¶ affected the level of pavement distress for the international roughness index (IRI), longitudinal ¶ cracking, alligator cracking, AC deformation, and total deformation (Smith et al., 2008). ¶ The effects of changing temperatures are particularly apparent in the Arctic. Warming winter ¶ temperatures, especially in the high northern latitudes of Alaska, could cause the upper layer of ¶ permafrost to thaw. Over much of Alaska, the land is generally more accessible in winter, when the ¶ ground is frozen and ice roads and bridges formed by frozen rivers are available (NRC, 2008; Karl ¶ et al., 2009). Winter warming would therefore shorten the ice road season and affect access and ¶ mobility to northern regions. Thawing permafrost could also damage highways as a result of road ¶ base instability, increased slope instability, landslides and shoreline erosion. Permafrost melt could ¶ damage roads and bridges directly through foundation settlement (bridges and large culverts are ¶ particularly sensitive to movement caused by thawing permafrost) or indirectly through landslides ¶ and rockfalls. In addition, hotter, summers in Alaska and other mountainous western locations lead ¶ to increased glacial melting and longer periods of high stream flows, causing both increased ¶ sediment in rivers and scouring of bridge supporting piers and abutments. ¶ The change in range of maximum and minimum temperatures will likely produce both positive and ¶ negative impacts on highway operations/maintenance. In many northern states, warmer winters ¶ will bring about reductions in snow and ice removal costs, lessen adverse environmental impacts ¶ from the use of salt and chemicals on roads and bridges, extend the construction season, and ¶ improve the mobility and safety of passenger and freight travel through reduced winter hazards ¶ (Karl et al., 2009). ¶ On the other hand, warmer winter temperatures could also have negative impacts on highway ¶ operations and maintenance. Greater vehicle load restrictions may be required to minimize damage ¶ to roadways when they begin to subside and lose bearing capacity during the spring thaw period. ¶ With the expected earlier onset of seasonal warming, the period of springtime load restrictions ¶ might be reduced in some areas, but it is likely to expand in others with shorter winters but longer ¶ thaw seasons (Peterson et al., 2008)

### Storms

#### Roads are particularly vulnerable to increased storm activity due to GW

NTPP ‘9 (National Transportation Policy Project, Bipartisan coalition of transportation policy experts, business and civic leaders, and is chaired by four distinguished former elected officials who served at the federal, state, and local levels, Published December 15 2009, Bipartisan Policy Center, <http://bipartisanpolicy.org/sites/default/files/Transportation%20Adaptation%20(3).pdf>)

Storms, particularly hurricanes, can cause major ¶ damage to transportation infrastructure. Increases ¶ in storm intensity will have signiﬁcant impacts ¶ throughout the United States, especially in coastal ¶ areas. Transportation infrastructure already experiences storm impacts, but may not be designed ¶ to withstand a greater number of high-intensity ¶ storm events. ¶ Among the most destructive effects of coastal ¶ storms are storm surges, which can cause ¶ temporary disruptions (inundation of facilities ¶ that renders them inoperable until the surge ¶ subsides) and permanent damage, destroying ¶ bridges, pavement, and other structures. Hurricane Katrina storm surges, for instance, destroyed ¶ billions of dollars in infrastructure, including ¶ miles of coastal roads and rails and several major ¶ highway bridges. Storm surges will be exacerbated ¶ by further rising sea level, putting a greater range ¶ of infrastructure at risk. For instance, a Florida ¶ State University (FSU) study found that even if ¶ hurricane intensity did not change, sea-level rise ¶ of just one foot would triple the frequency of a ¶ seven-foot storm surge in coastal Florida from ¶ once every 76 years to once every 21 years.¶ 11¶ Changes in storm intensity, particularly when ¶ coupled with sea-level rise, will have major implications for emergency management as well. ¶ Low-lying evacuation routes may not be available in the future, and the increase in frequency ¶ of evacuations will call for additional resources ¶ devoted to the problem. Offshore pipelines are ¶ also vulnerable to hurricanes, with wave action ¶ and seabed erosion particularly affecting pipelines ¶ in shallow waters (as found in the Gulf of Mexico ¶ petroleum collection networks). Larger on-shore ¶ pipelines also face disruption from storm-induced ¶ power outages. For instance, after Hurricane ¶ Katrina, gasoline shortages were experienced along ¶ the East Coast because pipelines originating in the ¶ storm-damaged region were not operating from ¶ lack of power.¶ 12¶ Not all impacts are restricted to coastal storms and ¶ hurricanes. High storm winds also cause damage ¶ to signage and overhead cables, as well as to warehouse facilities at intermodal sites (which tend ¶ to be lightly built), and disrupt roadway operations with downed trees and debris. Potentially ¶ increased storm activity could include an increase ¶ in lightning strikes, which can disrupt electronic ¶ transportation infrastructure, such as signaling.

### Precipitation

#### **Changes in precipitation compromise the structure of our highways.**

Meyer et. al. 09, (Michael Frederick R. Dickerson Professor, School of Civil and Environmental Engineering, Georgia Institute of Technology, PhD Michael Flood Senior Planner at Parsons Brinckerhoff ¶ Chris Dorney Transportation/Land Use Planner at Parsons Brinckerhoff ¶ Ken Leonard Principal of Cambridge Systematics, ¶ Robert Hyman Associate at Cambride Systematics ¶ Joel Smith expert on climate change policy, lead author of the Intergovernmental Panel on Climate Change 2001 and 2007 assessment report; the latter shared the Noble Peace Prize with former Vice President Al Gore. Vice-President of Stratus Consulting, Boulder, CO. “Climate Change and the Highway System: Impacts and Adaptation Approaches”. National Cooperative Highway Research Program. 5/6/2009 http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-83%2805%29\_Task2-3SynthesisReport.pdf)

As discussed in section 3.2, changes in precipitation – of both rain and snow - will vary widely ¶ across the various regions in the U.S. These changes are expected to impact highways in several ¶ ways, depending on the specific regional precipitation levels and geographic conditions. ¶ In areas with increased precipitation, there is greater risk of short and long term flooding (e.g. more ¶ spring floods in the upper Midwest). In other areas more precipitation may fall as rain rather than ¶ snow in winter and spring, increasing the risk of landslides, slope failures, and floods from the ¶ runoff which can cause road washouts and closures. In addition, northern areas are projected to ¶ have wetter winters, exacerbating spring river flooding. In other areas the increase in precipitation ¶ could lead to higher soil moisture levels affecting the structural integrity of roads, bridges, and ¶ tunnels and leading to accelerated deterioration. If soil moisture levels become too high, the structural integrity of roads, bridges, and tunnels, which ¶ in some cases are already under age-related stress and in need of repair, could be compromised. ¶ Standing water can also have adverse impacts on the road base. (Karl et al., 2009; Smith et al., ¶ 2008) Overall, the increased risk of landslides, slope failures, and floods from runoff will lead to ¶ greater road repair and reconstruction needs (Karl et al., 2009). ¶ Some regions of the country will experience decreased precipitation. Where there is less ¶ precipitation, there may not be enough runoff to dilute surface salt causing steel reinforcing in ¶ concrete structures to corrode. In some regions, drought is expected to be an increasing problem.

### Sea Level Rise

#### Rising sea levels devastates coastal TI. This evidence cites multiple examples

Caldwell et al, Federal Highway Administration 9

(Harry Caldwell, Kate H. Quinn, Jacob Meunier, John Suhrbrier, and Lance Grenzeback, Govenrment Climate document, “Potential Impacts of Climate Change on Freight Transport”, 1/7/9, <http://climate.dot.gov/documents/workshop1002/caldwell.pdf>)

The most serious and costly water-related ¶ impacts of climate change are likely to be ¶ coastal flooding that would result from increased ¶ flood frequencies and flood elevations. The risk ¶ of damage to low-lying port facilities, locks, ¶ airports, roads, rail lines, tunnels, pipelines, ¶ ventilation shafts, and power lines is particularly ¶ great because of the large number of fright ¶ facilities – international gateways in particular – ¶ that are concentrated on the Atlantic, Pacific, ¶ and Gulf Coasts and along inland waterways ¶ (Figure 8). The transport infrastructure of low-lying ¶ port cites, such as New York, Boston, ¶ Charleston, Miami, New Orleans, Texas City, ¶ San Jose, and Long Beach, could be particularly ¶ at risk. For example, New York’s La Guardia ¶ Airport, which is less than seven feet above sea ¶ level, already maintains a dike and pumps for ¶ floodwaters. Newark International and John F. ¶ Kennedy International Airports are about 10 feet ¶ above sea level. In 2000, JFK was the country’s ¶ largest foreign trade gateway measured by value. ¶ Building higher retaining walls around floodprone airports is generally not a viable option, as ¶ these would interfere with aircraft takeoff and ¶ landing. ¶ At least four New York tunnels – the ¶ Lincoln, the Holland, the Queens Midtown, and ¶ the Brooklyn Battery (the longest continuous ¶ underwater vehicular tunnel in North America) – ¶ are also potentially subject to flooding, ¶ depending on the extent of sea level rise and ¶ storm surges. Several key freight rail facilities ¶ in New York City are also vulnerable to the ¶ effects of rising sea levels and storm surges, ¶ including the Greenville Yard, the Harlem River ¶ Yard, the Oak Island Yard, and the Express Rail ¶ Terminal. In all, New York City has nearly 600 ¶ miles of waterfront, nearly all of which could ¶ face flood and storm damage. Transportation facilities on the Gulf Coast ¶ are already prone to storm surges and flooding. ¶ On an annual basis, Louisiana, Florida, and ¶ Texas are the top three states in the nation in ¶ terms of the damage they suffer due to ¶ hurricanes and floods. Given the large number ¶ of facilities on the Gulf Coast dedicated to oil ¶ and gas production, distribution, and processing, ¶ the impact of climate change on United States ¶ energy supply could be dramatic. Two-thirds of ¶ the nation’s imported oil shipments enter ¶ through facilities in Texas and Louisiana. These ¶ same two states produce one-quarter of the ¶ nation’s domestic oil and gas supplies from ¶ 4,000 offshore production platforms. ¶ Inland freight facilities are also at risk ¶ (Figure 9). River flooding, rainstorms, and ¶ snowstorms are likely to affect key roadways, ¶ rail lines, and intermodal terminals. Chicago, ¶ the nation’s largest rail hub, is projected to ¶ suffer more frequent extreme weather events, ¶ although the effects of these may be mitigated ¶ by milder winter weather. The impact of climate change on the Great ¶ Lakes and St. Lawrence Seaway could be ¶ particularly dramatic. On the one hand, milder ¶ winters could lengthen the ice-free shipping ¶ season by several weeks, increasing vessel ¶ utilization and reducing the costs of icebreaking. On the other hand, falling water levels ¶ on the lakes will decrease water depths, ¶ necessitating shallower draft vessels, and ¶ therefore less tonnage capacity per trip. Per inch¶ of lost draft, a 740-foot ocean going vessel loses ¶ 100 tons of capacity, and a 1,000-foot bulk ¶ carrier loses 270 tons of capacity. By some ¶ estimates, Great Lakes shipping costs could ¶ increase by 30 percent due to decreased water ¶ levels resulting from climate change. Past ¶ instances of low water levels on the Great Lakes ¶ hint at the seriousness of the problem. Most ¶ recently, in 2000, low water levels forced ¶ carriers into “light loading,” reducing their cargo ¶ tonnage by five to eight percent. ¶ Harbor and channel dredging, the usual ¶ means of mitigating the effects of low water ¶ levels, will not be easy in the Great Lakes; ¶ deepening channels below the 27-foot project ¶ depth will require an authorization and ¶ appropriation from Congress. It will also have ¶ serious environmental impacts, because in some ¶ areas lakebed sediment is contaminated with ¶ mercury, PCBs, and heavy metals that if ¶ disturbed will become suspended in the water. ¶ In others areas, rocky bottoms will require ¶ blasting. On the St. Lawrence Seaway, the ¶ problem of decreasing draft will be no less ¶ acute, especially if the level of the Great Lakes ¶ falls as the level of the Atlantic rises. The ¶ decreasing disparity between water levels in the ¶ Great Lakes and the ocean would cause the flow ¶ of water through the seaway to diminish, and ¶ with it its ability to “self-scour.” If lake levels ¶ fall as much as some predictions suggest, a ¶ modal shift from water to rail or truck would be ¶ likely. While this might be good news for road ¶ and rail haulers, the maintenance costs on ¶ highways and rails would likely increase, given ¶ the heavier and bulkier loads traditionally ¶ carried by barge. ¶ Rising ocean levels and declining flows ¶ could also pose problems on the Mississippi ¶ River system, which handles a large percentage ¶ of the country’s bulk commodities, such as grain ¶ and coal. The result would be more water ¶ diversions and salt intrusion, and possibly the ¶ disappearance of much of the Mississippi Delta. ¶ This would necessitate a new shipping outlet to ¶ the Gulf. Droughts and floods would also ¶ disrupt traffic on the Mississippi. In 1988, low ¶ water levels prevented the movement of 800 ¶ barges in the river for several months. In 1993 ¶ and 1997, flooding again disrupted barge traffic ¶ and prevented ships from reaching the port of ¶ New Orleans for several days.

#### Climate change seriously deteriorates roads

Austroads, 4 (Austroads, road transport and traffic authorities of Australia and New Zealand, “Impact of Climate Change on Road Infrastructure, http://www.bitre.gov.au/publications/2004/files/cr\_001\_climate\_change.pdf)

A wetter climate leads to a higher rate of pavement deterioration, both as function of time and as a function¶ of the load in equivalent standard axles (ESAs). For modelling purposes, climate is represented by the ¶ ‘Thornthwaite moisture index’, which is a function of precipitation, temperature and potential evapotranspiration. The latter depends on a range of factors including temperature and length of daylight hours.¶ Across Australia, the index varies from +100 on Cape Yorke Peninsula to –50 in central Australia. ARRB¶ TR used the CSIRO data to adjust values of index for climate change. Index values were interpolated for¶ locations on the National Highway System. Roads in areas with higher value for the Thornthwaite index will¶ deteriorate faster than those with a lower value for the same traffic loading.

#### Changes in rainfall, temperature, evaporation, and sea level destroy roads

Serrao-Neumann et al, 11 (Silvia Serrao-Neumann, PhD in Philosophy, Research Fellow at Griffith University; Darryl Low Choy, Bachelor of Arts, Doctor of Philosophy, Professor at Griffith University; Rudi van Staden, Bachelor of Automotive Engineering, PhD, Research Fellow at Griffith School of Engineering; Florence Crick, PhD in Philosophy, Research Fellow at Griffith University; Oz Sahin, Bachelor of Engineering, Research Fellow at Griffith School of Engineering; Hong Guan, Engineering, PhD, Asociate Professor at Griffith Shool of Engineering; Gary Chai, Senior Research Fellow at Griffith School of Engineering; “Climate Change Impacts On Road¶ Infrastructure Systems and Services in South¶ East Queensland: Implications For¶ Infrastructure Planning and Management;” 12/21/11; http://soac2011.com.au/files/papers/SOAC2011\_0144\_final.pdf)

Climate change impacts on the road network demand a re-think about how roads are designed,¶ constructed and maintained (Tighe, 2008), particularly due to potential effects on road pavement. For¶ example, changes in average rainfall, temperature and evaporation patterns can alter the moisture¶ balances in the pavement foundation. Further, the rise in the water table due to rising sea level can¶ lead to the reduction of the structural strength of the pavement (Doré et al, 1997). Additionally, a rise¶ in air temperature can accelerate the ageing of road surfacing bitumen layers (Ahmad et al, 1998;¶ Masad et al, 1996). Consequently, climate change is likely to have impacts on the pavement¶ performance and influence the rate of pavement deterioration.

#### A slight oceans rise destroys over 1000 km of road

Serrao-Neumann et al, 11 (Silvia Serrao-Neumann, PhD in Philosophy, Research Fellow at Griffith University; Darryl Low Choy, Bachelor of Arts, Doctor of Philosophy, Professor at Griffith University; Rudi van Staden, Bachelor of Automotive Engineering, PhD, Research Fellow at Griffith School of Engineering; Florence Crick, PhD in Philosophy, Research Fellow at Griffith University; Oz Sahin, Bachelor of Engineering, Research Fellow at Griffith School of Engineering; Hong Guan, Engineering, PhD, Asociate Professor at Griffith Shool of Engineering; Gary Chai, Senior Research Fellow at Griffith School of Engineering; “Climate Change Impacts On Road¶ Infrastructure Systems and Services in South¶ East Queensland: Implications For¶ Infrastructure Planning and Management;” 12/21/11; http://soac2011.com.au/files/papers/SOAC2011\_0144\_final.pdf)

First, climate change impacts projected to affect SEQ such as increased temperatures, extreme rainfall events and sea level rise (CSIRO, 2007) are likely to accelerate the degradation of road networks and challenge their design, maintenance and rehabilitation processes (Engineers Australia, n.d; Department of Climate Change and Energy Efficiency, 2011). For example, a sea level rise of 1,1m could place an estimate of 1,000km of road network at risk in SEQ (Department of Climate Change and Energy Efficiency, 2011). Hence the sourcing of more resilient infrastructure operational materials and the building of road infrastructure that allow and support ongoing adaptation are essential to minimise climate change impacts (Zimmerman and Faris, 2010; Mills et al 2007). Further, as increased periods of extreme wet weather can accelerate degradation of roads, additional funds will be required for their repair and rehabilitation (Engineers Australia, n.d.).

#### **Sea- Level rise threatens thousands of miles of roads due to flooding and erosion**

Meyer et. al. 09, (Michael Frederick R. Dickerson Professor, School of Civil and Environmental Engineering, Georgia Institute of Technology, PhD Michael Flood Senior Planner at Parsons Brinckerhoff ¶ Chris Dorney Transportation/Land Use Planner at Parsons Brinckerhoff ¶ Ken Leonard Principal of Cambridge Systematics, ¶ Robert Hyman Associate at Cambride Systematics ¶ Joel Smith expert on climate change policy, lead author of the Intergovernmental Panel on Climate Change 2001 and 2007 assessment report; the latter shared the Noble Peace Prize with former Vice President Al Gore. Vice-President of Stratus Consulting, Boulder, CO. “Climate Change and the Highway System: Impacts and Adaptation Approaches”. National Cooperative Highway Research Program. 5/6/2009 http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-83%2805%29\_Task2-3SynthesisReport.pdf)

In many coastal states, the greatest impacts and largest projected damages to highway ¶ infrastructure will come from sea level rise (CNRA, 2009). Sea level rise will also increase the risk of ¶ coastal flooding and damage to transportation infrastructure: the same storm surge will now have ¶ more elevation because of higher sea levels. Sea level rise is likely to contribute to more frequent ¶ storm-related flooding of roads in coastal floodplains. An estimated 60,000 miles of coastal highway ¶ are already exposed to periodic flooding from coastal storms and high waves (Karl et al., 2009). ¶ Along with the temporary and permanent flooding of roads and tunnels, rising sea levels and storm ¶ surges will likely cause erosion of coastal road bases and bridge supports. ¶ In addition to more frequent and severe flooding, underground tunnels and other low-lying ¶ infrastructure may also experience encroachment of saltwater, which can lead to accelerated ¶ degradation of infrastructure. This can reduce the structure’s life expectancy, increase maintenance ¶ costs as well as the potential for structural failure during extreme events (Peterson et al., 2008; ¶ CSIRO, 2007; New York City Panel on Climate Change, 2009). Underground tunnels and other lowlying infrastructure will experience more frequent and severe flooding. Higher sea levels and storm ¶ surges may also erode the road base and undermine bridge supports. The loss of coastal wetlands ¶ and barrier islands will lead to further coastal erosion due to the loss of natural protection from ¶ wave action (Karl et al., 2009). ¶ Studies from a number of coastal states indicate thousands of miles of major roadway are at risk of ¶ flooding and erosion as climate change and land subsidence combine to produce a relative sea-level ¶ rise (Savonis et al., 2008; Maine DOT, 2009; Heberger, 2009). As coastal roads are flooded more ¶ frequently and for longer periods of time, road closures may become longer and the cost of repair ¶ may rise. These affected roads may need to be protected by raising or rerouting the road (Heberger, ¶ 2009). The significance of the vulnerability of coastal roads is compounded by the fact that many ¶ coastal highways serve as evacuation routes during hurricanes and other coastal storms. These ¶ routes could become seriously compromised and lead to evacuation route delays and stranded ¶ motorists because of rising sea levels (Karl et al., 2009).

#### Climate change poses threat to transportation infrastructure, safety, and economy

FHWA 10’ [Federal Highway Administration, US Department of Transportation, “Regional Climate Change Effects: Useful Information for Transportation Agencies”, http://www.fhwa.dot.gov/environment/climate\_change/adaptation/resources\_and\_publications/climate\_effects/effects03.cfm]

"Climate affects the design, construction, safety, operations, and maintenance of transportation infrastructure and systems. The prospect of a changing climate raises critical questions regarding how alterations in temperature, precipitation, storm events, and other aspects of the climate could affect the nation's roads, airports, rail, transit systems, pipelines, ports, and waterways." CCSP 2008a

The changing climate poses serious challenges to the transportation community, given the community's need to watch over transportation systems and infrastructure designed to last decades or longer. Transportation functions tied to construction, operations, maintenance, and planning should be grounded in an understanding of the environment expected to support transportation facilities. Decisions therefore need to be informed by an understanding of potential future changes in climate… Why should the transportation community care about this information? The impacts of climate change can include weakened bridges and road beds, temporarily or permanently flooded roads, damaged pavements, and changes in road weather that can affect safety and economic activity. Understanding and proactively addressing the potential impacts of climate change can help avoid the potential damage, disruption in service, and safety concerns that climate change may cause.

#### Climate change could also affect winter transport: harsher or shifting conditions could disrupt road travel.

**Department of Transportation - DOT Center for Climate Change and Environmental Forecasting ‘2** [DOT, “The Potential Impacts of Climate Change on Transportation”, October 2002, Federal Research Workshop, <http://climate.dot.gov/documents/workshop1002/workshop.pdf>, AD]

**Wintry weather of any type can produce¶ hazardous roadway conditions and can be a¶ major impediment to effective traffic¶ management.** Snow, freezing rain, freezing¶ drizzle and sleet can **greatly increase crash risk.**¶ Even non-precipitation events such as black ice¶ or roadway frost can greatly reduce vehicle¶ traction and maneuverability. Traffic managers¶ may employ control strategies (e.g., road,¶ bridge, and ramp closures) in an attempt to¶ mitigate some of these conditions. However**, the¶ result** of wintry precipitation on roadways **yields¶ reduced roadway capacity and increased travel¶ time delays.**¶ As stated in earlier sections, there may be a net¶ increase in freezing precipitation over certain¶ parts of the country due to projected atmospheric¶ warming. This may impact portions of the urban¶ corridor in the northeast. An increase in the¶ frequency of winter storms over the nation’s mid¶ section and east coast may also increase¶ snowfall amounts. Traffic managers of the¶ future would have to plan for the impacts of¶ these possibilities.¶ On the other hand, **a possible trend of warming¶ may reduce the frequency of occurrence of¶ wintry conditions from the Carolinas west across¶ the Tennessee Valley and into the southern¶ plains. In these localities, traffic managers¶ would have to deal with a population that is not¶ accustomed to driving in snow and ice. Traffic¶ managers in these situations may need to restrict¶ roadway access** **more often to minimize crash¶ frequency.**

### **LifeStyle**

#### **Highways are key to our everyday needs- personal mobility and facilitating freight.**

FHA 02 (Federal Highway Administration, part of the US Department of Transportation “2002 Status of the Nation's Highways, Bridges, and Transit: Conditions & Performance” 11/24/02. http://www.fhwa.dot.gov/policy/2002cpr/pdf/ch12.pdf)

Highways form the backbone of America’s transportation system, connecting all regions and States to one¶ another. This extensive highway network is nearly ubiquitous in its reach across America. For example, a¶ survey conducted in 1996 for a U.S. automobile magazine found that no point in the 48 contiguous states isThe Role of Highways and Transit 1-3¶ greater than 30 miles from a paved highway or dwelling. Moving people and goods across this network is¶ critical to meeting the everyday needs of our Nation’s people.¶ America’s highways are striking in their versatility, having been engineered to allow for a wide array of users¶ and vehicles simultaneously. A given stretch of urban interstate freeway might be shared by large commercial¶ trucks and vacationers passing through the area; local workers commuting to jobs in buses, carpools, and¶ private autos; residents running errands or shopping; delivery trucks bringing merchandise to shops or homes;¶ and business people and contractors driving from one customer to another.¶ Highway transportation depends on both public and private inputs and investment. In the United States, most¶ vehicles used on highways are owned and operated by private individuals and firms, while most highway¶ infrastructure is funded and maintained by the public sector. This stands in contrast to freight railroads, where¶ both vehicles and infrastructure are owned by private firms, and to mass transit, which is generally provided¶ by public agencies, either directly or through contracted private operators. Understanding this dual nature¶ of highway travel is important in understanding how public policy affects the efficient use of the¶ highway network.¶ Another key feature of highways, experienced by millions each day, is that they are subject to congestion.¶ High traffic volumes relative to highway capacity (experienced especially during peak travel periods) can lead¶ to reduced travel speeds and stop-and-go traffic, even on freeways (which have controlled access and no¶ traffic signals). Crashes and adverse weather conditions can also temporarily and unpredictably reduce¶ capacity, causing additional travel delay. While these congested periods are generally associated with¶ morning and evening weekday commuting flows, they may also coincide with weekend shopping, recreational¶ travel, and traffic incidents.¶ Highway transportation in the United States plays a significant role in two major areas: providing personal¶ mobility to households and facilitating freight movement:¶ Personal Mobility. The use of private automobiles on our large highway network provides Americans with a¶ high degree of personal mobility. Automobile transportation allows people to travel where they want, when¶ they want, and with whom they want. The freedom accorded by autos and highways accounts in large part¶ for the enormous popularity of automobile travel, leading to the high rates of automobile ownership and use¶ found in the United States.¶ Freight Movement. Highways are a key conduit for freight movement in the United States, accounting for 54¶ percent of total freight transport by weight (and 83 percent by value) in 1998. Highways can be used for¶ hauls of virtually any length, from coast-to-coast shipments to short mail and parcel delivery trips. While¶ technological and legal limits on truck size make other modes (such as railroads and barges) more suitable for¶ long-distance movements of bulk commodities, highways are important for drayage movements between¶ terminal facilities (such as ports and railheads).

#### Roads are critical to the entire US lifestyle.

Bragdon 08 (Clifford R. Vice President for Strategic Initiatives and Executive Director of the Florida Tech Research Park at Florida Institute of Technology. Former Associate Provost and Dean of the University of Florida. Former Distinguished Professor and Executive Director of the Center for Intermodal Transportation Safety and Security, CITSS, (a consortium of all public universities in Florida), established and funded by the U.S. Congress. Former Director and Vice-President of the National Aviation and Transportation Center and Dean for the School of Aviation and Transportation at Dowling College, Long Island, New York. Transportation Security. 2008 Published by Elsevier-Academic and Butterworth Press)

Twenty-four hours a day, seven days a week (24/7), road transportation touches the lives of nearly every citizen of the United States, including everyone who commutes to a job site, rides a bus, or hauls freight. The highways involve even more. Virtually every item in a person's house or place of employment and in shopping malls, department stores, or supermarkets spent time in a truck and traveled into that person's life via one of our nation's highway systems. Our road transportation system serves to unify America and sustain the American way of life, and without it, the world stops.

# Solvency

### Investment

#### We must incorporate climate risk analysis into all infrastructure investment plans.

NTPP ‘9 (National Transportation Policy Project, Bipartisan coalition of transportation policy experts, business and civic leaders, and is chaired by four distinguished former elected officials who served at the federal, state, and local levels, Published December 15 2009, Bipartisan Policy Center, <http://bipartisanpolicy.org/sites/default/files/Transportation%20Adaptation%20(3).pdf>)

Incorporate climate risk analysis into Federal ¶ Infrastructure Investment policies. Revise Federal ¶ Infrastructure Investment Executive Order(s) ¶ to explicitly incorporate climate-related risk ¶ analysis into infrastructure investment plans and ¶ decision-making. This could include developing ¶ inventories of transportation facilities vulnerable to climate change, and developing updated ¶ construction standards to address transportation ¶ and other infrastructure in vulnerable locations. cConduct a federal interagency assessment to develop and prioritize a climate adapta tion research, ¶ data, and policy agenda. This could be an important precursor to funding of a recommended ¶ interagency, interdisciplinary, long-term, ¶ national climate-adaptation research program in ¶ transportation and climate legislation this year.

#### Incorporating climate considerations into transportation legislation solves in the short term.

NTPP ‘9 (National Transportation Policy Project, Bipartisan coalition of transportation policy experts, business and civic leaders, and is chaired by four distinguished former elected officials who served at the federal, state, and local levels, Published December 15 2009, Bipartisan Policy Center, <http://bipartisanpolicy.org/sites/default/files/Transportation%20Adaptation%20(3).pdf>)

Near-term planning actions focus on the immediate¶ steps needed to integrate climate change¶ into the transportation planning process: revising¶ planning process requirements, establishing¶ long-term scenario planning that looks beyond¶ the current federally-mandated planning horizon,¶ beginning the process of inventorying transportation¶ facilities at risk from climate change, and¶ integrating climate impact considerations into¶ emergency planning.¶ 􀁂􀀀 Revise planning process requirements in the next¶ surface transportation authorization bill to address¶ climate considerations. Legislative action or guidance¶ should address the incorporation of climate¶ change considerations — both emissions mitigation¶ and adaptation — in the planning process.¶ This may be accomplished by adding climate¶ change as a distinct planning factor, requiring¶ and supporting cross-agency consultation among¶ climate science agencies, transportation agencies,¶ resource agencies and local governments; and/¶ or specifying that climate measures be included¶ as part of a performance-based planning and¶ program approach. Lead agency: DOT

### Maintenance and Hardening

NTPP ‘9 (National Transportation Policy Project, Bipartisan coalition of transportation policy experts, business and civic leaders, and is chaired by four distinguished former elected officials who served at the federal, state, and local levels, Published December 15 2009, Bipartisan Policy Center, <http://bipartisanpolicy.org/sites/default/files/Transportation%20Adaptation%20(3).pdf>)

The adaptation responses described above can be ¶ thought of as lying on a continuum of planning ¶ and investment choices. Each requires different ¶ management actions and provides different beneﬁts and costs to the agency. The range of adaptation strategies can be divided into four categories ¶ of options: ¶ 1. Manage/Maintain. These strategies assume ¶ that an increasing cost to repair and maintain infrastructure will be experienced due to ¶ increasing stress from severe events. A shorter ¶ service life also is possible due to increased climate stress. An incremental approach of absorbing increased damage into annual maintenance ¶ cycles may be a reasonable and cost-effective ¶ strategy for infrastructure that is at lower risk or ¶ is less signiﬁcant to overall mobility goals.¶ 2. Protect/Harden. These strategies enhance the ¶ resilience of infrastructure through techniques ¶ such as changing design standards (e.g., higher ¶ bridge heights, elevated roadways), building ¶ engineered protection (e.g., levees), developing ¶ or enhancing natural buffers (e.g., wetlands), ¶ etc. Essentially, this approach tries to ensure ¶ that existing and future infrastructure withstands projected changes in climate. It is most ¶ appropriate for critical infrastructure that is at ¶ risk and needs to stay in operation.¶ 3. Develop Redundant Services. These strategies ¶ prepare for intermittent loss of service by developing alternate routes or services to maintain ¶ continuity of travel when service is disrupted.¶ 4. Relocate/Abandon. These strategies focus on moving service to lower-risk areas. For instance, ¶ the increasing vulnerability of some coastal areas ¶ may make their continued operation infeasible. ¶ In some ways, this is the most radical option; ¶ transportation corridors have historically rarely ¶ been completely abandoned in the United ¶ States. Of course, as communities and businesses themselves relocate, infrastructure needs ¶ also will shift.¶

### Adaptation key

#### Climate change will destroy all factions of our infrastructure – adapting it is the only way to solve.

Hyman et al ’11 (Rob Hyman and Rebecca Lupes of the Federal Highway Adminstration, David Perlman of the Volpe National Transportation Systems Center, Transportation Research Board, June 2011, http://12.0.47.91/pubs/ec152.pdf#page=18)

The projected effects of climate change could have significant implications for the nation’s¶ transportation system. Rising sea levels, increasingly extreme temperatures, changes in the¶ frequency and intensity of storm events, and accelerating patterns of erosion could damage¶ infrastructure, flood roadways, and disrupt safe and efficient travel. Certain effects, such as sea¶ level rise and increases in storm intensity, present obvious challenges. Storm surge can damage¶ and destroy coastal roadways, rail lines, and bridges and sea level rise will only exacerbate such¶ effects. Rising sea levels can also present flooding risks to underground infrastructure such as¶ subways and road tunnels, allowing water to enter through portals and ventilation shafts. Subtle¶ changes, such as those expected in temperature, will also necessitate changes in the design,¶ construction, and maintenance of infrastructure—for instance, the incorporation of materials and¶ building techniques that can withstand temperature extremes. Some climate change effects may¶ positively impact transportation, as higher average temperatures in certain regions could reduce¶ safety and maintenance concerns associated with snow and ice accumulation. Although¶ mitigating the effects of climate change through reductions in greenhouse gases is an important¶ element of the Federal Highway Administration’s (FHWA’s) climate change strategy, the agency¶ places equal importance on acknowledging that certain changes may require appropriate¶ adaptation strategies.

#### The US shouldn’t be unprepared for climate change like we were in 2010 and 2008. We need to act like the UK to save our infrastructure before it’s too late.

Transportation Research Board of the National Academies ’11 [Transportation Research Board, “ Adapting Transportation to the Impacts of Climate Change”, June 2011, Transportation Research Circular, E-C152, <http://www.trb.org/Publications/Blurbs/165529.aspx> AD]

The cross-sector/departmental approach that is being taken by the U.K. government further demonstrates the linkages and interdependencies between the various sectors, including transportation, energy, water, and communications with respect to climate adaptation. This approach will ensure that adaptation in the transportation sector is not addressed in isolation. A 2010 URS Corporation report has identified two key types of **interdependencies that are likely to have far greater impacts on infrastructure functionality** than individual failures. The first interdependency is cascade failures, which refers to a series of linked impacts or failures, and the second is regional convergences of infrastructure, which, if impacted by an extreme weather event, could have consequences on functionality at a national scale in one or more of the sectors. Ensuring that adaptation is embedded in key policies at the national level, the ACC Program requires each U.K. government department to produce Departmental Adaptation Plans (DAPs). The Department for Transport’s (DfT) DAP highlights what has been done to date to understand and manage climate change related risk and the actions that will be taken in the period between 2010 and 2012. **The** ultimate **aim of the plan is to ensure the delivery of the department’s strategic aim** (“transport that works for everyone”) **through a U.K. transportation system that continues to operate effectively because its infrastructure and operations have been planned, designed, and maintained to be resilient to future climate change**. While not part of the ACC Program or other adaptation initiatives, the U.K. government has also recently been responsible for producing the first U.K. National Infrastructure Plan. The plan outlines the scale of the challenges facing the U.K.’s infrastructure (including energy, transportation, digital communications, floodwater, and waste management) and the major investment required to underpin sustainable growth. **The plan also addresses issues relating to climate adaptation across the range of infrastructure-related sectors, and identifies the need for transportation infrastructure to adapt to climate change in order to provide security and resilience against the increased risk from natural hazards, such as floods and heat waves.**

### Design-Solvency

#### Standards will have to be implemented, including smartgrids, emergency plans, and design codes

Engineering the Future, 11 (Britain’s national academy for engineering; “Infrastructure, Engineering and Climate Change adaptation – ensuring services in an uncertain future,” The Royal Academy of Engineering; February 2011, http://www.raeng.org.uk/news/publications/list/reports/Engineering\_the\_future\_2011.pdf)

Standards in many sectors were designed to withstand really extreme¶ conditions and in some cases may set sufficient standards to deal with¶ climate change effects. However, in telecommunications for example,¶ standards were never not initially developed with energy efficiency in mind.¶ In Ofcom, regulatory impact analysis looks at the energy consumption of¶ the technologies that are being regulated.¶ Smart grids need new standards. They also need smart meters with a user¶ interface to allow high consumption items to be remotely controlled and¶ chargeable appliances to be charged and switched to battery depending on¶ demand on the grid. Implementation is currently being planned, and this¶ functionality should be required.¶ Standards have to be developed to reflect the likely standards of service¶ that are achievable. Realistic standards are needed to prevent frustrated¶ investments. Absolute standards are a risk, potentially setting standards¶ too high. It may be better to allow failure in systems, which can then be¶ restored, rather than demand investment in a completely resilient system.¶ Standards required in the aftermath of an emergency should also be¶ reconsidered. For example, it may be preferable to prioritise the delivery of¶ a non-potable supply of water when the water supply is lost, rather than¶ requiring that a potable supply be reinstated which may take much longer¶ to achieve. Standards should allow partial services to be delivered when¶ circumstances demand it.¶ Design codes and standards will be important in influencing behaviour.¶ Standards can be put in place to limit the amount of water a building uses¶ and require developers to incorporate microgeneration into buildings. Low¶ energy light bulbs and HE boilers are an example where regulation has¶ been successfully introduced to require lower energy systems to be used.

#### Adaptive responses and redesigning key to maintain transportation infrastructure

National Research Council of The National Academies, 8

(NRC, Online Pubs, “Potential Impacts of Climate Change on U.S. Transportation”, 7/18/8,

<http://onlinepubs.trb.org/onlinepubs/sr/sr290.pdf>)

Operational responses are geared to addressing near-term impacts of¶ climate change. To make decisions today about rehabilitating or retrofitting transportation facilities, especially those with long design lives¶ (see Table 4-2 in the previous chapter), transportation planners and¶ engineers must consider how climate changes will affect these facilities¶ 50 years or more from now. Adapting to climate change will also require¶ reevaluation, development, and regular updating of design standards¶ that guide infrastructure design.¶ The purpose of design standards is to provide engineers with guidance¶ on how to construct infrastructure for safe and reliable performance.¶ 6¶ These standards represent the uniform application of the best engineering¶ knowledge, developed through years of experimental study and actual¶ experience. Often they become embedded in regulatory requirements and¶ funding programs.¶ 7¶ Design standards embody trade-offs between performance (e.g., safety, reliability) and cost. Faced with a myriad of factors¶ that can affect performance, engineers typically select the most demanding parameter—the 100-year storm, the heaviest truck, the most powerful¶ wind speed—as the basis for design, thereby building in a safety margin to¶ minimize the chances of failure.¶ Environmental factors are integral to the design of transportation¶ infrastructure. Conditions such as temperature, freeze–thaw cycles, and¶ duration and intensity of precipitation determine subsurface and foundation designs, choices of materials, and drainage capacity. The issue is¶ whether current design standards are adequate to accommodate the climate changes projected by scientists. Table 5-1 provides an assessment by¶ Meyer (2006) of the principal climate-induced changes and their implications for infrastructure design in both the short and long terms. Looking¶ across all climate changes, the author notes that the most dominant impact¶ is on those design elements most associated with forces resulting from¶ water flows. This finding is not surprising in view of the extensive damage¶ to transportation infrastructure and buildings caused by flooding and¶ storm surge in Hurricanes Katrina and Rita. Climate changes, however,¶ will not affect the design of all infrastructure modes equally, a second¶ important observation. For example, wave action is more critical than¶ temperature changes for coastal bridge design. Finally, climate extremes,¶ such as stronger wind speeds, increased storm surges, and greater wave¶ heights, will place the greatest demands on infrastructure because they are¶ likely to push the limits of the performance range for which facilities were¶ designed.

#### 4 areas of change needed to overcome the impacts of climate change – Operations, Design, Land Use, Planning

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Adaptation (as deﬁned by McKeown and Gardner) includes changes in policies and practices ¶ designed to deal with climate threats and risks. ¶ Adaptation can refer to changes that protect livelihoods, prevent loss of lives, or protect economic ¶ assets and the environment.¶ In the context of ¶ transportation, adaptation can be thought of as ¶ the transportation sector’s response to the climate ¶ impacts discussed above: what can or should be ¶ done to help the transportation system respond to ¶ the changing climate?¶ A range of adaptation and resiliency strategies are ¶ necessary to address the various climate change ¶ impacts to the transportation system discussed in ¶ the preceding section. These include both near term and longer-range actions, including: ¶ B Operational. In the short term, changes in ¶ operations and maintenance practices due to ¶ changes in the climate and climate extremes are ¶ necessary and already are happening in some ¶ areas. These responses include incorpo rating ¶ extreme weather events into routine operations, improving collabora tion with weather ¶ and emergency management as part of agency operations, and sharing best practices. Maintenance and asset management practices may ¶ need to be updated to accommodate changes in ¶ environmental factors (changes to freeze/thaw ¶ cycles, for instance).¶ B Design. Design changes to new infrastructure to address future climate condi tions will ¶ mitigate some expected impacts. In the medium ¶ term, changes in design and materials (revision ¶ of design standards to address climate change ¶ impacts, or rehabilitation to meet revised standards) can protect infrastructure from climate ¶ changes. In addition, monitoring and use of ¶ sensor technology can provide advance warning of potential infrastructure failures due to ¶ the effects of weather and climate extremes on ¶ transportation systems.¶ B Land Use. Long-term adaptation strategies ¶ might include changes in land use management ¶ policies in order to reduce risks to people and ¶ transportation infrastructure by avoiding areas ¶ vulnerable to climate change. Changing conditions may necessitate the relocation of existing ¶ infrastructure. Land use also may be utilized to ¶ realize the potential of natural systems (such as ¶ wetland buffers) to reduce risk to both infrastructure and communities.¶ B Planning and Institutional Changes. Institutional changes to integrate consideration of ¶ climate impacts into the transportation planning ¶ and investment decision-making process, along ¶ with more comprehensively incorporating other ¶ planning processes (e.g., economic development and ecological systems), will result in ¶ more resilient and cost-effective transportation ¶ systems. Possible changes that could be made ¶ include: lengthening the planning horizon of the ¶ transportation system past its current twenty- to ¶ thirty-year outlook, introducing risk assessment ¶ and vulnerability analyses, incorporating climate ¶ change into NEPA considerations, and forming new institutional arrangements and partnerships. In the short run, these changes may ¶ be driven by immediate local concerns about ¶ speciﬁc climate factors. For instance, a 2005 ¶ study recommended that the Seattle Department of Transportation synchronize sea-level ¶ rise assumptions among Seattle’s various city ¶ agencies (for instance, in the assumptions made ¶ for construction of seawalls) (Soo Hoo et al., ¶ 2005). In the longer term, a systematic approach ¶ is required to incorporate a range of climate ¶ information into transportation decisions.

### Relocation-Solvency

#### Relocation of TI and economic centers away from coastal/vulnerable areas is key to preventing further damage

National Research Council of The National Academies, 8

(NRC, Online Pubs, “Potential Impacts of Climate Change on U.S. Transportation”, 7/18/8,

<http://onlinepubs.trb.org/onlinepubs/sr/sr290.pdf>)

One of the most effective strategies for reducing the risks of climate change¶ is to avoid placing people and infrastructure in vulnerable locations, such¶ as coastal areas. Chapter 3 described the continuing development pressures¶ on coastal counties despite the increased risk of flooding and damage from¶ storm surge and wave action accompanying projected rising sea levels.¶ Many areas along the Atlantic, Gulf, and Pacific coasts will be affected. Once¶ in place, settlement patterns and supporting infrastructure are difficult to¶ change. In New York City, for example, a major concern of emergency¶ planners is handling the evacuation of some 2.3 million New Yorkers from¶ flood-prone areas in the event of a Category 3 or greater hurricane (New¶ York City Transit 2007). Continued development of such vulnerable areas will only place more communities and businesses at risk and increase the difficulty of evacuation in the event of a major storm

### Assessment-Solvency

#### Infrastructure will need assessment and replacement

Engineering the Future, 11 (Britain’s national academy for engineering; “Infrastructure, Engineering and Climate Change adaptation – ensuring services in an uncertain future,” The Royal Academy of Engineering; February 2011, http://www.raeng.org.uk/news/publications/list/reports/Engineering\_the\_future\_2011.pdf)

Amendments to design standards and operating practices will be required:¶ e.g. it will be important to incorporate adaptation into business-as-usual¶ maintenance routines; adapt to changing climate over the lifetime and¶ replacement cycle of assets, e.g. road surfaces and rail tracks.¶ Adaptation measures should be incorporated into the routine maintenance¶ processes and the lifecycle replacement of assets. Some major¶ infrastructure may require significant investment to meet adaptation¶ requirements, e.g. coastal rail tracks which cannot be moved and may¶ require complex and costly adaptation. New infrastructure will need to¶ be built consistently with adaptation requirements. Infrastructure¶ procurement needs to take future climate and weather conditions¶ into account.

#### **Risk Assessment approach allows for flexibility and constantly updated solutions**

Hodges, Tina, August 2011, Federal Transit Administration “Flooded Bus Barns and Buckled Rails: Public Transportation and Climate Change Adaptation” Tina Hodges, Program Analyst Office Budget and Policy Federal Transit Administration U.S. Department of Transportation <http://www.fta.dot.gov/documents/FTA_0001_-_Flooded_Bus_Barns_and_Buckled_Rails.pdf>

Risk assessment tools developed by governments and non-profits offer transit agencies guidance on how to prioritize climate risks by assessing the likelihood of occurrence and the magnitude of consequence. Key aspects include assessing criticality of transit assets to regional economy, accessibility and emergency evacuation, and identifying thresholds above which impacts are severe (e.g., inches of rain per hour before drainage systems are overwhelmed). Steps generally include 1) identify current and future climate hazards; 2) characterize the risk of climate change on agency infrastructure and operations; 3) link strategies to agency organizational structures and activities; 4) implement adaptation plans; and 5) monitor and reassess. Taking a risk management approach mitigates risk without expensively over-engineering assets. A flexible strategy takes action now but reassesses as new information becomes available—responding to multiple layers of uncertainty regarding future levels of greenhouse gas emissions, how climate hazards will impact transit, and the effectiveness of adaptation strategies [10].

#### **Federal Policy must include Research, planning, design changes, NEPA process and funding to $love effects of GW**

NTPP ‘9 (National Transportation Policy Project, Bipartisan coalition of transportation policy experts, business and civic leaders, and is chaired by four distinguished former elected officials who served at the federal, state, and local levels, Published December 15 2009, Bipartisan Policy Center, <http://bipartisanpolicy.org/sites/default/files/Transportation%20Adaptation%20(3).pdf>)

The previous sections highlight the need for adaptation planning at the national, state, and local ¶ levels to address the potential impacts of climate ¶ change on the nation’s transportation infrastructure. A wide range of policy options have ¶ been presented in the literature regarding adaptation approaches to deal with the impacts of ¶ climate change, as shown in Table 2.1 (see page ¶ 28). For our purposes, these policy options can be ¶ thought of as addressing one of ﬁve different areas:B Research. A summary of the policy options ¶ underscores the need for further research to ¶ develop successful approaches to adaptation. ¶ Research needs span both the climate science ¶ and transportation arenas and include: applied ¶ studies — such as the development of methods ¶ for transportation practitioners to inventory ¶ transportation assets, the development of a ¶ climate data clearinghouse for use by transportation agencies, and more advanced climate ¶ research to develop more accurate “downscaled” ¶ regional models that can provide outputs for ¶ the diverse range of geographies across the nation. Another critical research need cited is for ¶ improved monitoring technologies to provide ¶ transportation ofﬁcials with advance warning ¶ of potential structural failures due to climate ¶ change impacts.¶ B Planning. Climate risks and adaptation options ¶ need to be integrated into the transportation ¶ planning process. Because of the important role ¶ of state and local governments in the operations ¶ and maintenance of the transportation system ¶ in the nation, there is an increased need to ¶ encourage cross-disciplinary coordination and ¶ collaboration among the various government ¶ agencies, as well as with the private sector (for ¶ example, the private sector railroad operators ¶ who own and maintain the majority of the ¶ nation’s rail network). Another key policy option is the expansion of planning timeframes ¶ that agencies would need for incorporating the ¶ impacts of climate change into their long-range ¶ vision plans. The timeframes generally used ¶ for the federal transportation planning process — 20 to 30 years — are short compared ¶ to the multi-decadal period over which climate ¶ changes occur. While the current timeframe is ¶ realistic for investment planning, agencies need ¶ to consider incorporating longer-term climate ¶ change effects into their visioning and scenario ¶ planning processes that inform their long-range ¶ plans. The literature also identiﬁed a need for ¶ decision support tools to support the planning ¶ process, such as risk assessment tools and adaptive management approaches. ¶ B Design standards. Development of new design ¶ standards also is identiﬁed as a need to incorporate the impacts of climate change into design ¶ and operations. This includes both infrastructure design standards as well as revision of ¶ ﬂood frequency standards to reﬂect climate ¶ projections rather than only historic trend data ¶ (e.g., the 100-year ﬂood may now be a 25-year ¶ ﬂood). Along with new design standards there ¶ is a need to develop ways to share best practices ¶ for adaptation design strategies which state and ¶ local governments can easily access.¶ B Project delivery and the NEPA process. The ¶ fourth category of policy options is the project ¶ delivery and the NEPA process. For example, ¶ by updating federal agency regulations and ¶ procedures pertaining to climate impacts and ¶ adaptation strategies, state, and local agencies can better ensure efﬁciency in adaptation ¶ planning and implementation. A collaborative and ﬂexible approach to the federal permitting ¶ process can allow state and local agencies to ¶ align their efforts.¶ B Funding, performance, and accountability. ¶ The ﬁnal category of policy options revolves ¶ around funding, performance, and accountability. These policy options range from assessing ¶ the long-term costs and beneﬁts of adaptation ¶ measures to developing performance measures ¶ to determining how to prioritize and fund adaptation projects. The funding mechanisms at ¶ the federal and state level can provide incentives ¶ for addressing climate change impacts through ¶ proactive adaptation planning.

#### Research is a prerequisite to successful adaptive T.I. and responses

Joanne R. Potter et al, March 2008, Michael J. Savonis, Virginia R. Burkett U.S. Climate Change Science Program Synthesis and Assessment Product 4.7 “Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: Gulf Coast Study, Phase I” <http://files.library.northwestern.edu.turing.library.northwestern.edu/transportation/online/restricted/200819/PB2008110533.pdf>

The changing climate raises critical questions for the transportation sector in the United States. As global temperatures increase, sea levels rise, and weather patterns change, the stewards of our Nation’s infrastructure are challenged to consider how these changes may affect the country’s roads, airports, rail, transit systems, and ports. The U.S. transportation network – built and maintained through substantial public and private investment – is vital to the Nation’s economy and the quality of our communities. Yet little research has been conducted to identify what risks this system faces from climate change, or what steps managers and policy makers can take today to ensure the safety and resilience of our vital transportation system.

#### Risk Assessment key to identify endangered structures

Joanne R. Potter et al, March 2008, Michael J. Savonis, Virginia R. Burkett U.S. Climate Change Science Program Synthesis and Assessment Product 4.7 “Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: Gulf Coast Study, Phase I” <http://files.library.northwestern.edu.turing.library.northwestern.edu/transportation/online/restricted/200819/PB2008110533.pdf>

Ultimately, the purpose of a risk assessment approach is to enhance the resilience of the transportation network. Analysis of these factors can help transportation decision makers identify those facilities most at risk and adopt adaptation strategies to improve the resilience of facilities or systems. Structures can be hardened, raised, or even relocated as need be, and – where critical to safety and mobility – expanded redundant systems may be considered as well. What adaptation strategies are employed, and for which components of the system, will be determined considering the significance of specific parts of the network to the mobility and safety of those served, the effects on overall system performance, the cost of implementation, and public perceptions and priorities. Generally speaking, as the importance of maintaining uninterrupted performance increases, the appropriate level of investment in adaptation for high-risk facilities should increase as well. This study does not make recommendations about specific facilities or adaptation strategies, but rather seeks to contribute to the information available so that States and local communities can make more informed decisions.

### Research-Solvency

#### Congress should fund climate research

BPC, 09 (Bipartisan Policy Center; non-profit and politically-balanced organization, public policy think tank; “New Study Recommends Climate Adaptation Policies for Transportation Infrastructure;” 12/15/09 http://bipartisanpolicy.org/news/press-releases/2009/12/new-study-recommends-climate-adaptation-policies-transportation-infrastr)

Recommendations to Congress include:¶ Fund climate research. Authorize funding for the U.S. DOT and its Climate Center to fully participate in a multi-agency, interdisciplinary, climate adaptation research program. This program would engage both the transportation and climate research communities, with research priorities determined by the information and modeling needs of decision-makers at state and local transportation agencies. This research should include development of advanced climate modeling and integrated climate data and projections, infrastructure and system design standards to improve resilience of transportation in the face of climate change, and risk analysis tools geared towards integrating climate projections with transportation planning needs.

#### DOT cooperation with $cientific agencies key

NTPP ‘9 (National Transportation Policy Project, Bipartisan coalition of transportation policy experts, business and civic leaders, and is chaired by four distinguished former elected officials who served at the federal, state, and local levels, Published December 15 2009, Bipartisan Policy Center, <http://bipartisanpolicy.org/sites/default/files/Transportation%20Adaptation%20(3).pdf>)

In addition, an assessment of the lead federal¶ agencies best equipped to implement the recommendations¶ is included with the recommendations.¶ A strong federal partnership of DOT¶ working with science agencies such as NOAA and¶ the U.S. Geological Survey (USGS) will be necessary¶ to implement the research recommendations.¶ DOT is the logical lead agency for transportation¶ planning, project development, transportation¶ design and engineering considerations,¶ and programs and funding. Even among these¶ recommended actions, NOAA and USGS will be¶ essential to the data and mapping recommendations,¶ while FEMA will continue to be the lead¶ agency responsible for flood plain mapping. EPA¶ will also play a critical role in research, data, and¶ tools, as well as in shaping planning and project¶ development guidance.

### Public Transportation Key

#### Megaregions are key to solving transportation problems – Singapore proves

UNFCCC, 06 (United Nations framework Convention on Climate Change; international environmental treaty at the UN, treaty’s objective is to stabilize greenhouse gases that could interfere with the climate system; “Technologies for Adaptation to Climate Change;” 2006; http://unfccc.int/resource/docs/publications/tech\_for\_adaptation\_06.pdf)

The transport sector presents a particular challenge, given the dependence on¶ petroleum-based fuels, prevailing individual transport modes and well-established¶ travel lifestyles. But a number of cities have shown what is possible. Singapore, for¶ instance, has been adapting to the growth of urban transport using a number of¶ measures that will be also relevant for additional pressures resulting from climate¶ change. This includes developing better systems of mass transportation, and trying¶ to reduce the need for travel by creating urban zones that cluster homes, shops and¶ workplaces together.

### Ports-Solvency

#### To protect they’d have to build sea walls

UNFCCC, 06 (United Nations framework Convention on Climate Change; international environmental treaty at the UN, treaty’s objective is to stabilize greenhouse gases that could interfere with the climate system; “Technologies for Adaptation to Climate Change;” 2006; http://unfccc.int/resource/docs/publications/tech\_for\_adaptation\_06.pdf)

For protection, the most visibly reassuring option may be to build hard structures¶ such as sea-walls. But apart from being very expensive these can have damaging¶ side effects, for example by displacing erosion and sedimentation. It may be better¶ therefore to consider soft options that involve restoring dunes or creating or restoring¶ coastal wetlands, or continuing with indigenous approaches such as afforestation.

#### To retreat they’d have to clear a zone

UNFCCC, 06 (United Nations framework Convention on Climate Change; international environmental treaty at the UN, treaty’s objective is to stabilize greenhouse gases that could interfere with the climate system; “Technologies for Adaptation to Climate Change;” 2006; http://unfccc.int/resource/docs/publications/tech\_for\_adaptation\_06.pdf)

For retreat, the simplest approach might be to establish a set-back zone requiring¶ development to be at a specified distance from the water’s edge. And there are also¶ intermediate options in the form of “easements” – legal agreements that restrict the size or density of structures within areas at risk and specify permitted types of shoreline¶ stabilization. The area to which these apply can also be designed to automatically¶ move or “roll” landward as the sea advances.

### Roads-Solvency

#### Repairing highways that are subject to flooding is key to protecting TI from climate changes. New England proves.

National Research Council of The National Academies, 8

(NRC, Online Pubs, “Potential Impacts of Climate Change on U.S. Transportation”, 7/18/8,

<http://onlinepubs.trb.org/onlinepubs/sr/sr290.pdf>)

Under the 2004 Resource Management (Energy and Climate Change)¶ Amendment Act—New Zealand’s principal legislation for environmental ¶ management—Transit New Zealand was required to take into account the¶ effects of climate change as it plans, constructs, and maintains the state¶ highway network (Kinsella and McGuire 2005). The key climate changes¶ of concern to state highways are sea level rise, coastal storm surges, and¶ increased frequency and intensity of heavy rainfall events. The primary assets¶ at risk are bridges, culverts, causeways and coastal roads, pavement surfaces, surface drainage, and hillside slopes.¶ Transit New Zealand proceeded with a two-stage assessment to identify¶ those areas requiring action. Stage 1 involved assessing the need to act¶ now to manage future potential impacts of climate change. Three criteria¶ were used:¶ • Level of certainty that the climate change impact will occur at the¶ magnitude predicted in the specified time frame,¶ • Intended design life of the state highway asset, and¶ • Capacity of the agency’s current asset management practice to manage the impact.¶ The results of the Stage 1 assessment revealed that current asset management practice is generally adequate to deal with impacts of climate change¶ for most of the network, but that bridges and culverts with an intended¶ design life of more than 25 years may require case-by-case consideration¶ to ensure protection (Kinsella and McGuire 2005).¶ Stage 2 involved assessing the economic feasibility of acting now to manage future potential impacts of climate change and was focused on bridges¶ and culverts with design lives of greater than 25 years. Making several simplifying assumptions, the analysis examined three options: (a) doing nothing,¶ (b) retrofitting all existing bridges and culverts now to avoid future climate¶ change impacts, and (c) designing all new bridges and culverts to accommodate future climate changes to 2080. The analysis revealed that it would not¶ be economical to retrofit the existing stock of bridges and culverts, but it would be preferable to repair the assets when a specific loss or need became¶ evident. The primary reasons for this conclusion were uncertainties about¶ where and when the impacts of climate change will manifest themselves and¶ the historical number of bridges and culverts lost prematurely because of¶ other events. Retrofitting all new bridges and culverts to take climate change¶ into account was also determined not to be economical. Nevertheless, the¶ agency decided that, where possible, provision should be made for subsequent retrofitting (either lifting or lengthening the bridge) in the event impacts¶ are experienced. For major bridges (and culverts) where retrofitting is not¶ practical, the structure should be designed for projected future impacts of climate change on the basis of the best available information (Kinsella and¶ McGuire 2005).¶ Transit New Zealand has amended its Bridge Manual to include consideration of relevant impacts of climate change as a design factor. In addition,¶ the agency will continue to monitor climate change data and developments¶ and review its policy when appropriate.

#### Climate change is a threat to the highway system- Federal leadership key to solve.

Meyer et. al. 09, (Michael Frederick R. Dickerson Professor, School of Civil and Environmental Engineering, Georgia Institute of Technology, PhD Michael Flood Senior Planner at Parsons Brinckerhoff ¶ Chris Dorney Transportation/Land Use Planner at Parsons Brinckerhoff ¶ Ken Leonard Principal of Cambridge Systematics, ¶ Robert Hyman Associate at Cambride Systematics ¶ Joel Smith expert on climate change policy, lead author of the Intergovernmental Panel on Climate Change 2001 and 2007 assessment report; the latter shared the Noble Peace Prize with former Vice President Al Gore. Vice-President of Stratus Consulting, Boulder, CO. “Climate Change and the Highway System: Impacts and Adaptation Approaches”. National Cooperative Highway Research Program. 5/6/2009 http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-83%2805%29\_Task2-3SynthesisReport.pdf)

There is a growing consensus amongst academic researchers and highway agencies that ¶ climate change is a threat to many aspects of the highway system which warrants spending ¶ resources to investigate the specific risks it poses. Still, the majority of US highway agencies ¶ remain unaware (or dismissive) of the potential threats and have yet to take any adaptation ¶ actions. ¶ x The lack of engineering relevant and spatially precise climate data and the uncertainty ¶ surrounding those data remain obstacles and will likely remain so for the foreseeable future ¶ despite the best efforts of climate modelers. This should not, however, be an excuse for ¶ inaction. Some governments, such as New York City, realize the data shortcomings issue ¶ and have put forth alternative approaches (e.g. flexible adaptation pathways) to enable ¶ prudent decision making in light of the uncertainty. ¶ x Leadership is critical. Strong national mandates to consider adaptation and provide ¶ relevant data greatly encourage adaptation activities. That said, they need not be a ¶ prerequisite. Absent mandates, strong state or local leadership by individuals concerned ¶ about climate changes can also spur action as is the case in most US examples. Visible on the-ground changes, as in Alaska, can also focus attention on the topic. ¶ x Most agencies that are concerned about adaptation begin by conducting a risk assessment ¶ of existing assets. Most of these risk assessments remain largely qualitative and based on ¶ professional judgment. This will likely remain the case until more probabilistic climate ¶ projections become available. ¶ x Both domestically and internationally, limited action has been taken on the ground thus far ¶ to build climate resiliency into the transportation system. Indeed, with some notable ¶ exceptions, much adaptation work remains at a planning or risk assessment level and has ¶ yet to be incorporated into the design of individual projects. This is likely to change in the ¶ near future as the risk assessment studies progress and the global economy picks up ¶ providing more resources for adaptation. ¶ x Some risk assessments to date have shown the highway system to have only modest ¶ vulnerabilities to climate change. Others have indicated enough cause for concern to ¶ recommend action be taken. Whether an agency chooses to take adaptation action depends ¶ on their fiscal and political capacity to effect change and their level of tolerance for risk. It is ¶ quite possible that separate agencies, facing the same risks, might choose very different ¶ courses of action, especially absent any set of national or industry standards. ¶ x Risks to the highway system due to sea level rise and increased precipitation ¶ amounts/intensity appear to be the biggest cause for concern and amongst the first ¶ priorities for action. NCHRP 20-83 (5) Task 2.3 Synthesis Report ¶ Review of Key Climate Impacts to the Highway System ¶ and Current Adaptation Practices and Methodologies ¶ 75 ¶ Future phases of this project will take note of these observations and build off of them to generate ¶ new techniques for ensuring highway system resiliency as we enter a new period of climate ¶ uncertainty.

#### Other international actors prove that climate change is a real problem.

Transportation Research Board of the National Academies ’11 [Transportation Research Board, “ Adapting Transportation to the Impacts of Climate Change”, June 2011, Transportation Research Circular, E-C152, <http://www.trb.org/Publications/Blurbs/165529.aspx> AD]

**Many countries are taking action to adapt because they already recognize the vulnerability of their transportation infrastructure to climate changes**. The Dutch are building more dunes to protect their low-lying country. They are dredging sand from the bottom of the North Sea about 15 km from shore and piping it to the beach. There, bulldozers create the dunes and broaden the beach, wresting territory from the sea meter by meter. The area behind the existing dikes and dunes is so densely populated there was no room left to extend coastal flood defenses, so they elected to extend the beaches toward the sea—having run out of space, they opted to enlarge the country. Venice, Italy, has been vulnerable to rising water for many years. Venetians drove piles deep through the muck of the lagoon bottom to bedrock deep below. Then they built a city on top of those piles. But extracting industrial water through artesian wells driven into an underlying aquifer has caused the land (and the pilings) to subside. Coupling that with rising sea levels has caused periodic flooding of the city. **Italy is spending $6.35 billion to overcome this problem**. It is building a complex series of 78 mobile barriers across its three inlets that will be inflated when high tides or storms are forecast, causing them to rise and isolate the lagoon from the Adriatic Sea. It is also employing costal reinforcement, the raising of quaysides and paving, and other improvements in the area around the lagoon to reduce the impact of rising waters. **Two states in Germany are in danger of flooding from rising seas**. The state of Schleswig–Holstein is at risk of flooding from the North Sea and Baltic Sea. The length of their North Sea coastline is 553 km. Almost the entire mainland coastline at the North Sea side is protected with a system of sea dikes. **In case of flooding, evacuation is a problem because of the long distance to higher locations.** The height of the dikes is evaluated every 10 years, with respect to the rising sea level. If the evaluation indicates a deficient dike height for a certain stretch, this stretch is reinforced by increasing the height of the dikes to account for a forecasted 2100 sea level. The coastline of the state of Niedersachsen has seven barrier sand islands that protect the coastline. The whole coastline is protected with a system of sea dikes (1143 km total) and flood defenses in river arms and estuaries. The highest dikes have a height of about 9 m. The height line of the protected areas in Niedersachsen is up to 5 m above sea level. FHWA, AASHTO, and NCHRP have initiated a scan to gather information on how other countries are addressing the adaptation of highway infrastructure to the future impacts of climate change. The results of this scan will provide engineers and planners in the United States with new ideas on approaches that they can use in their own communities to adapt transportation to climate changes. **These countries’ efforts include diversity in scope and application, reflecting their varied geographic, environmental, and societal conditions. It is anticipated that this same diversity will allow the scan to identify lessons that match the diversity found in the United States and that can be used to improve U.S. adaptation effort.** The wide-ranging and multidisciplinary implications of climate change on transportation infrastructure require an approach that is multidisciplinary, risk-based, and dynamic and that builds on a relationship of cooperation among varying levels of government. Therefore, the climate change adaptation scan will focus on the following important areas. • Understanding how best to include climate change information in existing or new analysis techniques for planning new infrastructure and maintaining transportation systems. • Assessing how climate change impacts will affect asset management investment cycles and the life cycles of major investments. • Developing pavement, bridge, and other infrastructure design and materials specifications that account for expected climate change impacts, including climate change considerations in hydraulic modeling and design. • Considering climate change adaptation in the transportation planning process. • Developing policies and procedures for inventorying critical infrastructure and assessing vulnerabilities and risks due to climate change impacts. • Developing options for risk analysis frameworks. • Developing data collection standards to inform risk analysis, asset management, and decision making. • Finding opportunities to improve the resiliency of transportation infrastructure naturally, through the benefits of ecosystem services. • Documenting effective management strategies that are able to accommodate the climate change impacts on highway safety and operations.

### Reducing Carbon Emission: Roads

#### Railways are key to carbon reduction. UK proves.

Invensyrail, 11

(Ivensy Rail, Environmental Research, “the current and future carbon efficiency of the European rail industry”, 4/11/11, <http://www.invensysrail.com/whitepapers/I300153_Invensys_EnvironmentalResearch.pdf>)

However, significant further improvement is ¶ possible if the industry takes action itself. A study ¶ recently published by the Rail Safety & Standards ¶ Board¶ 4¶ analysed more than 80 initiatives for energy ¶ efficiency and carbon reduction. In addition we ¶ propose more radical changes, such as further ¶ electrification and increased use of regenerative ¶ braking systems (many of which remain inactive due ¶ to technical and safety limitations). ¶ Figure 1 shows the cost per percentage reduction in emissions ¶ for the most attractive initiatives.¶ What can the rail industry do to ¶ improve its carbon footprint?¶ There are four ‘quick wins’ with relatively low costs, ¶ but material reduction in emissions: ¶ − During non-peak hours, train cars can be ¶ removed to run shorter trains, whilst still ¶ achieving enough capacity, thus reducing ¶ energy use and track wear.¶ − Energy efficient driving can be achieved with ¶ electronic in-cab driver advice to minimise ¶ braking and maximise coasting.¶ − The energy use of stationary trains can be reduced ¶ with intelligent train control systems with ‘load ¶ shedding’, coupled with control centre software.¶ − The drag on rolling stock can be reduced by ¶ adding bogie fairings to existing rail stock, ¶ reducing running resistance.¶ In total, these initiatives would cost only £271m for ¶ the UK. Carbon dioxide emissions would then be ¶ reduced by 23%, and the annual energy savings ¶ would be £68m. The overall payback period is ¶ therefore less than 4 years.

#### Small changes to our roadways can reduce overall carbon emissions of roads by 50%

Chandler (MIT News Office) 11 (David L. Chandler, “Paving the way to greenhouse gas reductions” August 29, 2011, MIT News Office http://web.mit.edu/newsoffice/2011/concrete-pavements-0829.html)

Along with devising a method that others can apply to evaluating choices for a particular construction project, the team came up with some specific suggestions of actions that could improve a road’s life-cycle costs, emissions or both:¶ Increase maintenance work on roadways to keep the surface smoother, thus improving the gas mileage of the cars and trucks that use it. For example, instead of scheduling road maintenance every 20 years, do it every 10 years.¶ When pavement is replaced, pulverizing the old concrete and leaving it exposed for at least a year causes it to absorb carbon dioxide from the air, helping to cancel out part of the emissions released when the cement was produced.¶ Even the color of a road can mitigate its overall effect on Earth’s climate: Lighter roads reflect more sunlight, while darker ones absorb it and get hotter. Just as white roofs can help to reduce warming of the climate, so can lighter pavements — which can be produced by adding lighter-colored aggregate (gravel or crushed rock) to the concrete mixture.¶ Reassess the design criteria for road construction, to account for local and regional differences. Most specifications are now generic, which results in over-engineering many roads, making them stronger than they need to be. Simply reducing the paving thickness in places where this can be done without degrading performance could significantly reduce the amount of cement used, thus reducing both costs and emissions.¶ Add more fly ash, a waste product scrubbed from the emissions of coal-fired powerplants, to the concrete mix. This material is already widely used, but increasing its use could displace more cement powder, which is a highly energy-intensive material to produce.¶ Adding up these measures, Santero says, it’s possible to reduce the overall carbon emissions associated with concrete pavements by about 50 percent, relatively easily.

#### **Permeable pavements reduce $400 billion worth of CO2 emissions**

CCAP, February 2011, The Center for Clean Air Policy “The Value of Green Infrastructure for Urban Climate Adaption” Since 1985, CCAP has been a recognized world leader in climate and air quality policy¶ and is the only independent, non-profit think-tank working exclusively on those issues at¶ the local, national and international levels. Headquartered in Washington, D.C., CCAP¶ helps policymakers around the world to develop, promote and implement innovative,¶ market-based solutions to major climate, air quality and energy problems that balance¶ both environmental and economic interests.

Permeable pavement is made out of materials that allow water to soak back into the¶ ground rather than running over it and into other stormwarter management systems. The¶ goal of permeable pavement strategies is to produce runoff characteristics in cityscapes¶ that are similar to those in a meadow or a forest. Studies have shown that permeable pavement with proper “sub-soiling” (maintenance of a porous layer of soil underneath) can reduce runoff volume by 70 to 90%.52 Permeable pavement in a typical alley can infiltrate 3 inches of rainwater from a 1-hour storm with an infrastructure life expectancy of 30 to 35 years.53 It is typically designed with the capacity to manage a 10-year rain event within a 24-hour period—a standard that will likely need to be adjusted for to account for projected increases in frequency and intensity of storms in the future. Research also indicates that permeable pavement offers other benefits to cities, including reducing the need for road salt application on streets in the winter by as much as 75% and reducing road noise by 10 decibels. In terms of the effects on mitigating the urban heat island effect, permeable pavement tends to be cooler because of its higher reflectivity, lower capacity for absorbing heat, and greater evaporative capacity. Dark pavements absorb 65 to 90% of the sun’s heat while the more reflective permeable pavement absorbs only 25%. Consequently, each 10% increase in total reflective surface present in an urban area lowers the UHI surface¶ temperature by 4°C. A study in Los Angeles showed that by increasing pavement reflectivity alone by 10 to 35% across the city could lead to a 0.8°C decrease in UHI temperature and an estimated savings of $90 million per year from lower energy use and¶ reduced ozone levels. Reduced pavement area and natural vegetation in Davis, CA¶ helped reduce home energy bills by 33 to 50% compared to surrounding¶ neighborhoods.56 Extrapolating to the global potential for energy savings and emission¶ reductions, a 2007 paper estimated that increasing pavement reflectivity in cities¶ worldwide to an average of 35 to 39% could result in global CO2 reductions worth about $400 billion.

#### Road transportation funding is critical- comparative studies.

McMahon 02 ( Joe, President of McMahon Transportation Engineers and Planners “Defense Mobilization: Ensured¶ through the Strategic Highway¶ Network” Vol 6 No 2. Winter/Spring 2002 <<http://www.mcmtrans.com/newsletters/2002/MIMwinterSp02.pdf>>)

Cutting transportation funds is the wrong¶ approach¶ Never has it been more important that we address critical transportation infrastructure needs in this country. May God forbid¶ any major terrorist incident — biochemical or nuclear — which¶ requires fast response via our transportation system. Also ¶ vital to homeland defense is the movement of goods on our¶ transportation systems — almost 90 percent of goods travel ¶ via highways.¶ In a recent L.A. Times op-ed column, John Balzar cited the¶ extended time it takes to get highway projects planned,¶ designed, and constructed. He cited motorists’ $5.8 billion per¶ year maintenance costs due to inadequately maintained roads,¶ estimated by the American Society of Civil Engineers, and ¶ the $78 billion loss to the 1999 economy due to accidents and¶ traffic congestion.¶ He further noted that the defense budget proposes $5.9 billion for bio-terrorism preparations. Last year¶ bio-terrorism killed five people in this¶ country, while 13,000 needless deaths¶ occurred on unsafe roads.¶ The theme of the Institute of¶ Transportation Engineers’ 2002¶ Spring Conference, in Palm Harbor,¶ Florida, is “Meeting Our Customers’¶ Expectations,” with major emphasis¶ on the transportation response to¶ September 11. Our government’s¶ response should be to re-emphasize¶ the critical function of our transportation systems through a¶ continuing and increased funding¶ commitment to making needed¶ improvements. We should not fund¶ one area of homeland defense at the¶ expense of another equally vital area.

### Fed Key

#### The government and private sector can work together with help from NGO’s

UNFCCC, 06 (United Nations framework Convention on Climate Change; international environmental treaty at the UN, treaty’s objective is to stabilize greenhouse gases that could interfere with the climate system; “Technologies for Adaptation to Climate Change;” 2006; http://unfccc.int/resource/docs/publications/tech\_for\_adaptation\_06.pdf)

Action for adaptation can involve many organizations or institutions, but in practice¶ the responsibility tends to fall on the public sector. In coastal zones climate change¶ is likely to affect food and water security, biodiversity, and human health and safety¶ – collective goods and systems for which governments have prime responsibility.¶ Nevertheless, at all stages governments should ensure continuous public consultation.¶ This is mainly because people have a right to participate in the decisions that affect¶ their lives, indeed they will demand it – communities all over the world are becoming¶ increasingly resistant to top-down planning. But local acceptance and cooperation is¶ also vital because most measures will depend on local expertise for implementation¶ and maintenance. And there may be opportunities for more autonomous action¶ by communities, as in Viti Levu, Fiji, where villagers have been actively involved in¶ mangrove rehabilitation.¶ In some cases the private sector may also have an incentive to invest, as would be¶ the case for combating beach erosion at tourist resorts. The private sector could also¶ play a stronger role in transferring technology, given appropriate incentives in the¶ form of investment subsidies or tax relief. And¶ transnational corporations can help develop¶ capacity in the host country if they are required to¶ involve a local partner company.¶ There are also opportunities for non-governmental¶ organizations. In addition to raising public¶ awareness, they can act as intermediaries –¶ identifying technologies, facilitating investment¶ and providing management, technical and other¶ assistance.

### Emissions Reductions

#### Emissions reductions also reduces the cost of adaptation infrastructure costs

ITF, 2009, International Transportation Forum and the Organization for Economic Cooperation and Development “Reducing Transport GHG Emissions, Opportunities and Costs” Preliminary Findings <http://www.internationaltransportforum.org/Pub/pdf/09GHGsum.pdf>

Transport infrastructure and operations are vulnerable to a changing climate, especially insofar as this concerns changes in sea level, temperature, precipitation, wind strength and storm frequency. Engineering design standards and infrastructure operating practices may need to be modified to account for this and preserve infrastructure adequately from expected weather‐induced degradation. The ultimate scope of potential climate change impacts on transport is highly sensitive to regional and local variables but adaptation to climate change may compete for funds with emissions mitigation. Early emissions reduction from transport can contribute to reduced adaptation costs. Much can still be done to reduce transport CO2 emissions at negative or relatively low net societal costs. This study has analyzed all major published assessments of marginal abatement costs of greenhouse gas emissions. These assessments have examined costs and contribution to CO2 reduction for a number of technology and fuel‐based measures based on a range of assumptions regarding energy prices and baseline conditions. Despite these differences, a consistent finding of these assessments is that many technology and fuel‐related GHG reduction measures in the transport sector are relatively low cost or may even save money over time. This is because many measures have the potential to reduce fuel consumption. These savings increase as fuel prices increase – a likely development over the mid‐ to long-term. However, the studies also generally find that the absolute contribution of low‐cost CO2 abatement from transport will generally be less than that of other sectors – although this varies by region and country.

#### Planning, Design, and Management key to system efficiency

DOT, April 20, 2010. “Transportation’s Role in Reducing U.S. Greenhouse Gas Emissions” Volume 1: Synthesis Report, a report to Congress was prepared by the U.S. Department of Transportation (DOT) Center for Climate Change and Environmental Forecasting, supported by a consultant team led by Cambridge Systematics, Inc.  
Strategies to improve transportation system efficiency seek to optimize the use of the transportation network by improving transportation operations and reducing energy use and GHG emissions associated with a given unit of passenger or freight travel (e.g., person-miles, vehicle-miles, or ton-miles). The collective impact of these strategies is relatively modest compared to vehicle and fuel technology strategies—approximately a 3 to 6 percent reduction relative to baseline 2030 transportation emissions. Unlike vehicle and fuel technology strategies, however, many of these strategies also have significant co-benefits in the form of time-savings to travelers and reduced costs to shippers. Furthermore, they may represent important GHG reduction strategies on a local basis (e.g., in highly congested areas). System efficiency strategies rely largely on the planning, design, operations, and management of transportation systems–-factors within the control of national, state, and local transportation agencies. Efficiency strategies, such as intelligent traffic management, can lower GHG emissions by reducing fuel consumption associated with congestion (estimated at nearly 3 billion gallons per year). Operational efficiencies such as idle reduction, delay reduction, and more efficient routing and scheduling can also achieve benefits in the truck, rail, aviation, and marine sectors.

### **Permafrost**

#### Solutions to this permafrost will require cooperation with Russia

U.S. Arctic Research Commission Permafrost Task Force (2003) “Climate Change, Permafrost, and Impacts on Civil Infrastructure” Special Report 01-03, U.S. Arctic Research Commission, Arlington, Virginia

Climate-change scenarios indicate that human caused, or anthropogenic, warming will be most pronounced in the high latitudes. Empirical¶ evidence strongly indicates that impacts¶ related to climate warming are well underway¶ in the polar regions (Hansen et al., 1998; Morison¶ et al., 2000; Serreze et al., 2000; Smith et¶ al., 2002). These involve air temperature (Pavlov,¶ 1997; Moritz et al., 2002), vegetation¶ (Myneni et al., 1997; Sturm et al., 2001), sea¶ ice (Bjorgo et al. 1997), the cumulative mass¶ balance of small glaciers (Dyurgerov and Meier,¶ 1997; Serreze et al., 2000; Arendt et al., 2002),¶ ice sheets and shelves (Vaughan et al., 2001;¶ British Antarctic Survey, 2002; Rignot and¶ Thomas, 2002), and ground temperature¶ (Lachenbruch and Marshall, 1986; Majorowicz¶ and Skinner, 1997). Many of the potential environmental and socioeconomic impacts of global warming in the¶ high northern latitudes are associated with permafrost, or perennially frozen ground. The effects of climatic warming on permafrost and¶ the seasonally thawed layer above it (the *active¶ layer*) can severely disrupt ecosystems and human infrastructure and intensify global warming (Brown and Andrews, 1982; Nelson et al.,¶ 1993; Fitzharris et al., 1996; Jorgenson et al.,¶ 2001). Until recently, however, permafrost has¶ received far less attention in scientific reviews¶ and media publications than other cryospheric¶ phenomena affected by global change (Nelson¶ et al., 2002).¶ Throughout most of its history, permafrost science in western countries was idiosyncratic,¶ performed by individuals or small groups of researchers, and not well integrated with other¶ branches of cold regions research. Owing to¶ the importance of permafrost for development¶ over much of its territory, the situation in the former Soviet Union was distinctly different, with a large institute in Siberia and departments in the larger and more prestigious universities devoted exclusively to permafrost research.¶ Several factors converged in the late 1980s¶ and early 1990s to integrate permafrost research¶ into the larger spheres of international, systems,¶ and global-change science:¶ Easing of Cold-War tensions facilitated interactions between Soviet and western scientists. Conferences held in Leningrad¶ (Kotlyakov and Sokolov, 1990), Yamburg,¶ Siberia (Tsibulsky, 1990), and Fairbanks¶ (Weller and Wilson, 1990) during the late¶ 1980s and early 1990s were instrumental¶ in achieving international agreements.¶ • Publicity about the impacts of climate warming in the polar regions followed several¶ decades of unprecedented resource¶ development in the Arctic and raised concerns about the stability of the associated infrastructure (Vinson and Hayley, 1990).¶ • The global nature of climate change made apparent the need for widespread cooperation,¶ both within the permafrost research¶ community and between permafrost¶ researchers and those engaged in other¶ branches of science (Tegart et al., 1990).¶ • Permafrost scientists became increasingly¶ aware of the benefits accruing from the¶ development of data archives and free¶ exchange of information (Barry, 1988; Barry¶ and Brennan, 1993). Moreover, the increasingly integrated nature of arctic science demands widespread cooperation and collaboration.¶ Some funding agencies, such as the U.S. National Science Foundation, now require, as a condition of funding, that data be made accessible to all interested parties.¶ U.S. scientists have made major contributions¶ to the study of frozen ground (*geocryology*),¶ particularly since World War II. Useful¶ English-language reviews, many with emphasis¶ on Alaska, have been provided by Muller¶ (1947), Black (1950), Terzaghi (1952), Stearns¶ (1966), Ives (1974), Washburn (1980), Andersland¶ and Ladanyi (1994), Davis (2001), and¶ Hallet et al. (2004). Péwé (1983a) reviewed¶ the distribution of permafrost in the cordillera¶ of the western U.S.; Walegur and Nelson (2003)¶ discussed its occurrence in the northern Appalachians.¶ Péwé (1983c) outlined the distribution¶ of permafrost and associated landforms in¶ the U.S. during the last continental glaciation.¶ Permafrost science employs a complex and¶ occasionally confusing lexicon derived from¶ several languages and scientific disciplines. A¶ brief Glossary and a List of Acronyms at the¶ end of this document provide assistance for navigating unfamiliar terminology. A more comprehensive¶ glossary, published under the auspices¶ of the International Permafrost Association¶ (IPA), is readily available (van Everdingen,¶ 1998).

# 2AC-Topicality

### Transporation Infrastructure Investment

Joanne R. Potter et al, March 2008, Michael J. Savonis, Virginia R. Burkett U.S. Climate Change Science Program Synthesis and Assessment Product 4.7 “Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: Gulf Coast Study, Phase I” <http://files.library.northwestern.edu.turing.library.northwestern.edu/transportation/online/restricted/200819/PB2008110533.pdf>

Transportation is such an integral part of daily life in the United States that few pause to consider its importance. Yet the Nation’s strong intermodal network of highways, public transit, rail, marine, and aviation is central to our ability to work, go to school, enjoy leisure time, maintain our homes, and stay in touch with friends and family. U.S. businesses depend on reliable transportation services to receive materials and transport products to their customers; a robust transportation network is essential to the economy. In short, a sound transportation system is vital to the Nation’s social and economic future. Transportation professionals – including planners, designers, engineers, financial specialists, ecologists, safety experts, and others – work hard to ensure that U.S. communities have access to safe and dependable transportation services. Given the ongoing importance of the Nation’s transportation system, it is appropriate to consider what effect climate change may have on this essential network. Through a regional case study of the central Gulf Coast, this report begins to examine the potential implications of climate change on transportation infrastructure, operations, and services. Investments in transportation are substantial and result in infrastructure that lasts for decades. Transportation plans and designs should, therefore, be carefully considered and well informed by a range of factors, including consideration of climate variability and change.

Winkleman et al, ’12 [Steve Winkleman, Jan Muller, Erica Jue, associated with the CCAP and EESI, “CLIMATE ADAPTATION & TRANSPORTATION Identifying Information and Assistance Needs”, http://files.eesi.org/Climate\_Adaptation\_Transportation.pdf]

Extreme weather events, including coastal storm surges, flooding, heating and freezing, and severe rain, snow, ice, and wind events, as well as changing average conditions and seasonal weather patterns – including, sea level rise, precipitation totals, mean temperatures, evapotranspiration rates, and ecosystem changes, are projected to affect safety, cost-effectiveness, efficiency, and technical feasibility of transportation investment and asset management decisions. These impacts will vary from region to region and may even vary at the local and site scale. Anticipating the consequences of such disruptive changes and planning prudent responses before they become reality will help transportation agencies protect the transportation infrastructure upon which communities, regions, and the national economy depend for the movement of goods and people.

The general nature of potential climate change impacts on transportation has been reasonably well-defined. The specific operational implications for transportation agencies and the broader transportation community, however, are not well understood.

Neumann ’09 – Resources for the Future think tank [Resources for the Future, “Adaptation to Climate Change: Revisiting Infrastructure Norms”, December 2009, Resources for the Future Issue Brief 09-15, <http://www.rff.org/rff/documents/RFF-IB-09-15.pdf>]

The main threats presented by climate change to infrastructure assets include damage or

destruction from extreme events, which climate change may exacerbate; coastal flooding and

inundation from sea level rise; changes in patterns of water availability; and effects of higher

temperature on operating costs, including effects in temperate areas and areas currently

characterized by permafrost conditions. Almost half of the more than $60 billion annual federal infrastructure investment is for highways (in excess of $30 billion annually), with smaller but significant capital expenditures in dams and flood control (about 12 percent of the total), mass transit (about 11 percent), and aviation (about 9 percent). The federal role relative to state, local, and private roles is also highest in the transportation subsector. **The best opportunity for the federal government to** influence and enhance infrastructure’s adaptive capacity is thus in the transportation sector**.** In almost all cases, some adaptive capacity exists to respond to these threats through both public and private sector actions, but adaptive capacity can be significantly enhanced in the public sector by adopting three key policy reforms. 􀁺 First, although most public infrastructure is maintained as a capital asset, with annual operating, maintenance, and repair functions and a periodic replacement schedule, adopting a formal asset management approach could yield immediate benefits **and provide a framework for incorporating climate forecasts to enhance adaptive capacity.** 􀁺 Second, **the location of major capital infrastructure should be mapped against those areas of the country considered most vulnerable to climate stress,** and that information should be used to guide current and future investment in public infrastructure. These results should be actively publicized to most effectively signal the private sector about the expectations and limits of federal infrastructure provision. 􀁺 Third, efforts must begin to update infrastructure design standards to ensure that future infrastructure capital is more resilient to anticipated climate change and extreme events.

Humphrey, Senior Program Officer, TRB Division of Studies and Special Program, 8

(Nancy Humphrey, TRB Special Report, “Potential Impacts of Climate

Change on U.S. Transportation”, May-June 2008, <http://onlinepubs.trb.org/onlinepubs/trnews/trnews256climate.pdf>)

The flooding of coastal roads, railways, transit systems, and runways will be a likely result of a projected¶ global rise in sea level coupled with storm surges and¶ exacerbated by land subsidence in some locations. This¶ flooding represents the greatest potential impact of climate change on North America’s transportation system.¶ The vulnerability of transportation infrastructure¶ to climate change, however, will extend beyond coastal¶ areas. Federal, state, and local governments, in collaboration with owners and operators of infrastructure—¶ such as ports, airports, and private railroads and¶ pipelines—should inventory critical transportation¶ infrastructure, identifying whether, when, and where¶ the projected climate changes may be consequential.¶ Incorporate climate change into investment decisions.¶ Every day, public officials at various levels of government and executives of private companies make¶ short- and long-term investment decisions that have¶ implications for how the transportation system will¶ respond to climate change. Transportation decision¶ makers, therefore, should be preparing now for the¶ projected climate changes.¶ State and local governments and private infrastructure providers should incorporate adjustments for climate change into long-term capital improvement¶ plans, facility designs, maintenance practices, operations, and emergency response plans. A six-step¶ approach for determining appropriate investment priorities is presented in the box on page 23.

Neumann ’09 – Resources for the Future think tank [Resources for the Future, “Adaptation to Climate Change: Revisiting Infrastructure Norms”, December 2009, Resources for the Future Issue Brief 09-15, <http://www.rff.org/rff/documents/RFF-IB-09-15.pdf>, AD]

The American Recovery and Reinvestment Act (ARRA) attempts to address some of these

shortfalls in infrastructure provision; the act authorizes up to $150 billion in infrastructure funding

over three years.4 Most of this funding is focused on the transportation and energy sectors, with

smaller amounts focused on wastewater, drinking water, and flood protection. Some does

consider the impact of climate change on infrastructure operation and demand. For example,

much of the energy infrastructure investments are focused on renewable technologies and

development of a smart grid to accommodate greater reliance on renewables; there is a $1 billion

allocation to the Bureau of Reclamation for water resource development in drought‐likely areas;

and the roughly $4.5 billion allocation to the U.S. Army Corps of Engineers includes upgrades to

flood protection infrastructure, which is perhaps a nod to the likelihood of climate change

increasing flood risks. Nonetheless, virtually no provisions in the transportation funding take

account of the risks of climate change to these resources. The priority instead is on quickly moving

money to maximize the short‐term economic stimulus effect of the spending. As discussed in the next section, this shortcoming in efficiently adapting to climate change is potentially serious,

because shovel‐ready is almost certainly not climate‐ready.

### Transportation Infrastructure Investment-Design

Updating design standards is investment

Neumann ’09 – Resources for the Future think tank [Resources for the Future, “Adaptation to Climate Change: Revisiting Infrastructure Norms”, December 2009, Resources for the Future Issue Brief 09-15, <http://www.rff.org/rff/documents/RFF-IB-09-15.pdf>, AD]

**A longer‐term policy goal is investment in updating design standards**. Some of this work is already happening in Canada (Canadian Standards Association 2005, 2006). The asset management framework described might be usefully deployed, for example, to develop new climate‐ready standards and specifications**. In the United States, it is acknowledged that updating standards is a long process, involving many government, commercial, and nongovernmental standard‐setting organizations** (Meyer 2008; TRB 2008). The potential in using standard‐setting approaches to enhance adaptive capacity is significant, however. Updating flood‐proofing measures in coastal zones, for example, has encouraged innovation in architectural and building practices to improve the resiliency of structures built or rebuilt in high‐risk areas. Similar innovation can be spurred in such areas as materials science, engineering, and construction trades through a continuously updated standard‐setting process that considers forecasts of climate change and variability.

# 2AC-Disads

### AT-Spending

#### Climate adaption is cheaper in the long run

Winkleman et. al, ’12 [Steve Winkleman, Jan Muller, Erica Jue, associated with the CCAP and EESI, “CLIMATE ADAPTATION & TRANSPORTATION Identifying Information and Assistance Needs”, http://files.eesi.org/Climate\_Adaptation\_Transportation.pdf]

Climate adaptation is all well and good, but if proposed measures do not appeal to community self-interest – improving quality of life and enhancing the local economy – they are unlikely to garner the public support necessary for large scale implementation. Steve Winkelman described CCAP’s Growing Wealthier matrix that examines returns on investment, cost savings and quality of life improvements for individuals, business and governments.8 He presented a few examples of how preventative measures yield long-term returns.Preventative measures are cheaper than recovering from a disaster – preparedness is a least-cost strategy. While it might be tempting to climate-proof every community and piece of infrastructure for the worst-case event, we don’t need to and we can’t afford it. Risk-based decision making requires that preventative measures be prioritized based upon risks and available budget.

#### The benefits of revamping our transportation infrastructure to cope with global warming far outweigh the costs.

Transportation Research Board of the National Academies ’11 [Transportation Research Board, “ Adapting Transportation to the Impacts of Climate Change”, June 2011, Transportation Research Circular, E-C152, <http://www.trb.org/Publications/Blurbs/165529.aspx> AD]

The potential **impacts of global warming** on transportation and other built infrastructure **are sufficiently well defined to incorporate climate change into the long-term planning process for transportation systems.** There are new techniques to learn and apply for dealing with problems with deep uncertainty. If we do so, **the marginal cost of adapting to climate change can be readily accommodated**. Further, the profession will have met its obligation to future generations of transportation users.

# 2AC-Counterplans

### States CP 2AC

#### ---50 State Fiat is illegitimate and a voting issue

#### A.  [Non sequitur](https://www.google.com/search?hl=en&biw=1218&bih=715&sa=X&ei=RiADUIa3B5KJ2AXZ-amdCw&ved=0CEIQvwUoAQ&q=non+sequitur&spell=1). No policymaker is ever in the position to choose between state or federal policy action. State action is not relevant to the question of whether or not the federal government should increase investment.

#### B. Education. The states counterplan distorts the topic by pushing affirmatives to peripheral areas like territories and federal lands. This crushes topic specific education.

#### C. Ground. The counterplan fiats through critical solvency arguments. After all, the critical warrant for most federal action is state inaction.

#### ---Perm-Do Both----Only federal leadership can overcome institutional barriers-Extend our National Transportation Policy Project evidence from the 1AC. The complexity of investment that requires coordination at the local, state, regional and national level requires federal action.

#### ---Federal Investment Key

#### A. Federal Infrastructure Projects-The CP doesn’t alter existing infrastructure projects at the federal level-This guts solvency

NTPP ‘9 (National Transportation Policy Project, Bipartisan coalition of transportation policy experts, business and civic leaders, and is chaired by four distinguished former elected officials who served at the federal, state, and local levels, Published December 15 2009, Bipartisan Policy Center, <http://bipartisanpolicy.org/sites/default/files/Transportation%20Adaptation%20(3).pdf>)

Near-term planning actions focus on the immediate¶ steps needed to integrate climate change¶ into the transportation planning process: revising¶ planning process requirements, establishing¶ long-term scenario planning that looks beyond¶ the current federally-mandated planning horizon,¶ beginning the process of inventorying transportation¶ facilities at risk from climate change, and¶ integrating climate impact considerations into¶ emergency planning.¶ 􀁂􀀀 Revise planning process requirements in the next¶ surface transportation authorization bill to address¶ climate considerations. Legislative action or guidance¶ should address the incorporation of climate¶ change considerations — both emissions mitigation¶ and adaptation — in the planning process.¶ This may be accomplished by adding climate¶ change as a distinct planning factor, requiring¶ and supporting cross-agency consultation among¶ climate science agencies, transportation agencies,¶ resource agencies and local governments; and/¶ or specifying that climate measures be included¶ as part of a performance-based planning and¶ program approach. Lead agency: DOT

#### B. Assessment-Lack of federal assessment to guide new investment will undermine adaptation efforts

BPC, 10 (Bipartisan Policy Center; non-profit and politically-balanced organization, public policy think tank; “Transportation Adaptation to Global Climate Change;” 1/21/10; http://bipartisanpolicy.org/sites/default/files/Transportation%20Adaptation%20(3).pdf)

Only the federal government can do the necessary ¶ interdisciplinary climate impact research, data ¶ gathering, modeling and forecasting, mapping, ¶ and structuring of the comprehensive planning ¶ necessary to ensure the resilience of our nation’s ¶ multimodal transportation systems, and the communities and businesses they serve. This federal ¶ legislative session provides a unique opportunity ¶ to address these emerging climate related infrastructure impacts. New federal surface transportation authorization is needed by October 1, 2009 ¶ and both Congressional leaders and the Administration have identiﬁed comprehensive climate and ¶ energy legislation as a priority this year.

#### C. State Politics-State level politics will undermine implementation

Meyer et. al. 09, (Michael Frederick R. Dickerson Professor, School of Civil and Environmental Engineering, Georgia Institute of Technology, PhD Michael Flood Senior Planner at Parsons Brinckerhoff ¶ Chris Dorney Transportation/Land Use Planner at Parsons Brinckerhoff ¶ Ken Leonard Principal of Cambridge Systematics, ¶ Robert Hyman Associate at Cambride Systematics ¶ Joel Smith expert on climate change policy, lead author of the Intergovernmental Panel on Climate Change 2001 and 2007 assessment report; the latter shared the Noble Peace Prize with former Vice President Al Gore. Vice-President of Stratus Consulting, Boulder, CO. “Climate Change and the Highway System: Impacts and Adaptation Approaches”. National Cooperative Highway Research Program. 5/6/2009 http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-83%2805%29\_Task2-3SynthesisReport.pdf)

The adaptation plans developed from these statewide efforts are almost always multi-sector plans,

not transportation plans. Nor is transportation always a priority – issues may rise to the forefront.

The Pennsylvania Climate Impact Assessment Report, for instance, fails to address transportation at

all. Colorado’s Climate Action Plan, for instance, lists 15 adaptation recommendations – of which 14

were related to water resources, which is a pressing concern for that state with the expected

decrease in precipitation and snowpack. Utah, similarly, focused almost entirely on water

resources.

#### ---Public Infrastructure

#### A. Public ownership-The federal government controls key sections of transportation infrastructure. Only the plan can initiate comprehensive adaptation strategies.

Neumann ’09 – Resources for the Future think tank [Resources for the Future, “Adaptation to Climate Change: Revisiting Infrastructure Norms”, December 2009, Resources for the Future Issue Brief 09-15, <http://www.rff.org/rff/documents/RFF-IB-09-15.pdf>, AD]

**The federal government is most heavily involved in funding new and improved infrastructure in**

**the transport, water, and sewer sectors, presenting an** opportunity for adaptation through federal

policy.Federal roles vary by infrastructure subsector and location, however. **Almost all major U.S.**

**road transportation and public transit infrastructure is publicly owned, and much is built with a**

**large share of federal funding and then maintained with state and local resources. The same is**

**true of airports**, but freight rail networks and port facilities are more commonly privately owned

and operated. Energy infrastructure, both generation and transmission, tends to be privately

owned but highly regulated by the public sector. **Large‐scale flood defense infrastructure is most often financed and maintained in the public sector, though often with cost‐sharing from multiple**

**layers of government.**

#### B. Private Investment Signal-Leveraging public transportation assets is key to motivating changes in the private sector. Extend our Neumann evidence from the 1AC. This especially critical to accessing rail and ports.

Neumann ’09 – Resources for the Future think tank [Resources for the Future, “Adaptation to Climate Change: Revisiting Infrastructure Norms”, December 2009, Resources for the Future Issue Brief 09-15, <http://www.rff.org/rff/documents/RFF-IB-09-15.pdf>, AD]

#### Almost all major U.S. road transportation and public transit infrastructure is publicly owned, and much is built with alarge share of federal funding and then maintained with state and local resources. The same is true of airports, but freight rail networks and port facilities are more commonly privately owned and operated. Energy infrastructure, both generation and transmission, tends to be privately owned but highly regulated by the public sector. Large‐scale flood defense infrastructure is most often financed and maintained in the public sector, though often with cost‐sharing from multiple layers of government.

## AT-States Counterplan

#### AT PERM: the plan will coop with states and interact with state departments to ensure adaptive infrastructure and crisis response

RAENG, February 2011, The Royal Academy of Engineering, Britain’s national academy for engineering “Infrastructure, Engineering and Climate Change Adaptation- ensureing services in an uncertain future”

<http://www.raeng.org.uk/news/publications/list/reports/Engineering_the_future_2011.pdf>

The infrastructure should be dealt with as a system of systems. Mechanisms are required to enable Government to make strategic decisions about the infrastructure as a whole. Regulators will need to work together in planning changes required by climate change adaptation. Resilience in one sector is dependent on resilience in another, so modeling infrastructure systems and scenario planning is essential to ensure that vulnerabilities in one sector do not compromise others. Sharing of data and collaboration across the supply chain will be requisite for such systems-level planning.

#### Federal action key to climate adaptation, management of various sectors and systems by the government necessary to prevent cascade failures of infrastructure

RAENG, February 2011, The Royal Academy of Engineering, Britain’s national academy for engineering “Infrastructure, Engineering and Climate Change Adaptation- ensureing services in an uncertain future”

<http://www.raeng.org.uk/news/publications/list/reports/Engineering_the_future_2011.pdf>

Adaptation to climate change requires two forms of response: dealing with long term effects on the infrastructure such as rising sea levels, and developing resilience to acute and extreme weather events such as flash flooding. Extreme events highlight the interdependencies in infrastructure as they are liable to lead to ‘cascade failure’ where the failure of one aspect of infrastructure, such as flood defences, can lead to other failures, e.g. flooded power stations leading to power cuts which thereby affect telecommunications networks. The interdependencies in infrastructure therefore need to be managed well, especially as infrastructure is becoming¶ more interdependent. For example, the smart grid will mean energy¶ systems rely more on ICT, and the electrification of transport systems will¶ mean transport is more reliant on the grid.¶ Resilience is thus required in all sectors to protect against cascade failure¶ and to adapt the infrastructure against a slowly changing climate over the¶ longer term. Managing national infrastructure is a systems issue, requiring¶ collaboration, planning and sharing of information between sectors. Systems resilience, rather than sector resilience, is required to adapt to¶ climate change. Current silos and boundaries must be broken down by culture and any other available levers used to build a picture of the state of the entire infrastructure system and local subsystems. The infrastructure system also requires joined up management within Government, with long-term planning for adapting and maintaining¶ infrastructure, and a regulatory and policy framework which provides the¶ degree of certainty needed for investors. The need for a plan to manage the¶ adaptation programme is urgent, but requires little cost and the plan can¶ be implemented in a measured way over time.

#### The government is already working on climate adaptability infrastructure under ARRA: they are the most experienced actor.

Neumann ’09 – Resources for the Future think tank [Resources for the Future, “Adaptation to Climate Change: Revisiting Infrastructure Norms”, December 2009, Resources for the Future Issue Brief 09-15, <http://www.rff.org/rff/documents/RFF-IB-09-15.pdf>, AD]

**The American Recovery and Reinvestment Act** (ARRA) attempts to address some of these

shortfalls in infrastructure provision; the act **authorizes up to $150 billion in infrastructure funding**

**over three years**.4 Most of this funding is focused on the transportation and energy sectors, with

smaller amounts focused on wastewater, drinking water, and flood protection**. Some does**

**consider the impact of climate change on infrastructure operation and demand**. For example,

much of the energy infrastructure investments are focused on renewable technologies and

development of a smart grid to accommodate greater reliance on renewables; there is a $1 billion

allocation to the Bureau of Reclamation for water resource development in drought‐likely areas;

and the roughly $4.5 billion allocation to the U.S. Army Corps of Engineers includes upgrades to

flood protection infrastructure, which is perhaps a nod to the likelihood of climate change

increasing flood risks. Nonetheless, virtually no provisions in the transportation funding take

account of the risks of climate change to these resources. The priority instead is on quickly moving

money to maximize the short‐term economic stimulus effect of the spending. As discussed in the next section, this shortcoming in efficiently adapting to climate change is potentially serious,

because shovel‐ready is almost certainly not climate‐ready.

## AT: Private CP

#### The federal government is required to undertake such a project as updating our transportation infrastructure to take into account climate change – the private sector wouldn’t be able to do it alone.

Neumann ’09 – Resources for the Future think tank [Resources for the Future, “Adaptation to Climate Change: Revisiting Infrastructure Norms”, December 2009, Resources for the Future Issue Brief 09-15, <http://www.rff.org/rff/documents/RFF-IB-09-15.pdf>, AD]

**A longer‐term policy goal is investment in updating design standards**. Some of this work is already happening in Canada (Canadian Standards Association 2005, 2006). The asset management framework described might be usefully deployed, for example, to develop new climate‐ready standards and specifications**. In the United States, it is acknowledged that updating standards is a long process, involving many government, commercial, and nongovernmental standard‐setting organizations** (Meyer 2008; TRB 2008). The potential in using standard‐setting approaches to enhance adaptive capacity is significant, however. Updating flood‐proofing measures in coastal zones, for example, has encouraged innovation in architectural and building practices to improve the resiliency of structures built or rebuilt in high‐risk areas. Similar innovation can be spurred in such areas as materials science, engineering, and construction trades through a continuously updated standard‐setting process that considers forecasts of climate change and variability.

## AT-Warming CP

#### The international community is taking steps to slow down climate change – we should do the same, but more importantly we need to protect our infrastructure from climate change.

Transportation Research Board of the National Academies ’11 [Transportation Research Board, “ Adapting Transportation to the Impacts of Climate Change”, June 2011, Transportation Research Circular, E-C152, <http://www.trb.org/Publications/Blurbs/165529.aspx> AD]

**Identifying the causes of climate change** **and addressing these causes** through the implementation of mitigation measures **is becoming common practice in policy development around the world**. Adapting to the impacts of climate change is also becoming increasingly important in a policy context. **The United Kingdom** (U.K.) is currently leading the way when it comes to the implementation of climate change policy frameworks by being the first country to **have a legally binding long-term framework to cut carbon emissions by 80%**, enacted through the United Kingdom’s Climate Change Act. The Climate Change Act also sets out the requirements for the country’s response to climate change adaptation and the appropriate actions to be undertaken.

## AT: Cap-and-Trade CP

### Hurts airline industry

#### Cap-and-trade would increase airline costs and decrease the amount of air travel

GAO, 09 (United States Government Accountability Office; the audit, evaluation, and investigative arm of the US Congress; “Aviation and Climate Change: Aircraft Emissions Expected to Grow, but Technological and Operational Improvements and Government Policies Can Help Control Emissions”; June 2009; http://www.gao.gov/new.items/d09554.pdf)

A cap-and-trade program can be designed to cap emissions at different points in the economy. For example, a cap-and-trade program could be designed to cap “upstream” sources like fuel processors, extractors, and importers. Under this approach, a cap would be set on the emissions potential that is inherent in the fossil fuel. The upstream cap would restrain the supply and increase the prices of fossil fuels and thus the price of jet fuel relative to less carbon-intensive alternatives. Alternatively, under a “downstream” program, direct emitters, such as commercial airlines, would be required to hold allowances equal to their total carbon emissions each year. (See fig. 9.) However, economic research indicates that both types of programs would provide commercial airlines with an incentive to reduce their fuel consumption in the most cost-effective way for each airline, such as by reducing weight, consolidating flights, or using more fuel-efficient aircraft, if they were included in such a program. To the extent that airlines would pass along any program costs to customers through higher passenger fares and shipping rates, travelers and shippers could respond in various ways, including by traveling less frequently or using a different, cheaper transportation mode.51

#### Cap-and-trade and emission tax would severely hurt the airline industry

GAO, 09 (United States Government Accountability Office; the audit, evaluation, and investigative arm of the US Congress; “Aviation and Climate Change: Aircraft Emissions Expected to Grow, but Technological and Operational Improvements and Government Policies Can Help Control Emissions”; June 2009; http://www.gao.gov/new.items/d09554.pdf)

Both a cap-and-trade program and an emissions tax would impose costs on the aviation sector and other users of carbon-based fuels. The extent to which the costs associated with an emissions control program are incurred by commercial airlines and passed on will depend on a number of economic factors, such as the level of market competition and the responsiveness of passengers to changes in price. Officials of some industry organizations we met with said that because airlines are in a competitive industry with a high elasticity of demand,65 they are constrained in passing on their costs, and the costs to industry likely will be large. The Association of European Airlines reported that airlines will have very limited ability to pass on the costs of the EU ETS. Furthermore, the International Air Transport Association has estimated that the costs to the industry of complying with the EU ETS will be €3.5 billion in 2012,66 with annual costs subsequently increasing.67 Others we interviewed, however, stated that airlines will be able to pass on costs, and the increases in ticket prices will not be large. For example, the EU estimates that airlines will be able to pass on most of the costs of their compliance with the EU ETS, which will result in an average ticket price increase of €9 on a medium-haul flight.68 However, the revenue generated by the tax or by auctioning allowances could be used to lessen the overall impact on the economy, or the impact on certain groups (for example, low income) or sectors of the economy by, for example, reducing other taxes.69

Finally, according to some airline industry representatives, a program to control greenhouse gas emissions would add to the financial burden the aviation industry and its consumers already face with respect to other taxes and fees. For example, passenger tickets in the United States are subject to a federal passenger ticket tax of 7.5 percent, a segment charge of $3.40 per flight segment, and fees for security and airport facilities (up to $4.50 per airport). In addition, international flights are subject to departure taxes and customs-related fees. However, none of these taxes and fees attempt to account for the cost of greenhouse gas emissions, as a tax or cap-and-trade program would do. In addition, the revenue generated from an emissions tax or by auctioning allowances under a cap-and-trade program, could be used to offset other taxes, thereby lessening the economic impact of the program.

### Doesn’t solve emissions

#### Cap-and-trade would be based off of faulty predictions for emissions – Europe proves

GAO, 09 (United States Government Accountability Office; the audit, evaluation, and investigative arm of the US Congress; “Aviation and Climate Change: Aircraft Emissions Expected to Grow, but Technological and Operational Improvements and Government Policies Can Help Control Emissions”; June 2009; http://www.gao.gov/new.items/d09554.pdf)

In addition, the baseline that is used to project future emissions and set the emissions cap can affect the extent to which a cap-and-trade program will contain or reduce emissions.54 The point in time on which a baseline is set also can influence the environmental benefits of a cap-and-trade program. For example, some environmental interest groups in Europe have claimed that the environmental benefits of including aviation in the EU ETS will be minimal, since the emissions cap will be based on the mean average of aviation emissions from 2004 through 2006, leading to minimal future emissions reductions.55

### Hurts the government

#### Cap-and-trade could hurt the government by forcing them to determine how to allocate the allowances, to oversee trading, and to monitor and enforce the program

GAO, 09 (United States Government Accountability Office; the audit, evaluation, and investigative arm of the US Congress; “Aviation and Climate Change: Aircraft Emissions Expected to Grow, but Technological and Operational Improvements and Government Policies Can Help Control Emissions”; June 2009; http://www.gao.gov/new.items/d09554.pdf)

In addition, industry groups and other experts have raised concerns that a cap-and-trade program could be administratively burdensome to the government, which would need to determine how to allocate the allowances to sources, oversee allowance trading, and monitor and enforce compliance with the program. Generally speaking, an upstream program may have lower administrative costs than a downstream program because it would likely involve fewer emissions sources.

Some members of the aviation industry have said they view open and global cap-and-trade programs positively, although they report that not all types of cap-and-trade programs will work for them. For instance, ICAO and other industry organizations have said they would prefer an open cap-and-trade program (in which airlines are allowed to trade allowances with other sectors and sources) to a closed one (in which airlines are allowed to trade emissions allowances only with one another) because an open program would give airlines more flexibility in meeting their emissions cap. Staff we met with at the Association of European Airlines expressed willingness for aviation to participate in a cap-and-trade program as long as it is global in scope, is an open system, is not in addition to similar taxes, and does not double-count emissions.56 In addition, some industry groups and government agencies we met with said that a global program would best ensure that all airlines would take part in reducing emissions.

### Only popular if global

#### Cap-and-trade would be preferred if it were global

GAO, 09 (United States Government Accountability Office; the audit, evaluation, and investigative arm of the US Congress; “Aviation and Climate Change: Aircraft Emissions Expected to Grow, but Technological and Operational Improvements and Government Policies Can Help Control Emissions”; June 2009; http://www.gao.gov/new.items/d09554.pdf)

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## AT: States CP – Cap-and-Trade Specific

### AT: FG fails

#### Federal government solves best – more powerful and comprehensive

Wang 11 (Ucilia Wang; freelance journalist, writes about renewable energy, former associate editor at Greentech Media and a staff writer at Red Herring, writes for Renewable Energy World, Earth2tech/GigaOm, Forbes, Technology Review (MIT), and PV Magazine; “Why States Are Struggling With Cap-and-Trade Programs;” May 31, 2011; http://gigaom.com/cleantech/why-states-are-struggling-with-cap-and-trade-programs/)

But Christie’s decision sends a bad message. If more states follow New Jersey’s lead and withdraw from the cap-and-trade program, it will add more uncertainty to the cleantech market. There is no federal cap-and-trade program in the U.S., which is why states have taken up the charge. An energy bill with a cap-and-trade component passed the House in 2009 but never gained support in the Senate. But with some states participating in these programs, and some states opting not to participate, the state cap-and-trade programs aren’t as powerful or comprehensive as federal mandates would be.

Note: Christie is Republican New Jersey Governor Chris Christie

## AT: States CP – General

### Federal Action Key

#### Federal government action and investment is key – private sector can’t solve

GAO, 09 (United States Government Accountability Office; the audit, evaluation, and investigative arm of the US Congress; “Aviation and Climate Change: Aircraft Emissions Expected to Grow, but Technological and Operational Improvements and Government Policies Can Help Control Emissions”; June 2009; http://www.gao.gov/new.items/d09554.pdf)

Government-sponsored research into low-fuel consumption and low-emissions technologies can help foster the development of such technologies, particularly in combination with a tax or a cap-and-trade program. Experts we surveyed said that increased government research and development could be used to encourage a number of low-emissions technologies, including open rotor engines and blended wing-body aircraft. According to the Final Report of the Commission on the Future of the United States Aerospace Industry, issued in 2002, the lack of long-term investments in aerospace research is inhibiting innovation in the industry and economic growth. This study also asserted that national research and development on aircraft emissions is small when compared with the magnitude of the problem and the potential payoffs that research drives. Experts we met with said that government sponsorship is crucial, especially for long-term fundamental research, because private companies may not have a sufficiently long-term perspective to engage in research that will result in products for multiple decades into the future. According to one expert we interviewed, the return on investment is too far off into the future to make it worthwhile for private companies. NASA officials said that private industry generally focuses only on what NASA deems the “next generation conventional tube and wing technologies,” which are usually projected no more than 20 years into the future. Furthermore, raising fuel prices or placing a price on emissions through a tax or cap-and-trade program is likely to encourage greater research by both the public and private sectors into low-emissions technologies because it increases the pay off associated with developing such technologies.

## AT: Emissions Tax CP

### Emissions Tax worse than Cap-and-Trade

#### An emissions tax would provide less certainty about reductions than cap-and trade

GAO, 09 (United States Government Accountability Office; the audit, evaluation, and investigative arm of the US Congress; “Aviation and Climate Change: Aircraft Emissions Expected to Grow, but Technological and Operational Improvements and Government Policies Can Help Control Emissions”; June 2009; http://www.gao.gov/new.items/d09554.pdf)

Economic research indicates that an emissions tax is generally a more economically efficient policy tool to address greenhouse gas emissions than other policies, including a cap-and-trade program, because it would better balance the social benefits and costs associated with the emissions reductions. In addition, compared to a cap-and-trade program, an emissions tax would provide greater certainty as to the price of emissions. However, it would in concept provide less certainty about emissions reductions because the reductions would depend on the level of the tax and how firms and consumers respond to the tax.64

## AT: Subsidies CP

### Turn Warming

#### Subsidy programs actually INCREASES warming by encouraging some firms to remain in business longer

GAO, 09 (United States Government Accountability Office; the audit, evaluation, and investigative arm of the US Congress; “Aviation and Climate Change: Aircraft Emissions Expected to Grow, but Technological and Operational Improvements and Government Policies Can Help Control Emissions”; June 2009; http://www.gao.gov/new.items/d09554.pdf)

Although subsidies are similar to taxes, economic research indicates that some subsidy programs can be economically inefficient, and need to be financed (for example, using current tax revenue or by raising taxes). For example, although some subsidy programs could lead to emissions reductions from individual sources, they may also result in an overall increase by encouraging some firms to remain in business longer than they would have under other policies such as an emissions tax.

## AT: Tech Standards CP

### Not economically efficient

#### Emissions standards are not as economically efficient as other reduction approaches

GAO, 09 (United States Government Accountability Office; the audit, evaluation, and investigative arm of the US Congress; “Aviation and Climate Change: Aircraft Emissions Expected to Grow, but Technological and Operational Improvements and Government Policies Can Help Control Emissions”; June 2009; http://www.gao.gov/new.items/d09554.pdf)

Although standards can be used to limit greenhouse gas emissions levels from aircraft, economic research indicates that they generally are not as economically efficient as market-based instruments because they do not effectively balance the benefits and costs associated with the emissions reductions.71 For example, unlike market-based instruments, technology standards would give engine manufacturers little choice about how to reduce emissions and may not encourage them to find cost effective ways of controlling emissions.72 In addition, according to IPCC, because technology standards may require emissions to be reduced in specified ways, they may not provide the flexibility to encourage industry to search for other options for reducing emissions. However, according to EPA, performance standards to address certain emissions from airlines, such as those adopted by ICAO and EPA, gave manufacturers flexibility in deciding which technologies to use to reduce emissions.73 Nonetheless, although performance standards can provide greater flexibility and therefore be more cost-effective than technology standards, economic research indicates that standards generally provide sources with fewer incentives to reduce emissions beyond what is required for compliance, compared to market-based approaches. Moreover, standards typically apply to new, rather than existing, engines or aircraft, making new engines or aircraft more expensive, and as a result, the higher costs may delay purchases of more fuel-efficient aircraft and engines.

Current international aviation standards also may require international cooperation. Because ICAO sets standards for all international aviation issues, it may be difficult for the U.S. government, or any national government, to set a standard that is not adopted by ICAO, although member states are allowed to do so. Industry groups we met with said that any standards should be set through ICAO and then adopted by the United States and other nations and, as mentioned earlier, some environmental groups have petitioned EPA to set such standards.

### NASA currently researching

#### NASA is researching technologies to reduce noise and fuel emissions

GAO, 09 (United States Government Accountability Office; the audit, evaluation, and investigative arm of the US Congress; “Aviation and Climate Change: Aircraft Emissions Expected to Grow, but Technological and Operational Improvements and Government Policies Can Help Control Emissions”; June 2009; http://www.gao.gov/new.items/d09554.pdf)

Various U.S. federal agencies, including NASA and FAA, have long been involved in research involving low-emissions technologies.74 For example, NASA’s subsonic fixed-wing research program is devoted to the development of technologies that increase aircraft performance, as well as reduce both noise levels and fuel burn. Through this program, NASA is researching a number of different technologies to achieve those goals, including propulsion, lightweight materials, and drag reduction. The subsonic fixed-wing program is looking to develop three generations of aircraft with increasing degrees in technology development and fuel burn improvements—the next-generation conventional tube and wing aircraft, the unconventional hybrid wing-body aircraft, and advanced aircraft concepts.75 NASA follows goals set by the National Plan for Aeronautics Research and Development and Related Infrastructure for fuel efficiency improvements76 for each of these generations (see table 6).77

### AT: NASA doesn’t solve

#### NASA claims federal research and development are effective to reduce emissions

GAO, 09 (United States Government Accountability Office; the audit, evaluation, and investigative arm of the US Congress; “Aviation and Climate Change: Aircraft Emissions Expected to Grow, but Technological and Operational Improvements and Government Policies Can Help Control Emissions”; June 2009; http://www.gao.gov/new.items/d09554.pdf)

However, budget issues may affect NASA’s research schedule. As we have reported, NASA’s budget for aeronautics research was cut by about half in the decade leading up to fiscal year 2007, when the budget was $717 million.78 Furthermore, NASA’s proposed fiscal year 2010 budget calls for significant cuts in aeronautics research, with a budget of $569 million. As NASA’s aeronautics budget has declined, it has focused more on fundamental research and less on demonstration work. However, as we have reported, NASA and other officials and experts agree that federal research and development efforts are an effective means of achieving emissions reductions in the longer term.79 According to NASA officials, the research budget for its subsonic fixed-wing research program, much of which is devoted to technologies to reduce emissions and improve fuel efficiency, will be about $69 million in 2009.