### Advantage 1 is the Economy

#### New Environmental Regulations Make It Impossible For Coal to Compete in the Current Market

McCullough 3/5/2013 (Mark, Executive Vice President American Electric Power, AMERICAN ENERGY SECURITY AND INNOVATION; ¶ COMMITTEE: HOUSE ENERGY AND COMMERCE; ¶ SUBCOMMITTEE: ENERGY AND POWER¶ THE NEED FOR REVOLUTIONARY TECHNOLOGY DEVELOPMENT, CQ Congressional Testimony, lexis)

The specifics of EPA’s recently proposed NSPS standards for new EGUs further support our concerns that the CAA is not the proper vehicle to address GHG emissions. The proposed regulations do not represent a balanced or cost-effective solution. For example, EPA has taken the extraordinary step of combining two separate well-established NSPS source categories that set different standards for different fuels for all other types of emissions, and proposed a single NSPS limit for CO2 emissions that applies to all new fossil-fueled EGUs from those two categories.5 The proposal requires that both new coal-fueled and natural gas-fueled EGUs meet a CO2 emissions limit of 1,000 pounds per megawatt-hour (lb/MWh). AEP believes that the proposed regulations are inconsistent with the CAA because they fail to establish standards that can be achieved regardless of the fuel used (a so-called “fuel neutral” standard). Instead, for the first time, EPA has proposed to set one, uniform, performance standard for all sources within the combined EGU source category that is potentially achievable only by units burning fuels with the lowest inherent emissions (i.e., natural gas).6¶ Under the proposed regulations, all new baseload and intermediate demand fossil-fueled EGUs would have to achieve an emission rate equivalent to EPA’s estimate of the emission rate achievable at a new natural gas combined cycle unit. However, due to different fuel characteristics, plant designs, and operational considerations between coal and natural gas power plants, a coal-fueled power plant cannot meet a CO2 emission rate equivalent to natural gas without some form of technology capable of reducing CO2 from the power plant emissions. This proposed regulation is instead fuel discriminatory in that it prevents the construction of any new coal-fueled units without a defined, plausible plan for CCS implementation. CCS is not currently commercially available or economically viable at this time, as described later.

#### Means No New Plants Absent Incentives For Commercialization

Ken Silverstein, Contributor 3/13/2013 @ 8:46AM Coal To Gas Moves Are Generating Economic Waves http://www.forbes.com/sites/kensilverstein/2013/03/13/coal-to-gas-moves-are-generating-economic-waves/

All utilities that own and operate coal-fired fleets must decide whether to retire or to retrofit their aging plants, many of which were built in the 1950s. Multiple federal regulations are now in the pipeline and involve mercury, coal ash and greenhouse gases. That will result in the closing of a cadre of coal plants and the construction of numerous combined-cycle natural gas facilities.¶ “Our analysis shows that switching to cleaner energy sources and investing in energy efficiency often makes more economic sense than spending billions to extend the life of obsolete coal plants,” says Steve Frenkel, director of the Union of Concerned Scientists‘ Midwest office. “Regulators should require utility companies to carefully consider whether ratepayers would be better off by retiring old coal plants and boosting electricity generation from natural gas and renewable energy sources like wind.”¶ Spending billions to upgrade old coal plants is unwise, he continues, saying that as much as 18 percent of the nation’s coal portfolio should be mothballed. That equates to 353 generators in 31 states.¶ While the industry is hoping for delay, action will ultimately be inevitable. Standard & Poor’s says that a third of coal plants are working to comply. Utilities such as Exelon Corp. and PSEG Corp. began ditching their older generators in the 1990s and replacing them with cleaner alternatives.¶ But the ratings agency says that two-thirds of the existing U.S. coal fleet is older than 30 years and must either be retired or retrofitted. The older and smaller facilities are better candidates for closure while the newer and bigger coal plants could be modernized. Coal now supplies about 40 percent of the electricity here while natural gas comprises about 30 percent, says the Energy Information Administration. That could rise to 40-50 percent in 20 years.¶ Coal is responsible for about a third of all carbon dioxide emissions. It also releases double the other pollutants regulated by the Clean Air Act that include sulfur dioxide and nitrogen oxide. When combusted, natural gas produces roughly half the emissions as does coal. But it, too, has its critics who say that the exploration methods are harmful and that more of the national treasure should be invested in sustainable energy.¶ Several utilities have recently announced that they would retire their older coal-fired plants and replace them with those that burn natural gas. The decisions are predicated on federal and state environmental laws as well as prior court cases, not to mention the relative cheap price of natural gas.¶ Georgia Power, a subsidiary of Southern Company, is retiring 2,000 megawatts of fossil-fired generation. Altogether, it will be shedding 15 coal and oil facilities. Five years ago, the parent’s fuel mix consisted of 70 percent coal but now it is 47 percent. That coal configuration will fall further unless technologies that would capture and bury carbon are commercialized.

#### Two Internal Links to the Economy

#### First Is Coal Production

#### Even Conservative Estimates Show That the Phase Out of Coal Collapses The Economy

Fred Upton Chair of the Energy and Commerce Committee in the House of Representatives November 30, 2012 NAM STUDY: EPA Regulations Will Drive Up Manufacturing Costs, Cripple Economic Recovery http://energycommerce.house.gov/blog/nam-study-epa-regulations-will-drive-manufacturing-costs-cripple-economic-recovery

A new study released this week by the National Association of Manufacturers finds major new EPA rules could cost manufacturers hundreds of billions of dollars and eliminate millions of American jobs. The study examines the cumulative impact of EPA’s new layers of red tape that are burdening job creators with high costs and driving up energy prices. The authors warn EPA’s actions will prohibit job creation and investment and could cripple our economic recovery.¶ The report analyzes the cumulative cost of new major EPA rules affecting our nation’s power sector, including the Utility MACT Rule, the Boiler MACT Rule, the Coal Ash Rule, the Coal Combustion Residuals Rule, the Cooling Water Intake Structures Rule, the Cross-State Air Pollution Rule, and the anticipated new National Ambient Air Quality Standards for Ozone.¶ The report finds compliance costs for the six regulations could total up to $111.2 billion by EPA estimates and up to $138.2 billion by industry estimates. Total capital expenditures are projected at $174.6 billion to $539.3 billion according to EPA data and from $404.5 billion to $884.5 billion according to industry.¶ “EPA’s expansion of red tape is strangling job creators and American consumers at a time when they can least afford it. This report offers further evidence that EPA’s policies will hinder our economic recovery and the growth of American manufacturing,” said Energy and Power Subcommittee Chairman Ed Whitfield (R-KY). “Rather than burdening American businesses with high compliance costs and uncertainty, we need commonsense policies that will foster investment and help bring manufacturing jobs back to America.”¶ The Energy and Commerce Committee has been leading the fight against EPA’s regulatory assault on jobs and affordable energy during the 112th Congress. Advancing bipartisan legislation like the Energy Tax Prevention Act, the TRAIN Act, the EPA Regulatory Relief Act, and the Coal Residuals Reuse and Management Act, the committee has offered commonsense solutions to shield job creators and American families from EPA’s costly new rules and destructive overreach.

#### That Spills Over to All Sectors

Steve Goreham January 2, 2013 “Lisa Jackson leaving EPA and path of economic destruction”

http://communities.washingtontimes.com/neighborhood/climatism-watching-climate-science/2013/jan/2/lisa-jackson-leaving-epa-and-path-economic-destruc/

Lisa Jackson, President Obama’s chief of the Environmental Protection Agency, resigned last week. For four years she led our nation down a regulatory path of economic destruction unmatched in the 40-year history of the EPA. New regulations from Jackson’s reign of terror affect power plants, industrial plants, refineries, and vehicles, as well as the cost of almost all goods and services. Unless her policies are rolled back, Americans will pay for decades with higher energy prices, job losses, and economic stagnation in exchange for negligible environmental benefits.¶ In January 2008, during his first presidential campaign, President Obama stated, “So if somebody wants to build a coal-fired plant they can. It’s just that it will bankrupt them because they’re going to be charged a huge sum for all that greenhouse gas that’s being emitted.” When cap-and-trade legislation failed in Congress in 2010, Jackson became Obama’s instrument to destroy the US coal-fired utility industry.¶ President Obama and Lisa Jackson put faith in Climatism, the belief that man-made greenhouse gases are destroying the planet. They trust people like NASA scientist James Hansen, who has characterized coal plants as “factories of death.” Therefore, any and all means must be used to eliminate coal plants and other greenhouse gas sources.¶ Since 2009, the EPA has pursued limits on greenhouse gas emissions. In July 2012, the EPA proposed a limit of 1,000 pounds of carbon dioxide emissions per megawatt of electricity generated for new plants. This limit would prevent construction of coal plants unless “carbon capture” is used, an unproven and expensive technology.¶ The EPA’s Cross-State Air Pollution Rule (CSAPR) was finalized in July 2011, seeking new stringent reductions in sulfur dioxide and nitrogen oxide emissions from power plants. Since 1970, US emissions of sulfur dioxide and nitrogen dioxide have fallen by 56 percent and 40 percent respectively, and continue to fall to low parts-per-billion levels, even though electricity output from coal is higher. But the EPA ignored the ongoing progress, speculating that new regulations were necessary to save hundreds of billions of dollars in health care costs. Up to 576 coal-fired power plants may need retrofit to meet the new standards at a cost approaching $120 billion.¶ In February 2012, the EPA finalized the Utility MACT (Maximum Achievable Control Technology), the first ever regulation of power plant emissions of mercury. Jackson announced the rule at the National Children’s Hospital in Washington, D.C., stating that the rule would “protect our children.” While exploiting children in her announcement, she failed to mention that US mercury emissions were down almost 60 percent from the early 1990s and continue to fall. Nor did she mention that natural emissions of mercury from volcanoes, geysers, and deep-sea vents are 100 times larger than emissions from US power plants. If all mercury emissions are halted from US utilities, the effect on children will be too small to detect. But the Electric Reliability Coordinating Council places the regulation cost at up to $100 billion per year.¶ Coal-fired power plants generated 42 percent of US electricity in 2011. More than twenty states receive at least 50 percent of their electricity from coal plants. The destruction of the coal utility industry will boost the price of electricity for consumers and raise the cost of all goods and services that use electricity.¶ Other major EPA regulations have been hastily introduced with high estimated implementation costs, often in conflict with state regulations. Jackson’s team proposed to designate coal ash as a hazardous substance (cost over $50 billion), despite the fact that 40 percent of coal ash is recycled into bricks, drywall, asphalt and cement. The EPA headquarters was built with cement containing coal ash. The EPA issued a rule to regulate emissions from industrial boilers, at a cost of tens of billions of dollars. The EPA and the Department of Transportation established new vehicle mileage requirements, boosting automobile standards from today’s 26 miles per gallon to 54.5 mpg by the year 2025 (bye-bye minivan). Regulation of hydraulic fracturing of natural gas is next on the ever-expanding EPA regulatory plate, despite the fact that fracking is already covered by other state and federal statutes. The EPA even considered regulations on dust emissions from farms.¶ Expected economic losses from EPA regulation are huge. US Gross Domestic Product could be reduced each year, with losses peaking at $500 billion by 2030. Employment could drop by 2.5 million jobs. Household incomes could decline by $1,200 annually. Low income families, with utility costs a higher share of the household budget, would be hit hardest.¶ The United States has some of the cleanest air and water in the world, both much improved during the last 50 years. The greatest air pollution risk to the average citizen is smoke from their fireplace or campfire. Suppose we step back from the Jackson path of destruction and re-establish common sense in our environmental policy?

#### Second is Natural Gas

#### Market Trends Are Pushing Towards an Overreliance on Natural Gas – Maintaining Coal Production is Key to Energy Diversity

McCullough 3/5/2013 (Mark, Executive Vice President American Electric Power, AMERICAN ENERGY SECURITY AND INNOVATION; ¶ COMMITTEE: HOUSE ENERGY AND COMMERCE; ¶ SUBCOMMITTEE: ENERGY AND POWER¶ THE NEED FOR REVOLUTIONARY TECHNOLOGY DEVELOPMENT, CQ Congressional Testimony, lexis)

AEP believes that it is not prudent for EPA, or any other agency, to adopt federal policies that foreclose the use of coal in the future development of baseload generation. Locking exclusively into new natural gas baseload generation over the long term could increase an over reliance on natural gas for power generation to the detriment of the economy. Rather, maintaining fuel diversity through a balanced portfolio of energy resources that includes coal has been a successful strategy in providing abundant, reliable, low-cost electricity to power the nation’s economic growth and high standard of living. The continued reliance on a diverse portfolio of fuels is clearly the wisest course of action to safeguard against the risk of market price fluctuations of natural gas or any of our energy resources over the long-term. By contrast, foreclosing the option to use of coal over the long-term could burden U.S. consumers with additional and unnecessary costs as U.S. energy providers replace retiring older generation sources and try to keep up with rising demand over the coming years. Further, as EGUs begin to rely more heavily on a single fuel source for electric generation, we run the risk that the energy prices will become increasingly volatile over the long term, with implications for the entire economy.

#### Great power wars

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 stales. Research in this vein has been considered at systemic, dyadic and national levels. Several notable contributions follow. First, on the systemic level. Pollins (20081 advances Modclski 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. 19SJ) that leads to uncertainty about power balances, increasing the risk of miscalculation (Fcaron. 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. Mom berg and Hess (2002) find a strong correlation between internal conflict and external conflict, particularly during periods of economic downturn. They write. The linkage, between internal and external conflict and prosperity are strong and mutually reinforcing. Economic conflict lends 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 (Hlomhen? & Hess. 2(102. p. X9> Economic decline has also been linked with an increase in the likelihood of terrorism (Blombcrg. Hess. & Wee ra pan a, 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), DcRoucn (1995), and Blombcrg. Hess, and Thacker (2006) find supporting evidence showing that economic decline and use of force arc at least indirecti) correlated. Gelpi (1997). Miller (1999). and Kisangani and Pickering (2009) suggest that Ihe tendency towards diversionary tactics arc 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 United States, and thus weak Presidential popularity, are statistically linked lo an increase in the use of force. In summary, rcccni economic scholarship positively correlates economic integration with an increase in the frequency of economic crises, whereas political science scholarship links economic decline with external conflict al systemic, dyadic and national levels.' This implied connection between integration, crises and armed conflict has not featured prominently in the economic-security debate and deserves more attention.

#### Coal-Direct Chemical Looping goes commercial in five years and solves all pollution disads

Koprowski 2-20-13 (Gene, “Coal: The Cleanest Energy Source There Is?” http://www.foxnews.com/science/2013/02/20/coal-cleanest-energy-source-there-is/, Mike)

Researchers have discovered a stunning new process that takes the energy from coal without burning it -- and removes virtually all of the pollution. The clean coal technique was developed by scientists at The Ohio State University, with just $5 million in funding from the federal government, and took 15 years to achieve. “We’ve been working on this for more than a decade,” Liang-Shih Fan, a chemical engineer and director of OSU’s Clean Coal Research Laboratory, told FoxNews.com, calling it a new energy conversion process. “We found a way to release the heat from coal without burning.” The process removes 99 percent of the pollution from coal, which some scientists link to global warming. Coal-burning power plants produced about one-third of the nation’s carbon dioxide total in 2010, or about 2.3 billion metric tons, according to the Environmental Protection Agency (EPA). Retrofitting them with the new process would be costly, but it would cut billions of tons of pollution. “In the simplest sense, conventional combustion is a chemical reaction that consumes oxygen and produces heat,” Fan fold FoxNews.com. “Unfortunately, it also produces carbon dioxide, which is difficult to capture and bad for the environment.” And simply put, the new process isn't. Heating, Not Burning, Coal Fan discovered a way to heat coal, using iron-oxide pellets for an oxygen source and containing the reaction in a small, heated chamber from which pollutants cannot escape. The only waste product is therefore water and coal ash -- no greenhouse gases. As an added benefit, the metal from the iron-oxide can be recycled. “Oxidation” is the chemical combination of a substance with oxygen. Contrast this with old-fashioned, coal-fired plants, which use oxygen to burn the coal and generate heat. This in turn makes steam, which turns giant turbines and sends power down electric lines. The main by-product of that old process — carbon dioxide, known chemically as CO2 — is released through smokestacks into the earth’s atmosphere. Fan’s process, called “coal-direct chemical looping,” has been proven in a small scale lab at OSU. The next step is to take it to a larger test facility in Alabama, and Fan believes the technology can be commercialized and used to power an energy plant within five to 10 years, if all goes smoothly. The technology generated 25 kilowatts of thermal energy in current tests; the Alabama site will generate 250 kilowatts. Can Coal Ever Be 'Clean'? Some environmentalists are skeptical of the technology, and of the idea of clean coal in general. “Claiming that coal is clean because it could be clean -- if a new technically unproven and economically dubious technology might be adopted -- is like someone claiming that belladonna is not poisonous because there is a new unproven safe pill under development,” wrote Donald Brown at liberal think tank Climate Progress. Yet the federal Department of Energy believes that the process can create 20 megawatts to 50 megawatts by 2020, said Jared Ciferno, the agency’s director of coal and power-production research and development, in a statement. The government plans to continue to support the project, as well as the concept of "clean coal" in general. Meanwhile, Fan is exploring the possibility of establishing a start-up company and licensing the process to utilities, and has the potential to patent 35 different parts of the process. Other scientists and experts are enthused about the prospects for this technology. Yan Feng with Argonne National Laboratory's Environmental Science Division, Climate Research Section, called it “an advancement in chemical engineering. “It is very important that we act on CO2 capturing and sequestration as well as emission controls of other warming agents like tropospheric ozone and black carbon." Adds a spokesman for Kingsport, Tenn.-based Eastman Chemical Company, a global Fortune 250 chemical manufacturer that works in clean energy, “researchers continue to uncover innovative ways to use coal efficiently/sustainably.” Concludes Dawei Wang, a research associate at OSU, the technology's potential benefits even go beyond the environment and issues like sustainability. "The plant could really promote our energy independence. Not only can we use America's natural resources such as Ohio coal, but we can keep our air clean and spur the economy with jobs,” he said.

### Advantage 2 is Warming

#### Warming is real and anthropogenic—Skeptics are bought off clowns

Prothero 12 (Donald Prothero, Professor of Geology at Occidental College, Lecturer in Geobiology at CalTech, "How We Know Global Warming is Real and Human Caused," 3/1/12, EBSCO)

How do we know that global warming is real and primarily human caused? There are numerous lines of evidence that converge toward this conclusion. 1. Carbon Dioxide Increase Carbon dioxide in our atmosphere has increased at an unprecedented rate in the past 200 years. Not one data set collected over a long enough span of time shows otherwise. Mann et al. (1999) compiled the past 900 years' worth of temperature data from tree rings, ice cores, corals, and direct measurements in the past few centuries, and the sudden increase of temperature of the past century stands out like a sore thumb. This famous graph is now known as the "hockey stick" because it is long and straight through most of its length, then bends sharply upward at the end like the blade of a hockey stick. Other graphs show that climate was very stable within a narrow range of variation through the past 1000, 2000, or even 10,000 years since the end of the last Ice Age. There were minor warming events during the Climatic Optimum about 7000 years ago, the Medieval Warm Period, and the slight cooling of the Litde Ice Age in the 1700s and 1800s. But the magnitude and rapidity of the warming represented by the last 200 years is simply unmatched in all of human history. More revealing, the timing of this warming coincides with the Industrial Revolution, when humans first began massive deforestation and released carbon dioxide into the atmosphere by burning an unprecedented amount of coal, gas, and oil. 2. Melting Polar Ice Caps The polar icecaps are thinning and breaking up at an alarming rate. In 2000, my former graduate advisor Malcolm McKenna was one of the first humans to fly over the North Pole in summer time and see no ice, just open water. The Arctic ice cap has been frozen solid for at least the past 3 million years (and maybe longer),[ 4] but now the entire ice sheet is breaking up so fast that by 2030 (and possibly sooner) less than half of the Arctic will be ice covered in the summer.[ 5] As one can see from watching the news, this is an ecological disaster for everything that lives up there, from the polar bears to the seals and walruses to the animals they feed upon, to the 4 million people whose world is melting beneath their feet. The Antarctic is thawing even faster. In February-March 2002, the Larsen B ice shelf -- over 3000 square km (the size of Rhode Island) and 220 m (700 feet) thick -- broke up in just a few months, a story -typical of nearly all the ice shelves in Antarctica. The Larsen B shelf had survived all the previous ice ages and interglacial warming episodes over the past 3 million years, and even the warmest periods of the last 10,000 years -- yet it and nearly all the other thick ice sheets on the Arctic, Greenland, and Antarctic are vanishing at a rate never before seen in geologic history. 3. Melting Glaciers Glaciers are all retreating at the highest rates ever documented. Many of those glaciers, along with snow melt, especially in the Himalayas, Andes, Alps, and Sierras, provide most of the freshwater that the populations below the mountains depend upon -- yet this fresh water supply is vanishing. Just think about the percentage of world's population in southern Asia (especially India) that depend on Himalayan snowmelt for their fresh water. The implications are staggering. The permafrost that once remained solidly frozen even in the summer has now thawed, damaging the Inuit villages on the Arctic coast and threatening all our pipelines to the North Slope of Alaska. This is catastrophic not only for life on the permafrost, but as it thaws, the permafrost releases huge amounts of greenhouse gases which are one of the major contributors to global warming. Not only is the ice vanishing, but we have seen record heat waves over and over again, killing thousands of people, as each year joins the list of the hottest years on record. (2010 just topped that list as the hottest year, surpassing the previous record in 2009, and we shall know about 2011 soon enough). Natural animal and plant populations are being devastated all over the globe as their environments change.[ 6] Many animals respond by moving their ranges to formerly cold climates, so now places that once did not have to worry about disease-bearing mosquitoes are infested as the climate warms and allows them to breed further north. 4. Sea Level Rise All that melted ice eventually ends up in the ocean, causing sea levels to rise, as it has many times in the geologic past. At present, the sea level is rising about 3-4 mm per year, more than ten times the rate of 0.1-0.2 mm/year that has occurred over the past 3000 years. Geological data show that the sea level was virtually unchanged over the past 10,000 years since the present interglacial began. A few mm here or there doesn't impress people, until you consider that the rate is accelerating and that most scientists predict sea levels will rise 80-130 cm in just the next century. A sea level rise of 1.3 m (almost 4 feet) would drown many of the world's low-elevation cities, such as Venice and New Orleans, and low-lying countries such as the Netherlands or Bangladesh. A number of tiny island nations such as Vanuatu and the Maldives, which barely poke out above the ocean now, are already vanishing beneath the waves. Eventually their entire population will have to move someplace else.[ 7] Even a small sea level rise might not drown all these areas, but they are much more vulnerable to the large waves of a storm surge (as happened with Hurricane Katrina), which could do much more damage than sea level rise alone. If sea level rose by 6 m (20 feet), most of the world's coastal plains and low-lying areas (such as the Louisiana bayous, Florida, and most of the world's river deltas) would be drowned. Most of the world's population lives in low-elevation coastal cities such as New York, Boston, Philadelphia, Baltimore, Washington, D.C., Miami, and Shanghai. All of those cities would be partially or completely under water with such a sea level rise. If all the glacial ice caps melted completely (as they have several times before during past greenhouse episodes in the geologic past), sea level would rise by 65 m (215 feet)! The entire Mississippi Valley would flood, so you could dock an ocean liner in Cairo, Illinois. Such a sea level rise would drown nearly every coastal region under hundreds of feet of water, and inundate New York City, London and Paris. All that would remain would be the tall landmarks such as the Empire State Building, Big Ben, and the Eiffel Tower. You could tie your boats to these pinnacles, but the rest of these drowned cities would lie deep underwater. Climate Change Critic's Arguments and Scientists' Rebuttals Despite the overwhelming evidence there are many people who remain skeptical. One reason is that they have been fed distortions and misstatements by the global warming denialists who cloud or confuse the issue. Let's examine some of these claims in detail: \* "It's just natural climatic variability." No, it is not. As I detailed in my 2009 book, Greenhouse of the Dinosaurs, geologists and paleoclimatologists know a lot about past greenhouse worlds, and the icehouse planet that has existed for the past 33 million years. We have a good understanding of how and why the Antarctic ice sheet first appeared at that time, and how the Arctic froze over about 3.5 million years ago, beginning the 24 glacial and interglacial episodes of the "Ice Ages" that have occurred since then. We know how variations in the earth's orbit (the Milankovitch cycles) controls the amount of solar radiation the earth receives, triggering the shifts between glacial and interglacial periods. Our current warm interglacial has already lasted 10,000 years, the duration of most previous interglacials, so if it were not for global warming, we would be headed into the next glacial in the next 1000 years or so. Instead, our pumping greenhouse gases into our atmosphere after they were long trapped in the earth's crust has pushed the planet into a "super-interglacial," already warmer than any previous warming period. We can see the "big picture" of climate variability most clearly in ice cores from the EPICA (European Project for Ice Coring in Antarctica), which show the details of the last 650,000 years of glacial-inters glacial cycles (Fig. 2). At no time during any previous interglacial did the carbon dioxide levels exceed 300 ppm, even at their very warmest. Our atmospheric carbon dioxide levels are already close to 400 ppm today. The atmosphere is headed to 600 ppm within a few decades, even if we stopped releasing greenhouse gases immediately. This is decidedly not within the normal range of "climatic variability," but clearly unprecedented in human history. Anyone who says this is "normal variability" has never seen the huge amount of paleoclimatic data that show otherwise. \* "It's just another warming episode, like the Medieval Warm Period, or the Holocene Climatic Optimum or the end of the Little Ice Age." Untrue. There were numerous small fluctuations of warming and cooling over the last 10,000 years of the Holocene. But in the case of the Medieval Warm Period (about 950-1250 A.D.), the temperatures increased only 1°C, much less than we have seen in the current episode of global warming (Fig. 1). This episode was also only a local warming in the North Atlantic and northern Europe. Global temperatures over this interval did not warm at all, and actually cooled by more than 1°C. Likewise, the warmest period of the last 10,000 years was the Holocene Climatic Optimum ( 5,000-9,000 B.C.E.) when warmer and wetter conditions in Eurasia contributed to the rise of the first great civilizations in Egypt, Mesopotamia, the Indus Valley, and China. This was largely a Northern Hemisphere-Eurasian phenomenon, with 2-3°C warming in the Arctic and northern Europe. But there was almost no warming in the tropics, and cooling or no change in the Southern Hemisphere.[ 8] From a Eurocentric viewpoint, these warming events seemed important, but on a global scale the effect was negligible. In addition, neither of these warming episodes is related to increasing greenhouse gases. The Holocene Climatic Optimum, in fact, is predicted by the Milankovitch cycles, since at that time the axial tilt of the earth was 24°, its steepest value, meaning the Northern Hemisphere got more solar radiation than normal -- but the Southern Hemisphere less, so the two balanced. By contrast, not only is the warming observed in the last 200 years much greater than during these previous episodes, but it is also global and bipolar, so it is not a purely local effect. The warming that ended the Little Ice Age (from the mid-1700s to the late 1800s) was due to increased solar radiation prior to 1940. Since 1940, however, the amount of solar radiation has been dropping, so the only candidate remaining for the post-1940 warming is carbon dioxide.[ 9] "It's just the sun, or cosmic rays, or volcanic activity or methane." Nope, sorry. The amount of heat that the sun provides has been decreasing since 1940,[ 10] just the opposite of the critics' claims (Fig. 3). There is no evidence of an increase in cosmic ray particles during the past century.[ 11] Nor is there any clear evidence that large-scale volcanic events (such as the 1815 eruption of Tambora in Indonesia, which changed global climate for about a year) have any long-term effects that would explain 200 years of warming and carbon dioxide increase. Volcanoes erupt only 0.3 billion tonnes of carbon dioxide each year, but humans emit over 29 billion tonnes a year,[ 12] roughly 100 times as much. Clearly, we have a bigger effect. Methane is a more powerful greenhouse gas, but there is 200 times more carbon dioxide than methane, so carbon dioxide is still the most important agent.[ 13] Every other alternative has been looked at and can be ruled out. The only clear-cut relationship is between human-caused carbon dioxide increase and global warming. \* "The climate records since 1995 (or 1998) show cooling." That's simply untrue. The only way to support this argument is to cherry-pick the data.[ 14] Over the short term, there was a slight cooling trend from 1998-2000, but only because 1998 was a record-breaking El Nino year, so the next few years look cooler by comparison (Fig. 4). But since 2002, the overall long-term trend of warming is unequivocal. All of the 16 hottest years ever recorded on a global scale have occurred in the last 20 years. They are (in order of hottest first): 2010, 2009, 1998, 2005, 2003, 2002, 2004, 2006, 2007, 2001, 1997, 2008, 1995, 1999, 1990, and 2000.[ 15] In other words, every year since 2000 has been on the Top Ten hottest years list. The rest of the top 16 include 1995, 1997, 1998, 1999, and 2000. Only 1996 failed to make the list (because of the short-term cooling mentioned already). \* "We had record snows in the winter of 2009-2010, and also in 2010-2011." So what? This is nothing more than the difference between weather (short-term seasonal changes) and climate (the long-term average of weather over decades and centuries and longer). Our local weather tells us nothing about another continent, or the global average; it is only a local effect, determined by short-term atmospheric and oceano-graphic conditions.[ 16] In fact, warmer global temperatures mean more moisture in the atmosphere, which increases the intensity of normal winter snowstorms. In this particular case, the climate change critics forget that the early winter of November-December 2009 was actually very mild and warm, and then only later in January and February did it get cold and snow heavily. That warm spell in early winter helped bring more moisture into the system, so that when cold weather occurred, the snows were worse. In addition, the snows were unusually heavy only in North America; the rest of the world had different weather, and the global climate was warmer than average. Also, the summer of 2010 was the hottest on record, breaking the previous record set in 2009. \* "Carbon dioxide is good for plants, so the world will be better off." Who do they think they're kidding? The Competitive Enterprise Institute (funded by oil and coal companies and conservative foundations[ 17]) has run a series of shockingly stupid ads concluding with the tag line "Carbon dioxide: they call it pollution, we call it life." Anyone who knows the basic science of earth's atmosphere can spot the gross inaccuracies in this ad.[ 18] True, plants take in carbon dioxide that animals exhale, as they have for millions of years. But the whole point of the global warming evidence (as shown from ice cores) is that the delicate natural balance of carbon dioxide has been thrown off balance by our production of too much of it, way in excess of what plants or the oceans can handle. As a consequence, the oceans are warming[ 19, 20] and absorbing excess carbon dioxide making them more acidic. Already we are seeing a shocking decline in coral reefs ("bleaching") and extinctions in many marine ecosystems that can't handle too much of a good thing. Meanwhile, humans are busy cutting down huge areas of temperate and tropical forests, which not only means there are fewer plants to absorb the gas, but the slash and burn practices are releasing more carbon dioxide than plants can keep up with. There is much debate as to whether increased carbon dioxide might help agriculture in some parts of the world, but that has to be measured against the fact that other traditional "breadbasket" regions (such as the American Great Plains) are expected to get too hot to be as productive as they are today. The latest research[ 21] actually shows that increased carbon dioxide inhibits the absorption of nitrogen into plants, so plants (at least those that we depend upon today) are not going to flourish in a greenhouse world. It is difficult to know if those who tell the public otherwise are ignorant of basic atmospheric science and global geochemistry, or if they are being cynically disingenuous. \* "I agree that climate is changing, but I'm skeptical that humans are the main cause, so we shouldn't do anything." This is just fence sitting. A lot of reasonable skeptics deplore the right wing's rejection of the reality of climate change, but still want to be skeptical about the cause. If they want proof, they can examine the huge array of data that points directly to human caused global warming.[ 22] We can directly measure the amount of carbon dioxide humans are producing, and it tracks exactly with the amount of increase in atmospheric carbon dioxide. Through carbon isotope analysis, we can show that this carbon dioxide in the atmosphere is coming directly from our burning of fossil fuels, not from natural sources. We can also measure the drop in oxygen as it combines with the increased carbon levels to produce carbon dioxide. We have satellites in space that are measuring the heat released from the planet and can actually see the atmosphere getting warmer. The most crucial evidence emerged only within the past few years: climate models of the greenhouse effect predict that there should be cooling in the stratosphere (the upper layer of the atmosphere above 10 km or 6 miles in elevation), but warming in the troposphere (the bottom layer below 10 km or 6 miles), and that's exactly what our space probes have measured. Finally, we can rule out any other suspects (see above): solar heat is decreasing since 1940, not increasing, and there are no measurable increases in cosmic rays, methane, volcanic gases, or any other potential cause. Face it -- it's our problem. Why Do People Continue to Question the Reality of Climate Change? Thanks to all the noise and confusion over climate change, the general public has only a vague idea of what the debate is really about, and only about half of Americans think global warming is real or that we are to blame.[ 23] As in the evolution/creationism debate, the scientific community is virtually unanimous on what the data demonstrate about anthropogenic global warming. This has been true for over a decade. When science historian Naomi Oreskes[ 24] surveyed all peer-reviewed papers on climate change published between 1993 and 2003 in the world's leading scientific journal, Science, she found that there were 980 supporting the idea of human-induced global warming and none opposing it. In 2009, Doran and Kendall Zimmerman[ 25] surveyed all the climate scientists who were familiar with the data. They found that 95-99% agreed that global warming is real and human caused. In 2010, the prestigious Proceedings of the National Academy of Sciences published a study that showed that 98% of the scientists who actually do research in climate change are in agreement over anthropogenic global warming.[ 26] Every major scientific organization in the world has endorsed the conclusion of anthropogenic climate change as well. This is a rare degree of agreement within such an independent and cantankerous group as the world's top scientists. This is the same degree of scientific consensus that scientists have achieved over most major ideas, including gravity, evolution, and relativity. These and only a few other topics in science can claim this degree of agreement among nearly all the world's leading scientists, especially among everyone who is close to the scientific data and knows the problem intimately. If it were not such a controversial topic politically, there would be almost no interest in debating it since the evidence is so clear-cut. If the climate science community speaks with one voice (as in the 2007 IPCC report, and every report since then), why is there still any debate at all? The answer has been revealed by a number of investigations by diligent reporters who got past the PR machinery denying global warming, and uncovered the money trail. Originally, there were no real "dissenters" to the idea of global warming by scientists who are actually involved with climate research. Instead, the forces with vested interests in denying global climate change (the energy companies, and the "free-market" advocates) followed the strategy of tobacco companies: create a smokescreen of confusion and prevent the American public from recognizing scientific consensus. As the famous memo[ 27] from the tobacco lobbyists said "Doubt is our product." The denialists generated an anti-science movement entirely out of thin air and PR. The evidence for this PR conspiracy has been well documented in numerous sources. For example, Oreskes and Conway revealed from memos leaked to the press that in April 1998 the right-wing Marshall Institute, SEPP (Fred Seitz's lobby that aids tobacco companies and polluters), and ExxonMobil, met in secret at the American Petroleum Institute's headquarters in Washington, D.C. There they planned a $20 million campaign to get "respected scientists" to cast doubt on climate change, get major PR efforts going, and lobby Congress that global warming isn't real and is not a threat. The right-wing institutes and the energy lobby beat the bushes to find scientists -- any scientists -- who might disagree with the scientific consensus. As investigative journalists and scientists have documented over and over again,[ 28] the denialist conspiracy essentially paid for the testimony of anyone who could be useful to them. The day that the 2007 IPCC report was released (Feb. 2, 2007), the British newspaper The Guardian reported that the conservative American Enterprise Institute (funded largely by oil companies and conservative think tanks) had offered $10,000 plus travel expenses to scientists who would write negatively about the IPCC report.[ 29] In February 2012, leaks of documents from the denialist Heartland Institute revealed that they were trying to influence science education, suppress the work of scientists, and had paid off many prominent climate deniers, such as Anthony Watts, all in an effort to circumvent the scientific consensus by doing an "end run" of PR and political pressure. Other leaks have shown 9 out of 10 major climate deniers are paid by ExxonMobil.[ 30] We are accustomed to hired-gun "experts" paid by lawyers to muddy up the evidence in the case they are fighting, but this is extraordinary -- buying scientists outright to act as shills for organizations trying to deny scientific reality. With this kind of money, however, you can always find a fringe scientist or crank or someone with no relevant credentials who will do what they're paid to do. Fishing around to find anyone with some science background who will agree with you and dispute a scientific consensus is a tactic employed by the creationists to sound "scientific". The NCSE created a satirical "Project Steve,"[ 31] which demonstrated that there were more scientists who accept evolution named "Steve" than the total number of "scientists who dispute evolution". It may generate lots of PR and a smokescreen to confuse the public, but it doesn't change the fact that scientists who actually do research in climate change are unanimous in their insistence that anthropogenic global warming is a real threat. Most scientists I know and respect work very hard for little pay, yet they still cannot be paid to endorse some scientific idea they know to be false. The climate deniers have a lot of other things in common with creationists and other anti-science movements. They too like to quote someone out of context ("quote mining"), finding a short phrase in the work of legitimate scientists that seems to support their position. But when you read the full quote in context, it is obvious that they have used the quote inappropriately. The original author meant something that does not support their goals. The "Climategate scandal" is a classic case of this. It started with a few stolen emails from the Climate Research Unit of the University of East Anglia. If you read the complete text of the actual emails[ 32] and comprehend the scientific shorthand of climate scientists who are talking casually to each other, it is clear that there was no great "conspiracy" or that they were faking data. All six subsequent investigations have cleared Philip Jones and the other scientists of the University of East Anglia of any wrongdoing or conspiracy.[ 33] Even if there had been some conspiracy on the part of these few scientists, there is no reason to believe that the entire climate science community is secretly working together to generate false information and mislead the public. If there's one thing that is clear about science, it's about competition and criticism, not conspiracy and collusion. Most labs are competing with each other, not conspiring together. If one lab publishes a result that is not clearly defensible, other labs will quickly correct it. As James Lawrence Powell wrote: Scientists…show no evidence of being more interested in politics or ideology than the average American. Does it make sense to believe that tens of thousands of scientists would be so deeply and secretly committed to bringing down capitalism and the American way of life that they would spend years beyond their undergraduate degrees working to receive master's and Ph.D. degrees, then go to work in a government laboratory or university, plying the deep oceans, forbidding deserts, icy poles, and torrid jungles, all for far less money than they could have made in industry, all the while biding their time like a Russian sleeper agent in an old spy novel? Scientists tend to be independent and resist authority. That is why you are apt to find them in the laboratory or in the field, as far as possible from the prying eyes of a supervisor. Anyone who believes he could organize thousands of scientists into a conspiracy has never attended a single faculty meeting.[ 34] There are many more traits that the climate deniers share with the creationists and Holocaust deniers and others who distort the truth. They pick on small disagreements between different labs as if scientists can't get their story straight, when in reality there is always a fair amount of give and take between competing labs as they try to get the answer right before the other lab can do so. The key point here is that when all these competing labs around the world have reached a consensus and get the same answer, there is no longer any reason to doubt their common conclusion. The anti-scientists of climate denialism will also point to small errors by individuals in an effort to argue that the entire enterprise cannot be trusted. It is true that scientists are human, and do make mistakes, but the great power of the scientific method is that peer review weeds these out, so that when scientists speak with consensus, there is no doubt that their data are checked carefully Finally, a powerful line of evidence that this is a purely political controversy, rather than a scientific debate, is that the membership lists of the creationists and the climate deniers are highly overlapping. Both anti-scientific dogmas are fed to their overlapping audiences through right-wing media such as Fox News, Glenn Beck, and Rush Limbaugh. Just take a look at the "intelligent-design" cre-ationism website for the Discovery Institute. Most of the daily news items lately have nothing to do with creationism at all, but are focused on climate denial and other right-wing causes.[ 35] If the data about global climate change are indeed valid and robust, any qualified scientist should be able to look at them and see if the prevailing scientific interpretation holds up. Indeed, such a test took place. Starting in 2010, a group led by U.C. Berkeley physicist Richard Muller re-examined all the temperature data from the NOAA, East Anglia Hadley Climate Research Unit, and the Goddard Institute of Space Science sources. Even though Muller started out as a skeptic of the temperature data, and was funded by the Koch brothers and other oil company sources, he carefully checked and re-checked the research himself. When the GOP leaders called him to testify before the House Science and Technology Committee in spring 2011, they were expecting him to discredit the temperature data. Instead, Muller shocked his GOP sponsors by demonstrating his scientific integrity and telling the truth: the temperature increase is real, and the scientists who have demonstrated that the climate is changing are right (Fig. 5). In the fall of 2011, his study was published, and the conclusions were clear: global warming is real, even to a right-wing skeptical scientist. Unlike the hired-gun scientists who play political games, Muller did what a true scientist should do: if the data go against your biases and preconceptions, then do the right thing and admit it -- even if you've been paid by sponsors who want to discredit global warming. Muller is a shining example of a scientist whose integrity and honesty came first, and did not sell out to the highest bidder.[ 36] \* Science and Anti-Science The conclusion is clear: there's science, and then there's the anti-science of global warming denial. As we have seen, there is a nearly unanimous consensus among climate scientists that anthropogenic global warming is real and that we must do something about it. Yet the smokescreen, bluster and lies of the deniers has created enough doubt so that only half of the American public is convinced the problem requires action. Ironically, the U.S. is almost alone in questioning its scientific reality. International polls taken of 33,000 people in 33 nations in 2006 and 2007 show that 90% of their citizens regard climate change as a serious problem[ 37] and 80% realize that humans are the cause of it.[ 38] Just as in the case of creationism, the U.S. is out of step with much of the rest of the world in accepting scientific reality. It is not just the liberals and environmentalists who are taking climate change seriously. Historically conservative institutions (big corporations such as General Electric and many others such as insurance companies and the military) are already planning on how to deal with global warming. Many of my friends high in the oil companies tell me of the efforts by those companies to get into other forms of energy, because they know that cheap oil will be running out soon and that the effects of burning oil will make their business less popular. BP officially stands for "British Petroleum," but in one of their ad campaigns about 5 years ago, it stood for "Beyond Petroleum."[ 39] Although they still spend relatively little of their total budgets on alternative forms of energy, the oil companies still see the handwriting on the wall about the eventual exhaustion of oil -- and they are acting like any company that wants to survive by getting into a new business when the old one is dying. The Pentagon (normally not a left-wing institution) is also making contingency plans for how to fight wars in an era of global climate change, and analyzing what kinds of strategic threats might occur when climate change alters the kinds of enemies we might be fighting, and water becomes a scarce commodity. The New York Times reported[ 40] that in December 2008, the National Defense University outlined plans for military strategy in a greenhouse world. To the Pentagon, the big issue is global chaos and the potential of even nuclear conflict. The world must "prepare for the inevitable effects of abrupt climate change -- which will likely come [the only question is when] regardless of human activity." Insurance companies have no political axe to grind. If anything, they tend to be on the conservative side. They are simply in the business of assessing risk in a realistic fashion so they can accurately gauge their future insurance policies and what to charge for them. Yet they are all investing heavily in research on the disasters and risks posed by climatic change. In 2005, a study commissioned by the re-insurer Swiss Re said, "Climate change will significantly affect the health of humans and ecosystems and these impacts will have economic consequences."[ 41] Some people may still try to deny scientific reality, but big businesses like oil and insurance and conservative institutions like the military cannot afford to be blinded or deluded by ideology. They must plan for the real world that we will be seeing in the next few decades. They do not want to be caught unprepared and harmed by global climatic change when it threatens their survival. Neither can we as a society.

#### Climate change causes massive extinctions – the plan is key to reverse this trend and prevent runaway warming

Hansen 8 (James Hansen, directs the NASA Goddard Institute for Space Studies,  adjunct professor in the Department of Earth and Environmental Sciences at Columbia University, “Tell Barack Obama the Truth – The Whole Truth,” Nov/Dec 2008)

Embers of election night elation will glow longer than any prior election. Glowing even in other nations, and for good reason. We are all tied together, more than ever, like it or not.¶ Barack Obama’s measured words on election night, including eloquent recognition of historic progress, from the viewpoint of a 106-year-old lady, still stoke the embers. But he was already focusing on tasks ahead, without celebratory excess.¶ Well he should. The challenge he faces is unprecedented. I refer not to the inherited economic morass, as threatening as it is. The human toll due to past failures and excesses may prove to be great, yet economic recessions, even depressions, come and go.¶ Now our planet itself is in peril. Not simply the Earth, but the fate of all of its species, including humanity. The situation calls not for hand-wringing, but rather informed action.¶ Optimism is fueled by expectation that decisions will be guided by reason and evidence, not ideology. The danger is that special interests will dilute and torque government policies, causing the climate to pass tipping points, with grave consequences for all life on the planet.¶ The President-elect himself needs to be well-informed about the climate problem and its relation to energy needs and economic policies. He cannot rely on political systems to bring him solutions – the political systems provide too many opportunities for special interests.¶ Here is a message I think should be delivered to Barack Obama. Criticisms are welcome.¶ Climate threat. The world’s temperature has increased about 1°F over the past few decades, about 2°F over land areas. Further warming is “in the pipeline” due to gases already in the air (because of climate system inertia) and inevitable additional fossil fuel emissions (because of energy system inertia).¶ Although global warming to date is smaller than day-to-day weather fluctuations, it has brought global temperature back to approximately the highest level of the Holocene, the past 10,000 years, the period during which civilization developed. Effects already evident include:¶ 1. Mountain glaciers are receding worldwide and will be gone within 50 years if CO2 emissions continue to increase. This threatens the fresh water supply for billions of people, as rivers arising in the Himalayas, Andes and Rocky Mountains will begin to run dry in the summer and fall.¶ 2. Coral reefs, home to a quarter of biological species in the ocean, could be destroyed by rising temperature and ocean acidification due to increasing CO2.¶ 3. Dry subtropics are expanding poleward with warming, affecting the southern United States, the Mediterranean region, and Australia, with increasing drought and fires.¶ 4. Arctic sea ice will disappear entirely in the summer, if CO2 continues to increase, with devastating effects on wildlife and indigenous people.¶ 5. Intensity of hydrologic extremes, including heavy rains, storms and floods on the one hand, and droughts and fires on the other, are increasing.¶ Some people say we must learn to live with these effects, because it is an almost god- given fact that we must burn all fossil fuels. But now we understand, from the history of the Earth, that there would be two monstrous consequences of releasing the CO2 from all of the oil, gas and coal, consequences of an enormity that cannot be accepted.¶ One effect would be extermination of a large fraction of the species on the planet. The other is initiation of ice sheet disintegration and sea level rise, out of humanity’s control, eventually eliminating coastal cities and historical sites, creating havoc, hundreds of millions of refugees, and impoverishing nations.¶ Species extermination and ice sheet disintegration are both ‘non-linear’ problems with ‘tipping points’. If the process proceeds too far, amplifying feedbacks push the system dynamics to proceed without further human forcing. For example, species are interdependent – if a sufficient number are eliminated, ecosystems collapse. In the physical climate system, amplifying feedbacks include increased absorption of sunlight as sea and land ice areas are reduced and release of methane, a powerful greenhouse gas, as permafrost melts.¶ The Earth’s history reveals examples of such non-linear collapses. Eventually, over tens and hundreds of thousands of years, new species evolve, and ice sheets return. But we will leave a devastated impoverished planet for all generations of humanity that we can imagine, if we are so foolish as to allow the climate tipping points to be passed.¶ Urgency. Recent evidence reveals a situation more urgent than had been expected, even by those who were most attuned. The evidence is based on improving knowledge of Earth’s history – how the climate responded to past changes of atmospheric composition – and on observations of how the Earth is responding now to human-made atmospheric changes.¶ The conclusion – at first startling, but in retrospect obvious – is that the human-made increase of atmospheric carbon dioxide (CO2), from the pre-industrial 280 parts per million (ppm) to today’s 385 ppm, has already raised the CO2 amount into the dangerous range. It will be necessary to take actions that return CO2 to a level of at most 350 ppm, but probably less, if we are to avert disastrous pressures on fellow species and large sea level rise.¶ The good news is that such a result is still possible, if actions are prompt. Prompt action will do more than prevent irreversible extinctions and ice sheet disintegration: it can avert or reverse consequences that had begun to seem inevitable, including loss of Arctic ice, ocean acidification, expansion of the subtropics, increased intensity of droughts, floods, and storms.¶ Principal implication. CO2 is not the only human-made gas that contributes to global warming, but it is the dominant gas with a lifetime that dwarfs that of the other major gases. Much of the CO2 increase caused by burning fossil fuels remains in the air more than 1000 years. So CO2 must be the focus of efforts to stop human-caused climate change.¶ It would be easy to jump to the conclusion that solution of global warming is to phase down total fossil fuel emissions by some specified percentage. That approach will not work as a strategy. The reason for that conclusion and an outline of a better strategic approach follow immediately from geophysical boundary constraints.¶ Figure 1a shows oil, gas and coal reserves, with the purple portion being the amount that has already been burned and emitted into the atmosphere. Despite uncertainty in the size of undiscovered resources, their amounts are certainly enough to yield atmospheric CO2 greater than 500 ppm. That amount would be disastrous, assuring unstable ice sheets, rising sea level out of humanity’s control, extermination of a large fraction of the species on Earth, and severe exacerbation of climate impacts discussed above.¶ Oil is used primarily in vehicles, where it is impractical to capture CO2 emerging from tailpipes. The large pools of oil remaining in the ground are spread among many countries. The United States, which once had some of the large pools, has already exploited its largest recoverable reserves. Given this fact, it is unrealistic to think that Russia and Middle East countries will decide to leave their oil in the ground.¶ A carbon cap that slows emissions of CO2 does not help, because of the long lifetime of atmospheric CO2. In fact, the cap exacerbates the problem if it allows coal emissions to continue. The only solution is to target a (large) portion of the fossil fuel reserves to be left in the ground or used in a way such that the CO2 can be captured and safely sequestered.¶ Coal is the obvious target. Figure 1b shows that if there were a prompt moratorium on construction of new coal plants, and if existing ones were phased out linearly over the period 2010-2030, then atmospheric CO2 would peak during the next few decades at an amount somewhere between 400 and 425 ppm. The peak value depends upon whose estimate of undiscovered reserves is more accurate. It also depends upon whether oil in the most extreme environments is exploited or left in the ground, and thus it depends on the carbon tax (see below).¶ This coal-phase-out scenario yields the possibility of stabilizing climate. Overshoot of the safe CO2 level is sufficiently small that improved agricultural and forestry practices, including reforestation of marginal lands, could bring CO2 back below 350 ppm, perhaps by the middle of the century. But if construction of new coal plants continues for even another decade it is difficult to conceive a practical, natural way to return CO2 below 350 ppm.¶

#### Two Internal Links to Warming

#### First is Global Coal

#### Global Coal Consumption is Inevitable – Its Only a Question of Whether We Can Adopt New Technologies

McCullough 3/5/2013 (Mark, Executive Vice President American Electric Power, AMERICAN ENERGY SECURITY AND INNOVATION; ¶ COMMITTEE: HOUSE ENERGY AND COMMERCE; ¶ SUBCOMMITTEE: ENERGY AND POWER¶ THE NEED FOR REVOLUTIONARY TECHNOLOGY DEVELOPMENT, CQ Congressional Testimony, lexis)

The dash to gas and the potential problems created in its wake has come at the same time that other countries around the world are increasingly turning to coal to fuel their economies. China is currently far and away the largest consumer of coal, and in fact is consuming almost as much coal as the rest of the world combined.1 Additionally, Europe is increasingly returning to coal to fuel its electric sector, with much of the imported coal coming from the United States.2 Consequently, any policy, direct or indirect, to restrict coal use within the U.S. is unlikely to have a significant impact on reducing global coal consumption. The more significant impacts will be felt however by the U.S. economy, particularly in regions of the country which rely on coal production for economic stability and low-cost electric generation.

#### Power Plants Are the Key Contributor to Warming

Henry A. Waxman, California Ranking Member (D) Congress 3/4 2013 ONE HUNDRED THIRTEENTH CONGRESS¶ Congress of the United States House of Representatives¶ COMMITTEE ON ENERGY AND COMMERCE 2125 RAYBURN HOUSE OFFICE BUILDING WASHINGTON, DC 20515-6115¶ Majority (202) 225-2927 Minority (202) 225-3641¶ MEMORANDUM March 4, 2013¶ To: Subcommittee on Energy and Power Democratic Members and Staff

According to EIA, U.S. energy-related combustion emissions are expected to decrease 3.4% in 2012 to the lowest level since 1994.20 This change is the result of increased use of renewable energy, fuel switching from coal to natural gas in the power sector, and slow economic growth.21 In 2012, coal combustion, almost entirely in the electric power sector, accounted for 32% of U.S. carbon emissions. U.S. energy-related carbon emissions have declined 11.5% since 2005 but are still 5.4% above 1990 levels.22 Estimates for total greenhouse gas emissions are not yet available for 2012, but a recent draft from the U.S. Environmental Protection Agency (EPA) calculates 2011 emissions that are similar to levels observed in the mid-1990s.23¶ Absent policy action in the U.S., carbon pollution is projected to grow in the coming years. President Obama has pledged to cut emissions by 17% below 2005 levels by 2020. However, absent additional action, the U.S. will not meet this target as carbon pollution from energy-related combustion is projected to be only 9% below 2005 levels.24 Moreover, without further action, EIA expects U.S. carbon pollution emissions to increase by 6% between 2012 and 2040.25 As vehicles become more fuel efficient, emissions from petroleum consumption will fall, but rising emissions from coal and natural gas combustion would more than offset this reduction.26

#### Now is the Key Time – Clean Coal Tech is Key

Statement of Rep. Henry A. Waxman Ranking Member, Committee on Energy and Commerce March 5, 2013 Hearing on “American Energy Security and Innovation: The Role of a Diverse Electricity Generation Portfolio” Subcommittee on Energy and Power

I have exactly the opposite view. In this Committee, we like to pretend that there is no connection between how we generate our energy and climate change. But the fact is, climate change is the biggest energy challenge we face as a country. We can’t have a conversation about America’s energy policy without also having a conversation about climate change.¶ In November, the International Energy Agency concluded that if the world does not take action to reduce carbon pollution before 2017, then it will be impossible to prevent the worst effects of climate change because of the carbon dioxide emissions that would be locked-in by energy infrastructure existing at that time.¶ That means that the energy policy decisions that we make today will have a real and direct impact on whether we can prevent the worst impacts of climate change in the future. ¶ Every decision to build a new fossil fuel-fired power plant poses climate risks. We need to understand and weigh those risks.¶ Otherwise, we are going to be locking in infrastructure that will produce carbon pollution for decades to come or creating stranded investments that must be shut down before they have served their useful life.¶ Ideally, this Committee would listen to the scientific experts and enact a responsible energy policy that recognizes the reality of climate change. But as the President said in his State of the Union Address, he will act if we don’t. EPA’s proposed carbon pollution standard for new power plants is a good first step. It is a fuel-neutral standard that requires new plants to keep their pollution below a specified level.¶ The proposed standard provides compliance flexibility and incentives for the deployment of carbon capture and sequestration technologies. Both natural gas and clean coal can meet this standard, which creates a level playing field for fossil fuel-fired generation.¶ Some utilities don’t like this proposed rule. The question we should ask them is how they can reconcile unrestrained and ever-increasing carbon pollution with the scientific reality of climate change.

#### CDCL solves runaway climate change – it’s the only technology that solves a complete collapse of coal

Energy News 2-22-13 (“Clean Coal Could be the Solution to Global Warming,” http://www.yourenergyblog.com/clean-coal-could-be-the-solution-to-global-warming Mike)

The damaging effects that result from burning coal may soon be nonexistent. It took scientists from Ohio State University 15 years and $5 million, but the clean coal technique has finally been developed. They have discovered a way to obtain the energy from coal without actually burning it, eliminating nearly all of the pollution. According to the U.S. Energy Information Administration (EIA), “Coal emits sulfur dioxide, nitrogen dioxide, and heavy metals (such as mercury and arsenic) and acid gases (such as hydrogen chloride), which have been linked to acid rain, smog, and health issues. Coal also emits carbon dioxide, a greenhouse gas.” Even with so many harmful side-effects, the U.S. continues get a large amount of its energy from coal, roughly 20 percent. Well enough is enough. It is time to embrace the clean coal technique. Eliminating 99 percent of the pollution from coal, the Coal-Direct Chemical Looping (CDCL) technique will have a significant impact on the rate of global warming. The Environmental Protection Agency has found that in 2010, coal-burning power plants were responsible for about one-third of the country’s carbon dioxide, equivalent to 2.3 billion metric tons. If energy can be obtained from coal without burning it, this number should drop considerably. Liang-Shih Fan, a chemical engineer and director of Ohio State’s Clean Coal Research Laboratory, explains the process, “We found a way to release the heat without burning. We carefully control the chemical reaction so that the coal never burns–it is consumed chemically, and the carbon dioxide is entirely contained inside the reactor.” The metal from the iron-oxide is recyclable and the only waste products are coal ash and water. If everything goes according to plan, Fan is confident that his discovery can be used to power energy plants within the next 10 years. Research Associate Dawei Wang shared his thoughts regarding the benefits of this technology, “The commercial-scale CDCL plant could really promote our energy independence. Not only can we use America’s natural resources such as Ohio coal, but we can keep our air clean and spur the economy with jobs.” President Obama is already in complete support for the development of clean coal. In 2011, he declared his goal of generating 80 percent of the nation’s energy from clean sources, including clean coal. The following year, he summarized the “all-of-the-above” energy strategy, which also incorporated clean coal technologies. Although the President is on board for clean coal development, two liberal senators recently introduced a bill that would put an end to Obama’s research and development for this safe alternative. Senator Barbara Boxer and Senator Bernie Sanders are attempting to eliminate The Energy Department’s Office of Fossil Energy Research and Development under the Sustainable Energy Act. Although many believe that the legislation will not pass Congress, nothing is for certain just yet. With the level of carbon emissions spiraling out of control, our nation is in desperate need of a solution. As of right now, the CDCL seems to be the only logical answer to reducing the current rate of global warming without completely eliminating the use of coal, one of the nation’s primary sources of energy.

#### Leadership is Key – Absent Largescale Tech Adoption Global Emissions Will Offset Domestic Carbon Emissions

Thomas K. Grose For National Geographic News March 15, 2013 As U.S. Cleans Its Energy Mix, It Ships Coal Problems Abroad http://news.nationalgeographic.com/news/energy/2013/03/130315-us-coal-exports/

The Tyndall Center study estimates that the burning of all that exported coal could erase fully half the gains the United States has made in reducing carbon emissions. For huge reserves of shale gas to help cut CO2 emissions, "displaced fuels must be reduced globally and remain suppressed indefinitely," the report said. (Related Quiz: "What You Don't Know About Natural Gas")

#### The US is in a Unique Spot to Advance Clean Coal Tech – The Plan is Key to Global Adoption of New Tech and is the Only Viable Method For Solving Global Emissions

Syd S. Peng is the Charles E. Lawall Chair in Mining Engineering Emeritus at West Virginia University February 13 2013 http://www.wvgazette.com/Opinion/OpEdCommentaries/201302150152

With its ambitious plans for promoting energy efficiency and expanding the use of renewable energy sources in the fight against global warming, the Obama administration has climbed aboard the biggest bandwagon in energy policy. But the idea that a modern economy can forgo the use of fossil fuels and nuclear power because a combination of conservation and "clean" energy sources can take their place is absurd.¶ There are legitimate reasons to be worried about climate change. Global energy consumption is so great and rising so fast that human activities are linked to climate change. Sea levels are rising, storms are becoming more frequent and stronger, and large parts of the United States and other countries are now subject to extreme drought, resulting in less food production.¶ But the fundamental question is not how we can expand the use of solar and wind energy while increasing its efficient use. The question is how much we're willing to do to ensure that Americans -- and billions of people throughout the world -- have affordable access to oil, natural gas and coal as well as nuclear power.¶ Reducing the consumption of energy would help control greenhouse-gas emissions. But that's not likely to be sufficient to solve the problem. Nor will replacing fossil fuels with alternative sources of energy like solar and wind, which are too impractical to be used for supplying base-load electricity on a large scale. Modern economies are thus bound to remain dependent on fossil fuels, which account for about 80 percent of the world's primary energy use.¶ An important technology has emerged that offers a way to capitalize on fossil fuels, coal in particular. Called "carbon sequestration," it is a way to capture carbon emissions from coal combustion and store them deep underground in geological formations and depleted oil and gas wells. China, India and other countries with fast-growing economies understandably want to use their vast coal resources for industrialization and to bring electricity to billions of people in rural areas who still do not have access to a power grid. But most countries with a lot of coal are not going to stop using it because of concerns about global warming.¶ With the right incentives and access to technology, however, sequestration can be made attractive so that key countries like China and India would back its use. But the leadership in developing and demonstrating the technology will have to come from the United States. We were the first country to crack down on smoking, require seat belts in cars, and adopt clean air regulations for airborne emissions that cause acid rain and ozone smog. Almost every industrialized country and many developing countries have followed our example. The logic seems unassailable: demonstrate the technology for carbon sequestration and other countries will follow suit, because carbon capture-and-storage may be the only realistic way to satisfy the world's enormous energy needs while lessening their side effects.¶ And instead of letting nuclear power slip away, we need to recognize that nuclear reactors have been overwhelmingly good for energy production and the environment. Nuclear reactors produce a huge amount of energy in the foreseeable future from a small amount of fuel. They have been good for our country.¶ For something as vital as energy production, we need federal policies that can help meet our national security and economic aspirations. If the government imposed an affordable price on carbon emissions from the production and use of energy, some of the revenue could be used to develop and demonstrate technologies for carbon sequestration and advanced nuclear power. Such technologies could help revive sagging manufacturing industries in the United States and provide a significant export.¶ It is essential that the United States maintain its technological leadership on the energy front. Developing new advances in clean coal and nuclear systems would provide an energy solution to the global warming problem and it would help ensure that we can maintain a livable environment.

#### Independently CDCL technology is key to global energy leadership – accelerates commercial deployment

U.S. DOE ’12 (“Energy Department Announces Awards to Projects Advancing Innovative Clean Coal Technology,” July 26, http://energy.gov/articles/energy-department-announces-awards-projects-advancing-innovative-clean-coal-technology, Mike)

As part of President Obama’s all-of-the-above approach to American energy, the Energy Department announced today the selection of eight projects to advance the development of transformational oxy-combustion technologies capable of high-efficiency, low-cost carbon dioxide capture from coal-fired power plants. The Energy Department’s $7 million investment - leveraged with recipient cost-share to support approximately $9.4 million in total projects - will support the development and deployment of Carbon Capture, Utilization, and Storage (CCUS) by focusing on further improving the efficiency and reducing the costs associated with carbon capture. “Advancing the development of clean coal technologies is an important part of President Obama’s strategy to develop every source of American energy,” said U.S. Energy Secretary Steven Chu. “These projects will build on the important progress made by this Administration in promoting innovative technologies that help make coal-fired energy cleaner and more cost-competitive. America’s leadership in developing new Carbon, Capture, Utilization and Storage technologies is helping to ensure the United States continues to lead the world in this growing global market.” The Energy Department is leveraging its cutting-edge research to show that not only can Carbon Capture and Sequestration (CCS) technology help industry make fossil energy use cleaner, safer and more sustainable, it also shows promise as a method to extract more, hard-to-access and presently untapped American fossil energy resources like oil and natural gas. By utilizing the captured carbon emissions to recover added oil and natural gas resources, CCUS provides an additional strong business and market case for companies or organizations looking to pursue the environmental benefits of CCS. As a promising near-term technology, oxy-combustion applied at facilities using pulverized coal-fired boilers for power or industrial applications, will support CCUS efforts and result in ultra-low emissions. The oxy-combustion process replaces the air used for combustion with a mixture of oxygen and recycled plant emissions, or “flue gas,” and/or water for temperature control. The remainder of the flue gas that is not recirculated is rich in carbon dioxide and water vapor - and is easily separated - producing a stream of carbon dioxide ready for utilization or sequestration. The selections announced today are part of a two-phase effort to evaluate and develop advanced oxy-combustion projects that yield cost-competitive options for CCUS. These projects will aim to achieve at least 90 percent carbon dioxide removal while delivering carbon dioxide at a capture cost of less than $25 per ton. The Phase 1 projects will focus on an engineering and economic analysis of the technologies while identifying the Phase 2 research and development needs to bring the technology closer to commercialization. The selection of Phase 2 projects will occur next year based upon Phase 1 results. These awards are part of a more than $5 billion investment strategy by the Obama Administration in clean coal technologies and R&D. This strategy, which has attracted over $10 billion in additional private capital investment, is designed to accelerate commercial deployment of clean coal technologies – particularly CCS – and to position the United States as a leader in the global clean energy race. Thanks in part to this strategy, the United States is currently leading the world in CCS technologies.

#### Second is China-

#### They Are a Key Emitter

US Energy Information Administration January 29, 2013 China consumes nearly as much coal as the rest of the world combined http://www.eia.gov/todayinenergy/detail.cfm?id=9751

Coal consumption in China grew more than 9% in 2011, continuing its upward trend for the 12th consecutive year, according to newly released international data. China's coal use grew by 325 million tons in 2011, accounting for 87% of the 374 million ton global increase in coal use. Of the 2.9 billion tons of global coal demand growth since 2000, China accounted for 2.3 billion tons (82%). China now accounts for 47% of global coal consumption—almost as much as the entire rest of the world combined.¶ Robust coal demand growth in China is the result of a more than 200% increase in Chinese electric generation since 2000, fueled primarily by coal. China's coal demand growth averaged 9% per year from 2000 to 2010, more than double the global growth rate of 4% and significantly higher than global growth excluding China, which averaged only 1%.

#### We Would Export the Tech to China – Cooperation Agreements Are Already in Place

By Joel Kirkland writer at ClimateWire August 22, 2011 US-China Deal Intended to Speed Clean Coal Research http://www.scientificamerican.com/article.cfm?id=us-china-deal-intended-to&print=true

U.S. and Chinese officials heading up a series of joint advanced coal projects Friday signed an intellectual property agreement meant to ease the sharing of innovative technology while protecting patents and licensing agreements.¶ Companies collaborating on research and development projects tied to the U.S.-China Clean Energy Research Center (CERC), a program started in 2009, can enter into regular commercial contracts. But energy technology companies participating in the U.S.-China program must negotiate licenses "in good faith" to ensure both nations benefit.¶ Inventors of technology can set the terms, according to a description of the agreement, including royalties and limits on the use of an invention. But the terms cannot be so restrictive that they in essence bar the sharing of advanced coal technology by the United States and China.¶ Major energy companies have a stake in the plan for protecting intellectual property, including U.S. energy giants General Electric and Duke Energy and the French conglomerate Alstom. U.S. and Chinese officials visiting the West Virginia University campus in Morgantown to sign the agreement Friday said the governments also have a lot to gain by greasing the wheels for further cooperation on clean energy.¶ Robert Marlay, director of the CERC program out of the U.S. Department of Energy, said the intellectual property agreement flows from direct talks among U.S. and Chinese leaders, "suggesting diplomatic and binding support of the agreement."

#### The Economic Feasibility of Coal Makes it the Litmus Test for US China Cooperation on Climate – All Other Approaches Would Fail

James Fallows is an Atlantic national correspondent 2010 December “Dirty Coal, Clean Future” http://www.theatlantic.com/magazine/archive/2010/12/dirty-coal-clean-future/308307/?single\_page=true

Isn’t “clean energy” the answer? Of course—because everything is the answer. The people I spoke with and reports I read differed in emphasis, sometimes significantly. Some urged greater stress on efficiency and conservation; some, a faster move toward nuclear power or natural gas; some, an all-out push for solar power and other renewable sources; others, immediate preparation for “geo-engineering” or “abatement” projects to offset the effects of climate disruption once they occur. But in a sense they were all in harmony, because everything on all the lists works toward the same end.¶ The best-known illustration of the need for an all-fronts approach is the “carbon wedge” analysis from the Carbon Mitigation Initiative at Princeton. Its premise is that to keep the carbon-dioxide level from going into the 500s, or twice its pre-industrial-age level, over the next 50 years, the world collectively will need to reduce its carbon-dioxide emissions by a total of about 26 billion tons per year. (Technically, CMI measures its goals in billions of tons of carbon contained within the carbon dioxide. For clarity, I’ve converted the figures.) To reach that total, CMI proposes seven “stabilization wedges” of a little less than 4 billion tons of carbon dioxide each. A 4-billion-ton “wedge” through efficiency efforts of all kinds; another wedge of that size through renewable power; another through avoiding deforestation and changing agricultural practices. Eventually it adds up. “There are many good options,” Julio Friedmann, a geologist at Lawrence Livermore National Laboratory, told me soon after I first met him in Beijing two years ago. “But there are no unlimited options. Each is limited by cost, limited by scale, limited by physics and chemistry, limited by thermodynamics. For example, there’s nothing wrong with switchgrass as a biofuel”—one of George W. Bush’s novel proposals—“but there’s not a lot of energy in it.”¶ We’ll hear from Friedmann again. This emphasis on limits is what begins pointing us back to coal.¶ “Emotionally, we would all like to think that wind, solar, and conservation will solve the problem for us,” David Mohler of Duke Energy told me. “Nothing will change, our comfort and convenience will be the same, and we can avoid that nasty coal. Unfortunately, the math doesn’t work that way.”¶ The math he has in mind starts with the role that coal now plays around the world, and especially for the two biggest energy consumers, America and China. Overall, coal-burning power plants provide nearly half (about 46 percent this year) of the electricity consumed in the United States. For the record: natural gas supplies another 23 percent, nuclear power about 20 percent, hydroelectric power about 7 percent, and everything else the remaining 4 or 5 percent. The small size of the “everything else” total is worth noting; even if it doubles or triples, the solutions we often hear the most about won’t come close to meeting total demand. In China, coal-fired plants supply an even larger share of much faster-growing total electric demand: at least 70 percent, with the Three Gorges Dam and similar hydroelectric projects providing about 20 percent, and (in order) natural gas, nuclear power, wind, and solar energy making up the small remainder. For the world as a whole, coal-fired plants provide about half the total electric supply. On average, every American uses the electricity produced by 7,500 pounds of coal each year.¶ Precisely because coal already plays such a major role in world power supplies, basic math means that it will inescapably do so for a very long time. For instance: through the past decade, the United States has talked about, passed regulations in favor of, and made technological breakthroughs in all fields of renewable energy. Between 1995 and 2008, the amount of electricity coming from solar power rose by two-thirds in the United States, and wind-generated electricity went up more than 15-fold. Yet over those same years, the amount of electricity generated by coal went up much faster, in absolute terms, than electricity generated from any other source. The journalist Robert Bryce has drawn on U.S. government figures to show that between 1995 and 2008, “the absolute increase in total electricity produced by coal was about 5.8 times as great as the increase from wind and 823 times as great as the increase from solar”—and this during the dawn of the green-energy era in America. Power generated by the wind and sun increased significantly in America last year; but power generated by coal increased more than seven times as much. As Americans have read many times, Chinese companies are the world’s leaders in manufacturing solar panels, often using technology originally developed in the United States. Many of the panels are used inside China for its own rapidly growing solar-power system; still, solar energy accounts for about 1 percent of its total power supply. In his book PowerHungry, Bryce describes a visit to a single coal mine, the Cardinal Mine in western Kentucky, whose daily output supports three-quarters as much electricity generation as all the solar and wind facilities in the United States combined. David MacKay, of the physics department at Cambridge University in England, has compiled an encyclopedia of such energy-related comparisons, which is available for free download (under the misleadingly lowbrow title Sustainable Energy—Without the Hot Air). For instance: he calculates that if the windiest 10 percent of the entire British landmass were completely covered with wind turbines, they would produce power roughly equivalent to half of what Britons expend merely by driving each day.¶ Similar patterns apply even more starkly in China. Other sources of power are growing faster in relative terms, but year by year the most dramatic increase is in China’s use of coal. “Coal simply is going to be with us for decades,” a technical adviser to China’s energy ministry told me this summer in Beijing. “We hope someday to have 15 percent of our power from renewable sources. Even so, the percentage of power generated by coal will not drop by more than a few points, and the absolute amount will quickly grow.” Another government energy expert in Beijing said that the only serious limit on how fast Chinese power companies can increase their use of coal is the capacity of the country’s transportation system. “It’s kind of an existential question, whether they can handle the physical volumes they are planning to consume,” he said. “Right now railroads are at capacity, you have entire highways being blocked with coal trucks, and the problems cascade.” Part of the reason China has committed some $80 billion over the next decade to build light-rail networks across the country is to get human passengers off the main rail lines, opening up more capacity to move coal.¶ “People without a technical background think, ‘Coal is dirty! It’s bad,’” I was told in Beijing by Ming Sung, a geologist and energy expert who was born in Shanghai, worked for decades in America and became a citizen, and has now returned to China. “But will you turn off your refrigerator for 30 years while we work on renewables? Turn off the computer? Or ask people in China to do that? Unless you will, you can’t get rid of coal for decades. As [U.S. Energy Secretary] Steven Chu has said, we have to face the nightmare of coal for a while.”¶ Coal will be with us because it is abundant: any projected “peak coal” stage would come many decades after the world reaches “peak oil.” It will be with us because of where it’s located: the top four coal-reserve countries are the United States, Russia, China, and India, which together have about 40 percent of the world’s population and more than 60 percent of its coal. It will be with us because its direct costs are in most circumstances far lower than those of the alternatives—that’s why so much is used. (Prices vary widely from place to place and company to company, but one utility executive said that the lowest-price coal plant might generate electricity for 2 cents per kilowatt-hour, while the same amount of power from a new wind farm in the same area might cost 20 cents.) It will be with us because its indirect costs, in miner deaths, environmental destruction, and carbon burden on the atmosphere are unregulated and “externalized.” Power companies that answer to shareholders or ratepayers have a hard time justifying a more expensive choice. “Coal is so cheap because its dirtiness still doesn’t count against it,” an air-pollution expert with the Natural Resources Defense Council told The Wall Street Journal 10 years ago. In the absence of climate legislation in the United States and international agreements to reduce emissions, the dirtiness still doesn’t count. Coal will be with us because changing a power infrastructure—like building a new transportation system or extending cable or fiber-optic connections through an entire country—is the very opposite of a “virtual” process, and takes many years to complete.¶ And it will be with us because of a surprising constraint: after a century in which medical diagnosis and treatment, computer and communications systems, aerospace and nanotech industries, and nearly every other form of technology have routinely achieved the magical, energy production is essentially what it was in the time of James Watt. With the main exception of nuclear-power plants and the hoped-for future exception of practical nuclear-fusion systems, we mostly create electricity by burning something that was once underground—coal, oil, natural gas—to boil water and turn turbines with the steam. (Windmills use the wind’s force, and hydropower systems use falling water, to turn turbines directly.) The computer of 10 years from now will be unrecognizably more powerful than today’s, and its predictably increased capability will make medical, navigation, and other systems better, too. If the power plant of 10 years from now is even slightly more efficient than today’s, that will be a major achievement. The most advanced of today’s “ultra-supercritical” coal-fired plants, which operate at very high temperatures and pressures to maximize the efficiency of combustion, convert up to 48 percent of the coal’s potential energy to electric power; the rest is lost as heat. “Subcritical” plants typically have efficiencies in the mid-30s. The costliest and most advanced technology is an improvement—but not a breakthrough. A breakthrough is what it would take to move beyond reliance on coal.¶ “I know this is a theological issue for some people,” Julio Friedmann of Lawrence Livermore said. “Solar and wind power are going to be important, but it is really hard to get them beyond 10 percent of total power supply.” He pointed out the huge engineering achievement it has taken to raise the efficiency of solar photovoltaic cells from about 25 percent to about 30 percent; whereas “to make them useful, you would need improvements of two- or threefold in cost,” say from about 18 cents per kilowatt-hour to 6 cents. He recited a skeptic’s line used about the Carter administration’s clean-energy programs—“You’re not going to run a steel plant with solar panels”—and then made a point that summarized the outlook of those who have decided they can best wage the climate fight by working on dirty, destructive coal.¶ “It is very hard to go around the world and think you can make any difference in carbon-loading the atmosphere without some plan for how people can continue to use coal,” Friedmann said. “It is by far the most prevalent and efficient way to generate electricity. People are going to use it. There is no story of climate progress without a story for coal. In particular, U.S.-China progress on coal.”

#### No Alt Causes – Coop on Coal is Unique

James Fallows is an Atlantic national correspondent 2010 December “Dirty Coal, Clean Future” http://www.theatlantic.com/magazine/archive/2010/12/dirty-coal-clean-future/308307/?single\_page=true

CHINA’S COOPERATION WITH the United States on coal is good news for the world. If the two countries had decided to make this another arena for demonstrating their respective toughness—if, as at the failed Copenhagen talks last winter, they had mainly exchanged accusations about who was more to blame for emissions problems—they would have guaranteed that the problems could not be solved. If that cooperation breaks down, Julio Friedmann said, “we’ll end up paying twice as much to get the same learnings—and delaying the technology on both sides by another decade.” Both sides seem to have looked for ways to keep the cooperation going. They have not been in the newspapers, but they deserve recognition for attempting to do the world’s work.

#### Cooperation solves extinction

Wenzhong, PRC Ministry of Foreign Affairs, 2-7-4 (Zhou, “Vigorously Pushing Forward the Constructive and Cooperative Relationship Between China and the United States,” http://china-japan21.org/eng/zxxx/t64286.htm)

China's development needs a peaceful international environment, particularly in its periphery. We will continue to play a constructive role in global and regional affairs and sincerely look forward to amicable coexistence and friendly cooperation with all other countries, the United States included. We will continue to push for good-neighborliness, friendship and partnership and dedicate ourselves to peace, stability and prosperity in the region. Thus China's development will also mean stronger prospect of peace in the Asia-Pacific region and the world at large. China and the US should, and can, work together for peace, stability and prosperity in the region. Given the highly complementary nature of the two economies, China's reform, opening up and rising economic size have opened broad horizon for sustained China-US trade and economic cooperation. By deepening our commercial partnership, which has already delivered tangible benefits to the two peoples, we can do still more and also make greater contribution to global economic stability and prosperity. Terrorism, cross-boundary crime, proliferation of advanced weapons, and spread of deadly diseases pose a common threat to mankind. China and the US have extensive shared stake and common responsibility for meeting these challenges, maintaining world peace and security and addressing other major issues bearing on human survival and development. China is ready to keep up its coordination and cooperation in these areas with the US and the rest of the international community. During his visit to the US nearly 25 years ago, Deng Xiaoping said, "The interests of our two peoples and those of world peace require that we view our relations from the overall international situation and a long-term strategic perspective." Thirteen years ago when China-US relations were at their lowest ebb, Mr. Deng said, "In the final analysis, China-US relations have got to get better." We are optimistic about the tomorrow of China-US relations. We have every reason to believe that so long as the two countries view and handle the relationship with a strategic perspective, adhere to the guiding principles of the three joint communiqués and firmly grasp the common interests of the two countries, we will see even greater accomplishments in China-US relations.

**Independently Chinese emissions are sufficient to cause extinction**

John Copeland Nagle 11, the John N. Matthews Professor, Notre Dame Law School, Spring 2011, “How Much Should China Pollute?,” Vermont Journal of Environmental Law, 12 Vt. J. Envtl. L. 591

China is the world’s worst polluter. It suffers more from air pollution than any other nation, hosting most of the world’s polluted cities.1 Nearly two-thirds of the country’s 360 million urban residents suffer from unhealthy levels of air pollution.2 Anecdotal reports by visitors to China frequently refer to the alarming nature of the air pollution there.3 China’s water is polluted, too. About 100 billion cubic meters of China’s water supply is contaminated.4 China is also the leading emitter of greenhouse gases that contribute to climate change.5 China’s carbon dioxide emissions nearly tripled between 1990 and 2008.6 And China’s pollution is only expected to get worse.7 It is building unbelievable amounts of coal-fired electric power plants,8 and the number of cars in China is increasing exponentially. China “is expected to release five times more carbon dioxide over the next twenty-five years than the Kyoto Protocol is projected to save.”9¶ That pollution creates problems for three separate entities. First, it is a problem for China itself. The health of the Chinese people suffers from the polluted air that they breathe and the polluted water that they drink. “Air pollution causes the premature deaths of 750 thousand Chinese people every year.”10 Just one percent of China’s urban residents “breathe[] air considered healthy by the World Health Organization.”11 China’s pollution also has a profound detrimental impact on the nation’s economy. Economists suggest that China’s staggering economic growth statistics would be much more modest if the economic effects of polluters are included.12 The health and economic aspects of pollution, in turn, cause domestic unrest that threatens the stability of the Chinese government. There have been numerous protests against pollution from existing or proposed facilities throughout China.13¶ Second, China’s pollution also produces an American problem.14 Pollution emitted in China reaches the United States, sometimes at levels prohibited by the Clean Air Act.15 China is also the most common antagonist in American debates about climate change. Members of Congress routinely make two arguments about China as a basis for opposing federal climate change legislation or international climate change treaties. The first argument claims that the United States will lose jobs to China if we internalize the costs of emitting greenhouse gases but China does not. The second argument insists that it is unfair for China to be allowed to continue to emit greenhouse gases if the United States is obliged to cap its emissions. Moreover, many American politicians note that the environment itself will suffer if the United States reduces its emissions but China does not. Such concerns persuaded the Senate to vote ninety-seven to zero in 1997 to ratify a resolution proclaiming that “the United States should not be a signatory to any protocol” to reduce greenhouse gas emissions “unless the protocol or other agreement also mandates new specific scheduled commitments to limit or reduce greenhouse gas emissions for Developing Country Parties within the same compliance period.”16 Numerous Senators pointed to the forthcoming Kyoto Protocol’s treatment of China as justifying the American refusal to endorse that agreement.17 The United States never did ratify the Kyoto Protocol, and similar concerns about China continue to animate congressional opposition to a new international climate change agreement.18 Third, the rest of the world suffers because of the inability of China and the United States to agree on a method for reducing their greenhouse gas emissions. Even if the rest of the world were to reach such an agreement, the failure to include China and the United States would doom the project from the start. Together, China and the United States account for forty-one percent of the world’s greenhouse gas emissions.19 Left unchecked, China’s emissions alone could result in many of the harms associated with climate change.20 That is why many observers believe that “[t]he decisions taken in Beijing, more than anywhere else, [will] determine whether humanity thrive[s] or perishe[s].”21

### Solvency

#### Clean Coal Power Initiative and Amendments to the Energy Policy Act of 1992 explicitly advocate chemical looping for coal

CSL ‘9 (“Loan Guarantee Implementation Plan,” February 20, Carbon Sequestration Leadership Forum is an international initiative to develop affordable technologies to separate and securely store carbon dioxide produced by energy facilities, http://www.cslforum.org/incentivesregistry/UnitedStates5.html, Mike)

Loan Guarantees: The Secretary of Energy may make loan guarantees of up to 80 percent of an energy project cost. Eligible projects “avoid, reduce or sequester air pollutants or anthropogenic emissions of greenhouse gases,” or those that “employ new or significantly improved technologies as compared to commercial technologies in service in the United States at the time the guarantee is issued.” The provision is aimed at helping develop the low-carbon energy industry in the U.S. and pays particular attention to gasification. The deadline for application for a loan guarantee was extended to February 26, 2009.¶ The Secretary of Energy may also provide loan guarantees for an amount up to 90 percent of the unpaid principal and interest due on any loan made to an Indian tribe for energy development. The Secretary is to give priority to any project that uses carbon capture and sequestration and other “new” technologies.¶ Western CCS: Federal assistance is authorized for a demonstration project to produce energy from a coal mined in the Western United States at an altitude of greater than 4,000 feet above sea level in an integrated gasification combined cycle plant that is carbon capture and sequestration “capable.”¶ Tax Credits: Section 1307 authorized $1.65 billion in tax credits for clean coal projects: $800 million worth of credit for Integrated Gasification Combined Cycle (IGCC) projects. $500 million for advanced coal electricity generation projects that utilize innovative technologies other than IGCC. $350 million for gasification projects that support activities other than electricity generation such as the production of gases used in chemical production.IGCC and industrial gasification projects are eligible for a 20 percent investment tax credit, while other advanced coal-based projects that produce electricity are eligible for a 15 percent credit.¶ Cost Sharing: Title IV - Coal, Subtitle A – Clean Coal Power Initiative (CCPI), Section 401. Authorization of Appropriations authorizes the expenditure of $200 million each fiscal year for FY2006-FY2014 for clean coal research in coal-based gasification and combustion technologies. At least 70 percent of the funds must be used to fund projects on coal-based gasification technologies and 30 percent can be used on “other technologies.” All projects must remove specified amounts of several pollutants and hit thermal efficiency targets. To gain this funding, all demonstration and commercial applications projects require at least a 50 percent cost share from private industry. The Secretary of Energy must give priority to projects that include separation or capture of carbon dioxide or the reduction of the demand for natural gas if deployed.¶ Title IV – Coal, Subtitle C – Clean Air Coal Program, Section 421. Amendments to the Energy Policy Act of 1992 - This section authorizes $3 billion over seven years to provide loans, cost sharing and cooperative agreements for clean coal technology deployment programs. The gasification provisions authorize a total of $2.5 billion to be spent on gasification projects to include IGCC, gasification co-production, hybrid gasification/combustion, advanced coal projects including oxidation combustion and chemical looping techniques as well as ultrasupercritical boilers and fuel cells. Between 25 and 75 percent of the projects must be for the sole purposes of generating electricity. Financial assistance to the projects is to be determined by the Secretary and cost sharing shall not exceed 50 percent.

#### Federal investment key to replace dying plants with clean ones

McCullough 3/5/2013 (Mark, Executive Vice President American Electric Power, AMERICAN ENERGY SECURITY AND INNOVATION; ¶ COMMITTEE: HOUSE ENERGY AND COMMERCE; ¶ SUBCOMMITTEE: ENERGY AND POWER¶ THE NEED FOR REVOLUTIONARY TECHNOLOGY DEVELOPMENT, CQ Congressional Testimony, lexis)

Throughout the past several decades of the power industry, technologies have taken an evolutionary path of advancement. As needs have arisen or new concepts were developed, existing power plants have adopted technologies as either retrofit installations or in-kind replacements to older technology. But times have changed and an opportunity has arisen. We support commercialization of Small Modular Reactor (SMR) technology for the next generation of nuclear power, which addresses the capital- intensive challenges with conventional nuclear power technology, and strongly encourage a concentrated focus on transformational technology development for fossil fuel power generation. As stated above, the current regulatory climate and market are such that no new coal-fired power plants are likely to be built so long as gas prices remain low.¶ At the same time, there are compelling arguments to maintain a balanced portfolio of energy resources for U.S. electric power generation. Currently, most power generation-related technology development is focused on modifications and retrofit applications to the existing power plant fleet. Yet, most of the existing fleet in the US is over 30 years of age and already carrying expensive and complex retrofit systems, many of which were installed at costs rivaling the original power plant. Any further modification or retrofit will add complexity and most likely reduce the energy efficiency of the power plant. A more fruitful and forward-thinking approach would be to invest in technology that would be ready to replace the existing fleet as it completes its useful life and heads for retirement in the coming decades. Now is the ideal time to adjust the focus of technology development to truly innovative, revolutionary concepts for energy conversion.¶ While innovation at the laboratory and pilot-scale level is thriving across the U.S., new coal-fueled electric power projects are not advancing to the large scale demonstration phase due to the high cost of these projects. To remedy this problem, the federal government must step in and take a strong leadership role in making revolutionary technologies a commercial reality for the future.¶ A change in focus from predominantly existing fleet applications and near-term solutions to a longer-reaching view is needed. We must invest in technologies that show promise of truly moving the needle in a meaningful manner in terms of cost, fuel efficiency, and environmental performance. The CURC-EPRI (Coal Utilization Research Council - Electric Power Research Institute) Roadmap lays out a plan to enable the needed innovative technology development utilizing annual budgets no greater than those appropriated to the DOE Fossil Energy clean coal programs over the past couple years.¶ One excellent example of innovation is in the field of chemical looping technology. Chemical looping is not a carbon capture technology, nor is it a combustion technology in the way we typically describe combustion today. In one application of chemical looping, coal undergoes a flameless chemical reaction with a metal oxide, known as an oxygen carrier. The oxide reacts with the carbon in the coal to produce a pure stream of CO2 while the chemical energy in the coal is transferred to the oxygen- depleted (reduced) metal. The CO2 can be compressed and sequestered, or hopefully utilized for a more meaningful purpose.¶ The reduced metal is then sent to an oxidation reactor, where air is introduced to provide the oxygen needed to re-form the metal oxide, generating large amounts of heat. That heat can be used to produce steam for use in the power generating cycle. The metal oxide that exits the oxidation reaction is then "looped" back to react again with more coal and the cycle repeats. Both The Ohio State University and Alstom are global leaders in this promising new technology and have advance the key design elements of the technology to the point where large investments are now needed to move to commercial-scale demonstrations.¶ With success, this and other new revolutionary technologies will enable our next generation of power plants to use coal with extremely high efficiency, with ultra-low emissions, and produce a pure stream of CO2 with no added energy penalty. Not only will these concepts revolutionize the power generation industry, they can open the vast, yet untapped, oil reserves in this country to Enhanced Oil Recovery (EOR) production by making enormous quantities of low-cost CO2 available for EOR purposes. These technology innovations are essential to a diverse energy future, but they require attention now and focused funding to enable industry to overcome the high cost of commercialization. Encouragingly, as stated in the CURC-EPRI Technology Roadmap, the funding needed to develop and commercialize these concepts is not beyond the levels invested in recent years with DOE's Fossil Energy clean coal programs; this funding just need to be focused on the proper technologies.

#### the Tech is Feasible

Gina Langen, Ohio State Office of Energy and Environment January 29, 2013 Successful 200+ Hour Continuous Operation of Coal-Direct Chemical Looping Combustion Technology at Ohio State http://oee.osu.edu/documents/Fan200.pdf

The Ohio State University successfully demonstrated 200+ hours of continuous operation of a fully ¶ integrated chemical looping combustion pilot plant for solid fuel conversion last quarter. The Coal-Direct ¶ Chemical Looping (CDCL) is an advanced oxy-combustion carbon capture technology for coal-fired ¶ power plants. This demonstration represents the first long-term integrated operation of any chemical ¶ looping technology in the world. ¶ Directed by Professor Liang-Shih Fan and his team of graduate students, the successful operation of the 25 ¶ kWth CDCL sub-pilot unit conducted at Ohio State’s Clean Energy Research Laboratory signifies the ¶ commercial potential for the Ohio State-patented CDCL technology.¶ Chemical looping technology is a transformational process for converting carbon-based fuels such as coal, ¶ syngas and natural gas to electricity, liquid fuels and/or hydrogen with low to negative net carbon ¶ emissions. As one of the ultimate technologies in the U.S. Department of Energy’s Carbon Emission ¶ Control Technology Roadmap, the chemical looping technology utilizes the reduction-oxidation reactions ¶ of an oxygen carrier to segregate the air source from the fuel. This eliminates the need for energy intensive ¶ CO2 separation systems that require high capital and operating costs. ¶ CONSOL Energy, in collaboration with Ohio State, performed an economic analysis of the CDCL process ¶ using DOE’s economic and boiler performance assumptions for a coal-fired, supercritical power plant. ¶ The results indicate that Ohio State’s CDCL process can meet and exceed DOE’s target of less than 35% ¶ increase in cost of electricity with greater than 90% carbon capture. ¶ The CDCL sub-pilot unit successfully demonstrated the integrated performance of the two major process ¶ components: the counter-current moving bed reducer and the fluidized bed combustor, establishing the ¶ viability of the process for the direct conversion of coal to electricity. The CDCL process utilizes an ironbased oxygen carrier cycling between the reducer and combustor reactors. ¶ Under DOE’s Carbon Capture Program, the fully integrated, streamlined CDCL plant is unique in both ¶ design and operation because of its moving bed design and non-mechanical valves. The CDCL system ¶ uses an in-situ ash removal system in the reducer to eliminate the need for additional fines removal ¶ devices, which lowers the unit capital and operating costs and simplifies the process design and operation. ¶ Office of Energy and Environment¶ 3018 Smith Laboratory ¶ 174 W. 18th Avenue¶ Columbus, OH 43210¶ Phone (614) 247-4762¶ oee.osu.eduhe 200+ hours of continuous operation, using metallurgical coke and sub-bituminous and lignite coals, ¶ demonstrated the robustness of the unique moving bed reducer design and non-mechanical valve operation ¶ by achieving nearly 100% solid fuel conversion with more than 99% carbon dioxide purity. ¶ The concentrated CO2 stream produced from the reducer contained very low concentrations of methane, ¶ oxygen, and carbon monoxide. From the reducer to the combustor, minimal carbon carry-over was ¶ observed from the transfer of oxygen carrier particles contributing to nearly 100% carbon capture ¶ efficiency. Additionally, pollutant analyses during the operation showed comparable NOx and SOx¶ concentrations in the reducer as compared to concentrations in a conventional pulverized coal combustion ¶ boiler equipped with a low NOx burner, and negligible amounts of both pollutants observed in the ¶ combustor effluent gas. The long-term demonstration validated the oxygen carrier particle performance in ¶ terms of its reactivity, recyclability and attrition resistance.¶ This program was primarily sponsored by DOE’s National Energy Technology Laboratory (Project #: DENT0005289, Project Title: Coal-Direct Chemical Looping Retrofit to Pulverized Coal Power Plants ¶ System for In-Situ CO2¶ Capture) and the Ohio Development Services Agency. In addition, Ohio State has ¶ conducted this research in collaboration with multiple industrial partners: Babcock & Wilcox Power ¶ Generation Group, Inc. (B&W PGG), CONSOL Energy, Inc., and Clear Skies Consulting LLC.¶ Further, a fully integrated 250-kWth pressurized Ohio State Syngas Chemical Looping (SCL) pilot unit is ¶ being designed and constructed at DOE’s National Carbon Capture Center in Wilsonville, Alabama and is ¶ expected to be in operation in late 2013 to further verify the operability and economic feasibility of ¶ advanced chemical looping technologies. Combined, more than 800 operating hours have been achieved ¶ using the SCL and CDCL sub-pilot units, which demonstrate the reliability and operability of the Ohio ¶ State design.¶ This remarkable feat follows the recent awarding of Phase I DOE funding for advanced oxy-combustion ¶ technologies. Ohio State is working with B&W PGG, the Phase I project principal investigator, to conduct ¶ a techno-economic study of a commercial 550 MWe¶ power plant using the CDCL process. The CDCL ¶ process can be implemented as a greenfield plant or as a cost-effective repowering option to existing coalfired power plants.

#### Government Subsidies Key

Climate Policy Watcher 19 October 2012 Shale gas boom threatens US efforts to release on clean coal http://www.climate-policy-watcher.org/?q=node/410

Analysts believe that the expensive technology needed to build clean coal plants, together with the shale gas boom recorded in the last years, is unlikely to become commercialized in the United States without heavy government subsidies. In fact, according to academic and business experts, since the share of coal in US power production has shrunk from over half to a bit more than a third, its future depends largely on financial, political and regulatory support provided to carbon capture and storage (CCS) technology. With current gas prices, deepening fiscal crisis and record low GHG emission levels since 1992, the sector faces difficulties in attracting investment. While keeping coal jobs in the US is part of the heated presidential campaign, where both candidates Obama and Romney expressed their support for clean coal but failed to specify how to finance CCS. Despite the significant financial support US Congress has provided for CCS technology since 2005, private investors still hesitate in front of an unclear regulatory framework that fails to incentivise investment. Tim Profeta, director of the Nicholas Institute of Environmental Policy at DukeUniversity, confirmed that “without a carbon price and with low natural gas prices these technologies are having problems drawing investment and attention”. However, CCS, where the US and China are competing for technology leadership, should, according to corporate analysts, remain a part of the generating mix, not only because GHG emissions will rebound as the economy recovers but also because of its booming applications in enhanced oil recovery (EOR). Long term energy policy that maintains a balance between coal and gas is also emphasised by the Electric Power Research Institute (EPRI), which warns about the vulnerability of a power fleet predominated by gas turbines due to increased exposure to high volatility and rapid escalations of natural gas prices. US Energy Information Administration (EIA) expects average natural gas spot prices of $2.71 per MMBtu (million British thermal unit) in 2012 and $3.3 per MMBtu in 2013.

### Plan

#### The United States Federal Government ought to provide loan guarantees for power plants that employ coal-direct chemical looping in the United States.