

## Statement of Vinod Khosla to Committee on Environment and Public Works hearing on "Green Jobs Created by Global Warming Initiatives"

### Introduction

Madam Chairman and honorable members of the Committee, there is a climate crisis, a security crisis and an impending oil crisis and these crisis's have the potential to create a large jobs crisis. As Stanford economist Paul Romer has said, a crisis is a terrible thing to waste. America's scientists and technologists, powered by new ideas and the energy of America's entrepreneurs, are best equipped to solve this problem. Specifically, the focus on environmental technologies, often criticized by some for potentially hurting the US economy, are an unprecedented economic opportunity with many beneficial side effects. Many business leaders like the CEOs, from companies like DuPont, GE and Duke Energy, who have called for tough federal limits on carbon dioxide emissions. Recently, that call was echoed by institutional investors managing \$4 trillion in assets. Climate change and climate change legislation presents an opportunity for the country. It will create jobs, not destroy jobs. Climate change is principally about our dependence on oil, coal and efficiency. I respectfully come before you today not to make an environmental case for climate change legislation but rather an economic one. Climate change legislation is good for our economy, our national security and our competitiveness. It is good for job creation and GDP growth. I come before you as a believer in free markets and in our advantage in innovation driven economic competition.

Madam Chairman, I submit the evidence of the US Climate Exchange partnership, a group whose members run the gamut from automakers (GM, Ford) to utilities and power producers (PG&E, Duke Energy), from insurance (AIG, Marsh) to oil (Shell, Conoco Phillips, BP). As they note:

"In our view, the climate change challenge, like other challenges our country has confronted in the past, will create more economic opportunities

than risks for the U.S. economy. Indeed, addressing climate change will require innovation and products that drive increased energy efficiency, creating new markets. This innovation will lead directly to increased U.S. competitiveness, as well as reduced reliance on energy from foreign sources. Our country will thus benefit through increased energy security and an improved balance of trade."

However, there are many forces that will oppose this change. Each \$4 change in the price of a barrel of oil costs Saudi Arabia (a country with a smaller population than California) a trillion dollars. Oil interests will and are funding massive PR campaigns against the moves to replace oil. In my Wall Street Journal editorial on January 23, 2007, I called on President Bush to declare a war on oil. This war is winnable, politically feasible with small compromises, and a great boon to all Americans - rural or urban, workers or shareholders, educated or unskilled.

### **Macro Trends: Oil, Coal & Natural Gas**

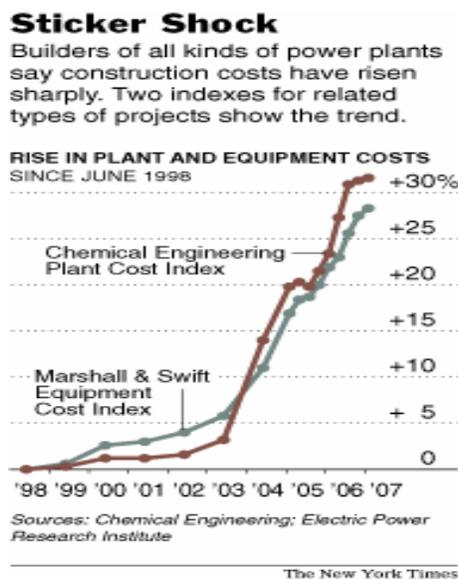
Today, we carry immense risk associated with the commodities upon which our society functions - risk we desperately need to start mitigating, risk that is costing us dearly and has the potential to cost us even more. Lord Oxburgh, the former chairman of Shell, noted recently that the oil industry had its head "in the sand", and predicted that oil prices could hit \$150 per barrel within 20 years. What would that do to our competitiveness given our large oil consumption? In addition, he noted that "we may be sleepwalking into a problem which is actually going to be very serious and it may be too late to do anything about it by the time we are fully aware."<sup>1</sup> In the last 8 years, oil has gone from roughly \$15 a barrel to \$80 - a rise of greater than 500%. Senator Richard Lugar has pointed out that we spend over \$300 billion a year on oil imports, and estimates that we spend an additional \$50 billion a year (at least) on protecting just our oil interests in the Middle East. He goes on to note that

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<sup>1</sup> <http://news.independent.co.uk/business/news/article2966842.ece>

by 2025, we will require almost 30 million barrels of oil per day! Should we really be spending more money lining Hugo Chavez' pockets and funding the people who fuel terrorism?

The risks of coal (and to a lesser extent, natural gas) are similar. Over the last few years, coal plant costs have risen rapidly - Innovest Strategic Advisors noted that "In 2006, the cost of new coal-fired power plants increased by 40%. This is representative of a continuing trend in which capital costs have increased by 90-100% since 2002."<sup>2</sup> The president of Siemens Power Group noted that "There's real sticker shock out there."<sup>3</sup> One common example is Duke Energy's proposed Cliffside plant, which was initially priced at \$2 billion for 2 800-MW units. 18 months down the line, the price tag had risen to \$3 billion. When the state utility approved only one of the two units, Duke came back with a cost estimate of \$1.83 billion - an 80% rise before construction had even started! Elsewhere, even newer, touted "clean coal" is prohibitively expensive - The AEP power plant in West Virginia had construction costs rise to \$2.23 billion for a 630 MW plant, more than 70% higher than previous estimates. This is a capital cost of \$3,539/kW! These cost increases impacts US competitiveness and job creation.

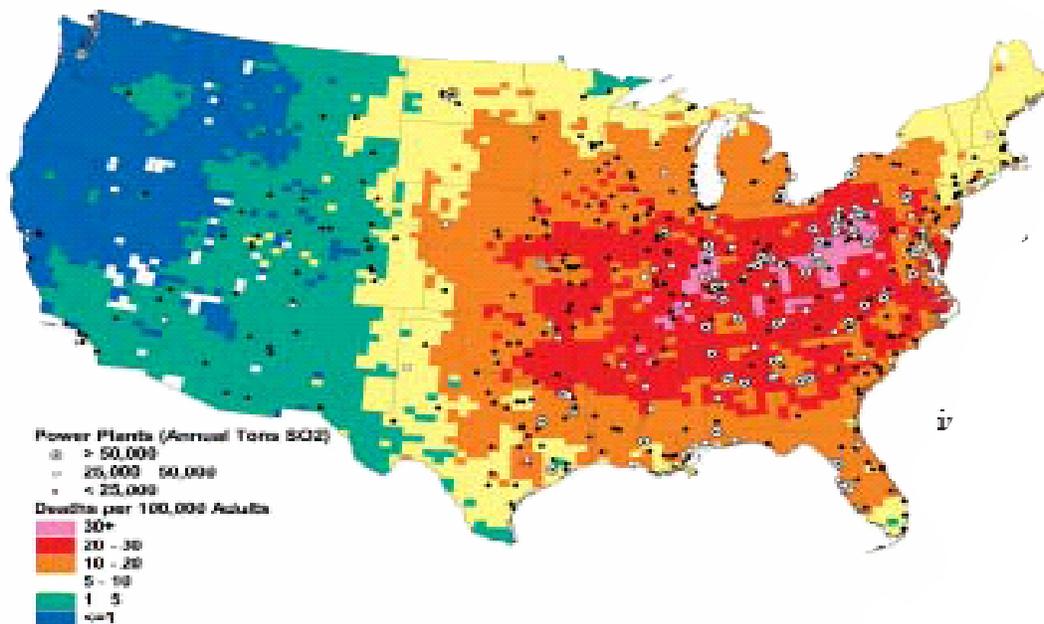


<sup>2</sup> <http://www.net.org/proactive/newsroom/release.vtml?id=29196>,

<sup>3</sup> [http://www.nytimes.com/2007/07/10/business/worldbusiness/10energy.html?\\_r=1&oref=slogin](http://www.nytimes.com/2007/07/10/business/worldbusiness/10energy.html?_r=1&oref=slogin)

Meanwhile, the immense pollution and carbon dioxide emissions of coal power loom over us like a dark cloud. The health risks of coal pollution have been cited often, but it bears repeating - The cost of coal is felt directly on our health and our healthcare costs. The American Lung Association notes that a 2004 study attributed 24,000 premature deaths each year due to power plant pollution. In addition, the ALA notes that “research estimates over 550,000 asthma attacks, 38,000 heart attacks and 12,000 hospital admissions are caused annually by power plant pollution.”<sup>4</sup> In the last century, more than a 100,000 deaths have been a result of mining, with over 200,000 black lung deaths<sup>5</sup>. This is part of the burden of coal. The typical 500 MW coal plant generates as much CO2 as 600,000 cars! These effects impact healthcare costs and hence US competitiveness and job creation. The chart below (from the Clean Air Task Force) shows the death rate around current coal power plants.

### Power Plant Deaths Per 100,000 Adults...



<sup>4</sup>[http://lungaction.org/reports/sota06\\_protecting.html](http://lungaction.org/reports/sota06_protecting.html)

<sup>5</sup> <http://stateofnature.org/sagoMineDisaster.html>

Coal plants produce approximately 130 million tons of toxic solid waste yearly - approximately three times the total municipal garbage in the US.<sup>6</sup>



Most importantly, the risks associated with these older energy technologies and future carbon emission costs has decreased investment and hurt job creation. One does not need to believe in climate change to support climate change legislation. The uncertainty around such legislation is hurting the US economy and jobs creation and many executives would prefer to deal with known legislation even if unwarranted rather than dealing with the uncertainty of unknown future legislation. In the last few years, we have finally started to realize the enormous externalities associated with coal, and public opinion has demanded that action be taken. There is strong consensus that some sort of carbon regulation is just around the corner. A 2004 survey of power company executives suggested that 50% of them expect carbon-trading laws in place within the next 5 years. Why? Because the uncertainty is making investment decisions difficult. And the perceived risk of climate legislation is worse than the legislation itself. David Crane, the CEO of

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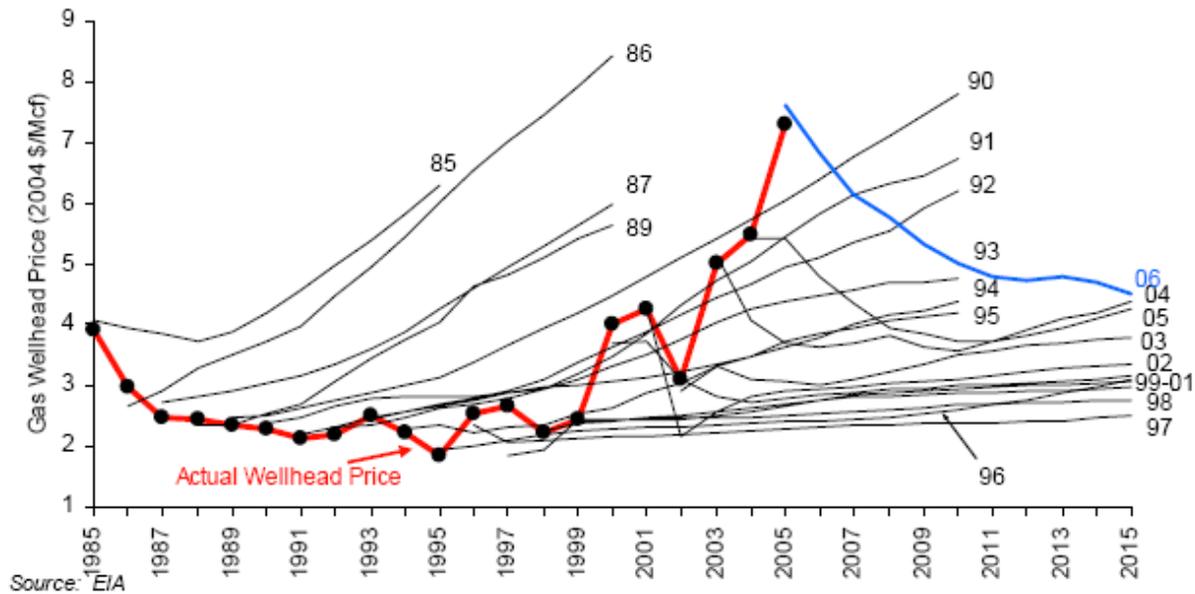
<sup>6</sup> “Big Coal: The Dirt Secret Behind America’s Energy Future”, Jeff Goodell

NRG Energy noted that "I've never seen a phenomenon take over the public consciousness" and that "This is the kind of thing that could stop coal." Gary Serio of Entergy Corp. notes that "It's very likely the investment decisions many are making, to build long-lived high-carbon-dioxide-emitting power plants, are decisions we'll all live to regret." This investment risk is a significant factor associated with coal - a new coal plant is not a one or five year investment, but rather a 50 year one. Many companies are delaying or cancelling plans ( see Appendix A for examples) to build new plants due to the cost and the sense of uncertainty of carbon emissions risk - a coal plant built without accounting for carbon costs may well prove to be uneconomic when carbon prices are taken into account. Synapse Energy Economics conducted a study and noted "Any utility proposing to build a coal plant would be reckless to make such a long term investment without fully assessing a variable [carbon pricing][ that could easily increase costs by \$86 million per year on average, or \$4.3 billion over a 50-year period, for a 600 MW coal plant [projections for the Big Stone II plant with the mid-range CO2 price projections of approximately \$20 per ton]." <sup>7</sup> This is a significant reason why 6 of the 10 largest power companies in the US support a carbon cap-and-trade regulation scheme - uncertainty about the costs and environment is not conducive to making large, long-term investments. **Delays in investment delay job creation and increase the cost of power to industry, reducing our competitiveness. Climate legislation will on the other hand create real competition for fossil energy.**

This investment risk and the cost to consumers and industry "risk" is captured well when we examine what happened to natural gas prices and the investment in gas power plants.

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<sup>7</sup> UCS, "Gambling With Coal", [www.ucsusa.org](http://www.ucsusa.org) and <http://www.state.sd.us/puc/commission/dockets/electric/2005/el05-022/testimonyschlisselsommer.pdf>.



The history of gas prices is a cause for pause - the chart above compares the predicted prices of natural gas in each year to actual prices that were realized on the market. The basic message: five years is impossible to predict, let alone fifty! When making a 50-year plant investment, commodity price-variability has to be considered; it does not seem to be accounted for today. Today, many of the gas plants built in the 1990's are essentially uneconomic, reduced to a role as peaking plants - with the capital investment essentially a sunk cost. Newer technologies like that from Great Point Energy that I will discuss later ameliorate these effects.

### Price Impact on Consumers & Industry: Coal versus Renewables

From a consumer and industry cost of energy point of view, we need to create competition for traditional fossil energy sources and to account for external costs associated with them. We need to give them choices.

Competition will drive down the costs of all energy but because of the huge subsidies provided to traditional energy industries in the past alternative greener technologies will need legislation to get them going to the point where they can achieve economies of scale. **Given these immature technologies and rapidly declining cost curves (while traditional fossil energy costs are rising), we believe these alternatives will be cheaper than traditional energy sources in the future, helping both our industry and our environment, while materially improving our energy and national security.**

Fortunately, renewable energy sources across the spectrum offer ways to alleviate much of the risks and costs outlined, providing us energy and fuel at lower costs with significantly reduced environmental impact. The Union of Concern Scientists (UCS) conducted a study on the effects of the implementation of a basic RPS (20% of electricity be renewable by 2020). The study noted that such an energy standard would result in the lowering of “business-as-usual” electricity prices by 1.8% each year (and natural gas prices at 1.5% lower) with a cumulative effect of approximately \$49 billion by 2020.<sup>8</sup> Importantly, these benefits would be felt across the economy, in the commercial, industrial, and residential sectors. Meanwhile, rising coal plants costs (as detailed earlier) have led the firms to ask for higher electricity rates, further burdening consumers and industry. In response to the price rise in its IGCC coal plant, AEP filed testimony in West Virginia requesting a \$108 million rate increase to support the construction!<sup>9</sup>

We are particularly optimistic about concentrated solar power (CSP) technology, and its cost advantages over coal (one of our investments - Ausra, is working in this area). We expect prices to decline to the \$0.07/KWh range (when the first 700MW plant is built<sup>10</sup>), below that of next generation IGCC coal (\$0.08 + carbon pricing, commodity risk), IGCC coal plus carbon capture and sequestration CCS (\$0.10 + commodity risks, cost of sequestration, insurance against leakage liability), and gas-fired CC (\$0.12 + commodity risk).

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<sup>8</sup> [http://www.ucsusa.org/clean\\_energy/renewable\\_energy\\_basics/renewing-americas-economy.html](http://www.ucsusa.org/clean_energy/renewable_energy_basics/renewing-americas-economy.html)

<sup>9</sup> [http://www.energyonline.com/Industry/News.aspx?NewsID=7158&Costs\\_Rise\\_fo](http://www.energyonline.com/Industry/News.aspx?NewsID=7158&Costs_Rise_fo)

<sup>10</sup> Dr. David Mills, Ausra

The recently announced PG&E power purchase agreement (for 550MW) to purchase solar thermal power came in at approximately \$0.10/KWh.<sup>11</sup> Environmentally, CSP plants produce no CO<sub>2</sub> emissions (or NOX, SO<sub>2</sub>, Mercury, sludge or any of the other coal “externalities”). CSP bears no transportation, supply or commodity price risk - the sun is a viable source of solar energy for a few billion years, slightly longer than coal. Meanwhile, any traditional pulverized coal plant built now is both an environmental menace for 50 years (with increasing emissions as the plants get older), as well as an investment failure once carbon pricing is introduced. I’d also like to question the “conventional wisdom” about solar power across the country. Traditional wisdom holds that solar power is not competitive in the Southeast. However, at Senator Lamar Alexander’s request, we were able to compute the cost of solar power in Tennessee at below \$0.06 KWh (using TVA’s cost of capital).

### **Price Impact on Consumers & Industry: Oil versus Renewables**

Elsewhere, oil offers one of the best opportunities towards reducing consumer and industry transportation costs. And it offers America, with its abundant land resources compared to other economies, a competitive advantage. Initially ethanol and other biofuel products will serve as an effective substitute product for oil, helping to give American consumers more options and choice (while oil prices were significant in 2006, demand was partially satisfied by the 5 billion gallons of ethanol consumed domestically - how much higher might gasoline prices have risen if an additional 4 billion gallons of gasoline was required?). Contrary to popular belief it also reduced net federal subsidies and helped the rural economy too. Discussing corn ethanol, economist John Urbanchuk notes “A 33 percent increase in crude oil prices - which translates into a \$1.00 per gallon increase in the price of conventional regular gasoline - results in a 0.6 percent to 0.9 percent increase in the CPI for food while an equivalent (33%) increase in corn prices (\$1.00 per

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<sup>11</sup> <http://www.iht.com/articles/2007/07/25/business/solar.php>

bushel) would cause the CPI for food to increase only 0.3 percent.”<sup>12</sup> (The next time someone suggests a food v. biofuel problem with ethanol, its worth pointing out that food v. oil is the real problem. Incidentally a 16oz steak takes the same amount of corn to produce as a gallon of ethanol.). More importantly, corn ethanol subsidies have actually been a net benefit to the federal treasury - The USDA’s chief economist noted recently that if you look at the fiscal year 2006 corn program, the cost was about \$8.5 billion [2005 crop]. Shift forward 1 year to fiscal year 2007 costs (2006 crop), direct payments are \$2.1 billion for corn - a net decrease of \$6 billion in corn subsidy costs because of \$3 billion ethanol subsidies. Beyond corn ethanol, the cheaper and more economical future is that of cellulosic ethanol. **In fact, Range Fuels (one of our investments) can produce cellulosic ethanol that is cheaper (on a per mile driven basis) than oil and will be in production next year!** Furthermore, we believe that \$1 a gallon wholesale cellulosic ethanol (with mpg similar to that of gasoline today) is possible within a decade. Even accounting for the 25% less mileage of ethanol as compared to gasoline (in today’s gasoline optimized engines), this will provide significant cost savings to consumers and industry across the board, without the commodity risk of big oil.

### Job Creation: Coal versus Solar CSP

Many of the old economy jobs are dying slowly- The National Mining Association reports that employment in the coal industry (coal miners) is almost half of what it was 25 years ago.<sup>13</sup> From a job creation and economic perspective, renewable energy will be a significant boom. The previously cited UCS study estimated that a 20% renewable power standard would create 355,000 new jobs over the period - far more than electric generation from fossil fuels (197,000 is the estimate for the latter). The threshold would spur more than \$72 billion in new capital investment; by 2020, it would likely be

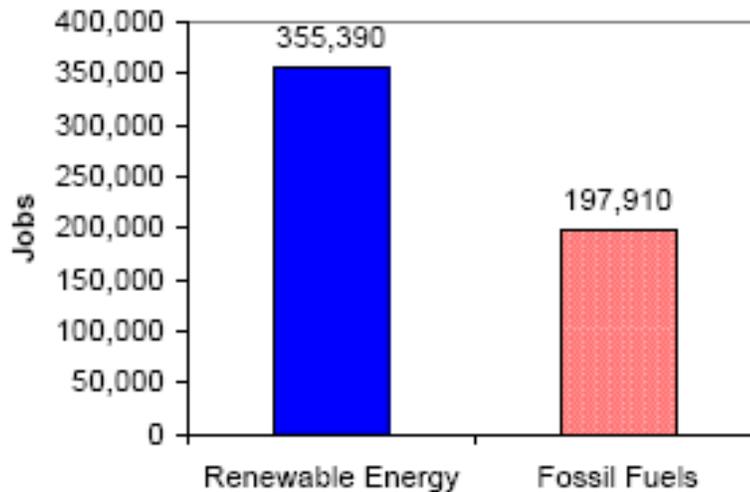
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<sup>12</sup> [http://www.ethanolrfa.org/objects/documents/1157/food\\_price\\_analysis\\_-\\_urbanchuk.pdf](http://www.ethanolrfa.org/objects/documents/1157/food_price_analysis_-_urbanchuk.pdf)

<sup>13</sup> [http://www.nma.org/pdf/c\\_trends\\_mining.pdf](http://www.nma.org/pdf/c_trends_mining.pdf) - NMA

providing an additional \$8.2 billion income and \$10.2 billion in GDP for the US economy.<sup>14</sup>

### Renewable Energy vs. Fossil Fuel Jobs, 2020 (20 percent by 2020 RES)



Elsewhere, a study at UC Berkeley (assuming a 20% national renewable standard by 2020) concluded that “Investing in renewable energy such as solar, wind and the use of municipal and agricultural waste for fuel would produce more American jobs than a comparable investment in the fossil fuel energy sources in place today.”<sup>15</sup> California has been one of the leaders in the usage of renewable energy, and benefits are set to flow - estimates suggest that the adoption of AB 32 will reduce CO<sub>2</sub> emissions by 25%, while creating 83,000 new jobs and \$4b in income.

In California, Black and Veatch, a traditional power industry engineering firm, conducted an extensive study on the economic benefits of solar CSP plants. They noted that each 100 MW of CSP resulted in 94 permanent operation and maintenance jobs, compared to 56 and 13 for a combined-cycle and simple-cycle turbine (technology used in coal IGCC and PC respectively) plant. It also noted that each 100MW would bring \$628 million in impact to the

<sup>14</sup> [http://www.ucsusa.org/clean\\_energy/renewable\\_energy\\_basics/renewing-americas-economy.html](http://www.ucsusa.org/clean_energy/renewable_energy_basics/renewing-americas-economy.html)

<sup>15</sup> <http://www.scienceblog.com/cms/node/2618>

state's gross output, compared to just \$64 million for a combined-cycle and \$47 million for a single-cycle turbine plant.

Table 5-8 Total Economic Impacts of One CSP or Conventional Plant in 2008 per 100 MW (\$2005)			
	Base Case Parabolic Trough	Combined Cycle Combustion Turbine	Simple Cycle Combustion Turbine
<b>Construction</b>			
Gross State Output, \$1,000	628,000	64,000	47,000
Earnings, \$1,000	196,000	23,500	17,700
Employment, job-years	3,990	448	327
<b>Operation</b>			
Gross State Output, \$1,000/year	12,800	10,000	2,000
Earnings, \$1,000/year	5,680	2,700	700
Employment, jobs	94	56	13
<b>Operation</b>			
Gross State Output, \$1,000/GWh	36	24	23
Earnings, \$1,000/GWh	16	6	8
Employment, jobs/GWh	0.26	0.16	0.15

Black & Veatch notes that “For each dollar spent on the installation of CSP plants, there is a total impact (direct plus indirect impacts) of about \$1.40 to gross state output for each dollar invested compared to roughly \$0.90 to \$1.00 for each dollar invested in natural gas fueled generation.”<sup>16</sup> Going further, Black and Veatch estimated the impact of low-deployment (2,100MW) and high-deployment (4,000MW) scenarios for CSP in the state. They determined:

“The deployment scenarios would result in about \$7 billion and \$13 billion in investment, respectively, of which an estimated \$2.8 and \$5.4 billion is estimated to be spent in California. This level of in-state investment has a total impact on Gross State Product of nearly \$13 billion for the low deployment scenario and over \$24 billion for the high deployment scenario, not

<sup>16</sup> “Economic, Energy, and Environmental Benefits of Concentrating Solar Power in California”, Black and Veatch, April 2006

including impacts from ongoing O&M expenditures. This level of investment creates a sizable direct and indirect impact to employment during construction at about 77,000 and 145,000 job-years for the low and high deployment scenarios, respectively. Ongoing operation of the CSP plants built under the deployment scenarios creates a total annual economic impact of \$190 and \$390 million."

The study also noted "that the installation of CSP, wind or other non-gas plants in lieu of new natural gas fueled generators can relieve a portion of the demand pressure behind gas price volatility. Lawrence Livermore Laboratory and others suggest that the natural gas price could decline by one to four percent for each change of 1 percent in demand. The 4,000 MW high deployment scenario could result in a savings of \$60 million per year for natural gas in California for a 1 percent price reduction for a 1 percent usage reduction. At the higher price impact range, the California savings could be four times greater." On top of all the economic benefits, CSP would also be significantly more environmentally friendly than coal - with almost no carbon footprint. The job creation data has been validated by the actual plant construction plans and jobs estimates of one of our investments, Ausra.

### Job Creation: Oil versus Biofuels

The previously cited UC Berkeley study noted that a biomass-centric approach would be a substantial boon to the US economy. Professor Daniel Kammen stated that "Renewable energy is not only good for our economic security and the environment, it creates new jobs ... At a time when rising gas prices have raised our annual gas bill to \$240 billion [2003-2004 oil prices], investing in new clean energy technologies would both reduce our trade deficit and reestablish the U. S. as a leader in energy technology, the largest global industry today."<sup>17</sup> Today, an \$80 barrel of oil provides limited value-added here in the US. By importing oil and refining the fuel domestically, we capture

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<sup>17</sup> [http://www.berkeley.edu/news/media/releases/2004/04/13\\_kamm.shtml](http://www.berkeley.edu/news/media/releases/2004/04/13_kamm.shtml)

perhaps \$5 or so of “value add” on top of the \$80 of value of the import. With corn ethanol and cellulosic ethanol, and other advanced biofuels offer us an opportunity to do far more - instead of capturing \$5 of \$85 in value, we can capture all of it within the country! America’s availability of land, technology, and know-how gives us a significant competitive advantage. Imagine the scenario - cellulosic ethanol technology developed in Denver, utilizing available land and forest waste in Oklahoma, Georgia, Montana, Idaho, and Washington, and delivering cheap \$1 cellulosic ethanol across the country! This isn’t some pipe dream - rather, something we expect as reality within the next couple of years! Can we imagine the impact of spending the \$320 billion (that we currently spend on oil imports) fueling agriculture in rural America, and reducing the trade deficit domestically?

Beyond the general examples cited here, we see specific examples of how action to combat climate change can help. Range Fuels (one of our investments), is soon to break ground on the first commercial-scale cellulosic ethanol plant in Soperton, Georgia, using wood waste that lies uncollected in Georgia’s forests. The first plant will create 70 jobs for the area, with subsequent plants to follow. A University of Georgia analysis notes that “the ethanol plant would be worth \$110 million per year to the county, including nearly \$500,000 of tax revenue... Range Fuels also expects to hire up to 80 full-time employees at wages much higher than the regional average.”<sup>18</sup> Moreover, as paper mills have shut down across the country, both Range Fuels and Mascoma (as well as other cellulosic ethanol approaches) offer an opportunity to help replace their impact and utilize their feedstock. Imagine a thousand such plants spread across a thousand counties across America.

### **Impact on Rural America**

While we have made the case that renewable energy will be good for America, its worth emphasizing that it will offer significant benefits to rural

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<sup>18</sup> <http://www.agobservatory.org/headlines.cfm?refID=99779>

America in particular. The UCS study estimated that an extra 30,000 jobs would be created in agriculture alone, and that the 20% RPS would generate approximately \$16.2 billion in income to farmers, ranchers, and rural landowners. Elsewhere, a 2004 NRDC study estimates producing the biomass feedstock necessary for biofuels could generate more than \$5 billion a year in income for farmers (by 2025)<sup>19</sup>. While some will ignore studies from environmental organizations as biased, it is hard to overcome the logic of replacing all \$80 of the value of imported oil by products produced in America. This makes economic sense, especially since it also creates competition for oil. Biomass and agricultural based energy could permanently correct the rural/urban economic development imbalance that has developed over the last 50 years. It could shift much of the oil portion of our GDP to rural GDP and create millions of new jobs.

### Risks of Coal, Oil and the Status Quo

While the economic case for action is significant, it's worth reiterating the risks inherent in our current status quo. From an investment perspective, the current climate finds businesses in a holding pattern, unwilling to fully commit resources because of what may happen next - carbon pricing and a fuller appreciation of the externalities of our current energy sources has the potential to blow the old investment models out of the water. What sane CEO would bet that no climate change legislation will be enacted in the next fifty years, the typical life of their investments? We must remove this unnecessary risk for our businesses. The devil we know is better than the one we don't when it comes to climate change legislation.

As we've detailed with coal and natural gas plants, an investment is not simply a one or five year gamble - it's a fifty year belief that prices and the economic climate will continue to allow the plant to be an economical source of power. Can you imagine the economic impact of \$100 billion coal plants that

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<sup>19</sup> <http://www.nrdc.org/air/energy/biofuels/biofuels.pdf>

are no longer economic (in a carbon-constrained world), their capital written-off almost completely? This sense of investment risk is present with oil as well - despite claims that the oil industry is doing all it can to lower prices, no new refinery has been built for 30 years. Lynn Westfall, the chief economist of Tesoro (an oil refinery owner) notes that "If you were to ask us to go build a brand new refinery anywhere in the world, I would tell you you'd be lucky to have it up and running in six or seven years," Westfall says. "And then you'd need 10 to 15 years of today's margins to pay it back. So building a new refinery is a 20-year bet that margins are going to remain very high."<sup>20</sup> These are the kind of gambles that we can no longer afford to continue taking.

There are real costs to climate change and they are becoming very visible. The effect of previous (and current) fossil fuel usage on our climate can be perceived in economic costs as well as environmental ones. **A GAO report notes that "Using computer-based catastrophe models, many major private insurers are incorporating some near-term elements of climate change into their risk management practices. One consequence is that, as these insurers seek to limit their own catastrophic risk exposure, they are transferring some of it to policyholders and to the public sector."**<sup>21</sup> It goes on to point that insurers (public and private) have paid \$320 billion in weather-related claims since 1980, and as a result, private insurers are factoring in climate change into their weather models and accounting for it - in a way public insurers haven't. As the report notes:

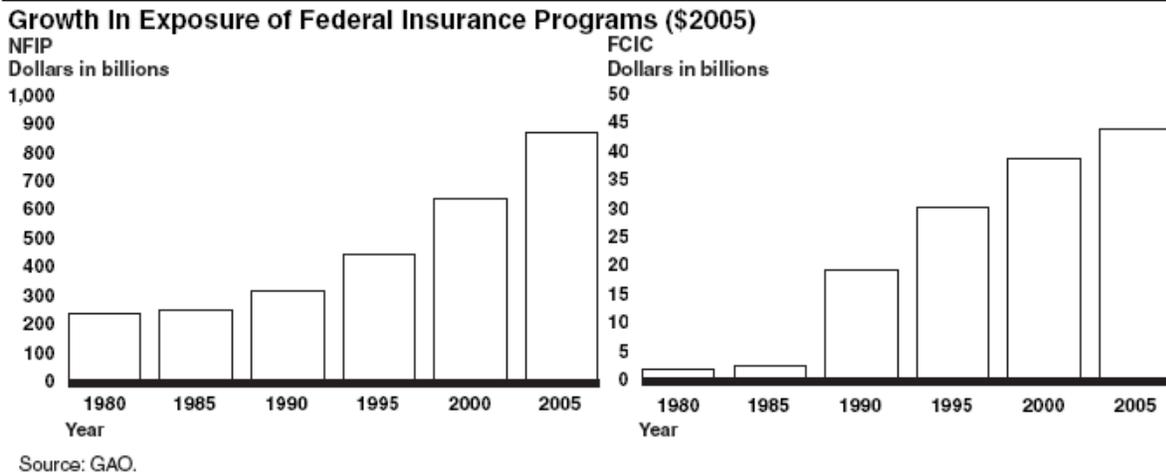
"Major private and federal insurers are both exposed to the effects of climate change over coming decades, but are responding differently. Many large private insurers are incorporating climate change into their annual risk management practices, and some are addressing it strategically by assessing its potential long-term industry-wide impacts. The two major federal insurance programs, however, have done little to develop comparable information. GAO acknowledges that the federal

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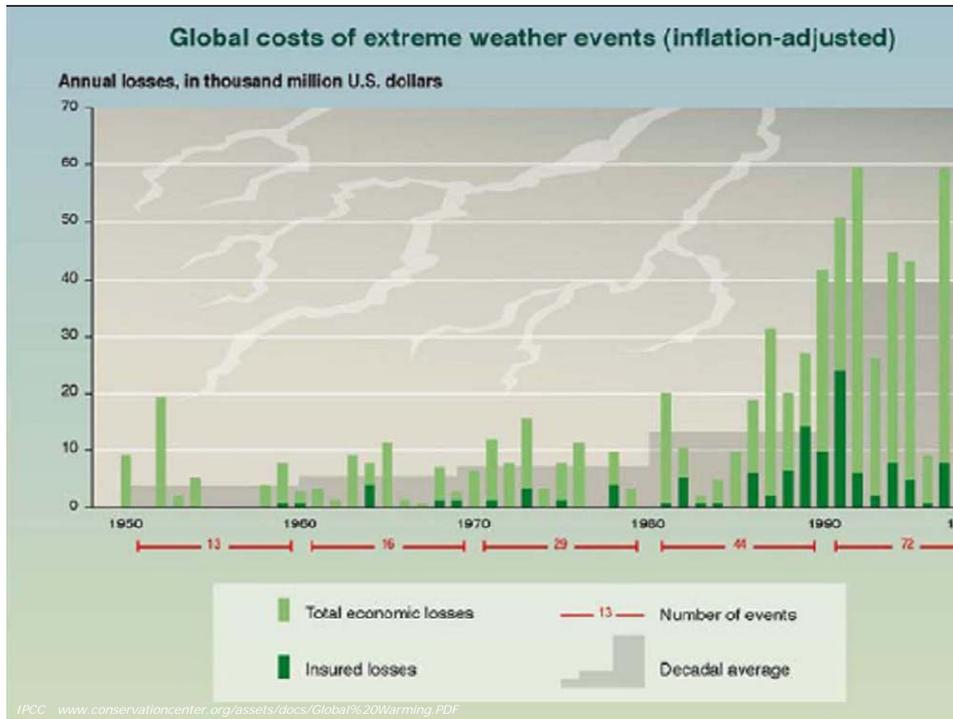
<sup>20</sup> <http://www.npr.org/templates/story/story.php?storyId=10554471>

<sup>21</sup> <http://www.gao.gov/new.items/d07285.pdf>

insurance programs are not profit-oriented, like private insurers. Nonetheless, a strategic analysis of the potential implications of climate change for the major federal insurance programs would help the Congress manage an emerging high-risk area with significant implications for the nation's growing fiscal imbalance."



Without significant action on the climate change problem (by reducing our usage to fossil fuels), the public taxpayer could be stuck with the bills of willful ignorance. When a very conservative magazine like the Economist documents through a skeptics lens the actual cost, insured and uninsured, of extreme weather related events, we must take note and consider this an economic not an environmental "nice to have" phenomenon.



Recently, an Economist editor admitted to me that two years ago you could not convince him to do anything about climate change on an economic basis. Today, he went on to say, they can document the real costs and risks of this potentially catastrophic problem as the chart above shows. He is now a believer that we should be addressing climate change as an economic phenomenon. When even those who would ignore the environmental aspects perceive renewable energy as a winning alternative, isn't it about time that we start listening?

Despite our apprehension about most coal plants, we do believe coal is a valuable economic resource and we should use it: given the scale of U.S coal reserves, utilizing them does seem like a prudent approach if the externalities are not overwhelming. One such approach is converting the coal to an environmentally friendlier fuel, such as natural gas (GreatPoint Energy - one of our investments, is working on such an approach). The advantages include cleaner fuel's and cheaper transportation using the existing pipeline network as well as higher reliability (as compared to expected reliability of IGCC coal plants). Moreover, the overall cost of production is expected to be less than

\$4.00/MMBtu, far below today's natural gas prices of \$7-8 /MMBtu. At this cost, GreatPoint Energy's gasification technology represents one of the lowest cost incremental sources of natural gas in North America - lower than new exploration and production, LNG imports, and other means of producing natural gas from carbon feedstocks through conventional gasification. Just as hybrid technology increases automobile efficiency and effectively reduces carbon emissions by roughly 20%, the GreatPoint technology reduces CO2 emissions by over 20% from coal use versus conventional coal technology. Add carbon sequestration to this process and carbon emission from coal based power plants can be reduced by more than 40% while keeping coal as a fuel source! The net effect is one of replacing \$7 MMBtu natural gas with a cheaper alternative, while using less energy (and less need for imported LNG), and reduced carbon emissions - all while utilizing a resource, coal, that we have plenty of. No less a coal supporter than Senator Dorgan has told me he is a supporter of such approaches.

### Energy & the role of the "Innovation Ecosystem" as a disrupter

Massive change in our energy industries is possible. For those of you who don't believe this is possible, there are many precedents for massive change. In 1982 when I started Sun Microsystems, I was told that one could not compete against IBM, Digital Equipment Corporation, Data General, Burroughs, Control Data and other stalwarts of the computer business. Most of them are now gone and a few have adjusted, humbled by the seemingly "toyish" microprocessor. In 1996 I got in a room with the CEO's of nine major US media companies, including the Washington Post, New York Times, Knight-Ridder, Tribune, Cox, Times-Mirror and others and tried to explain how the internet would disrupt their business models, and little companies like Yahoo, Ebay, Google and others would be a threat. Today Google is worth as much as all of them combined. The pharmaceutical companies went through a similar experience, ignoring biotechnology in the early days. Ten years ago every major

telecommunications company told me that they would never adopt the internet IP protocol as their core network just as we were starting a telecommunications equipment company called Juniper to produce IP equipment. Major "experts" like AT&T laughed at the idea that all long distance calls would be virtually free to consumers. Today, for failing to heed that trend, major players like AT&T are mere brands, their company sold for a song. In each of these cases less than ten years later, yesterday's "unthinkable fact" is today's "conventional wisdom". I expect to see the same in the energy business, with biofuels cheaper than oil, with more environmentally sound power generation technologies cheaper than coal based power generation, and increases in efficiency reducing the cost of power and offering our country an economic advantage.

The country that gets to this new future first will have a significant advantage globally. Tens of new Google's and Yahoo's and Microsoft's will be created in the next two or three decades. The country to develop these technologies and companies first will have a large share of these new economic sectors. America can be that country given our large markets, our competitive advantage in innovation and technology industries, and our university and R&D system. Trillions of dollars of new market value are at stake and we are well positioned to capture this value and its associated jobs and economic growth. And we can make the whole world a better place in the process.

### Conclusion

I believe that climate change will provide an opportunity for America to shine even further by leveraging the "innovation ecosystem", our biggest economic advantage in the world economy. We can get a huge competitive advantage from our Universities and R&D ecosystem, something traditional providers of energy don't have. Investments in the clean tech sector have risen four-fold in the past 5 years, and rose 78% in 2006 to \$2.9 billion - and are

projected to grow to about \$10 billion by the end of this decade (creating 500,000 new jobs)<sup>22</sup>. The smartest people, companies, and capital are recognizing the scale of the opportunity, are recognizing the sheer size and potential present in finding new energy solutions. All of the entrepreneurs present today will not succeed, but will all of the efforts fail? As Paul Romer puts it, new technologies will help demolish the old specter of diminishing returns, which led economic thinkers such as Ricardo and Keynes to suppose that growth had its limits. Instead, these new technologies create increasing returns, because new knowledge, which begets new products, is generated through research.<sup>23</sup> The combination of brilliant ideas and entrepreneurial spirit should lead us to a safer and more secure future. The power of ideas fueled by entrepreneurial energy is our future. Climate change legislation can help us get there faster and first - ensuring American dominance in the foreseeable future.

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<sup>22</sup> <http://www.americanventuremagazine.com/articles/742>

<sup>23</sup> <http://www.versaggi.net/ecommerce/articles/romer-econideas.htm>

## Appendix A

### **COAL'S UNPOPULARITY: A RISING TREND**

*The following is a report highlighting trends in coal power plant construction. Detailed are instances in states where key decisions by regulators, public officials or utilities themselves have led to coal plant construction being postponed or canceled all together. In addition, the renewable portfolio*

*standards set by each of the 20 states that have passed them are detailed as well. Finally, maps illustrating the potential for solar, geothermal and wind energy in Nevada are included. Below are specific examples as to why, nationwide, a growing trend against coal power plant construction may be occurring.*

**Most Newly Proposed Coal Power Plants Are Never Built.** According to the Department of Energy, proposals to build new power plants are often speculative and typically operate on “boom & bust” cycles, based upon the ever changing economic climate of power generation markets. As such, many of the proposed plants will not likely be built. For example, out of a total portfolio (gas, coal, etc) of

500 GW of newly planned power plant capacity announced in 2001, 91 GW have been already been scrapped or delayed. [Tracking New Coal-Fired Power Plants: Department of Energy, 5/1/07]

**Since 2006 Nearly Two Dozen Coal Projects Have Been Canceled.** According to the National Energy Technology Laboratory, a division of the Department of Energy, nearly two dozen coal projects have been canceled since early 2006. [Tracking New Coal-Fired Power Plants: Department of Energy, 5/1/07]

**The Cost of Raw Materials Needed to Build Coal-Fired Plants Has Risen.** One industry study showed that the cost of raw construction materials such as cement and steel is far higher than thought just two years ago. [Spokesman-Review, 9/5/07]

### **COAL PROJECTS SCALED BACK: STATE SPECIFIC EXAMPLES**

*Below are highlights from states across the country where regulators or utilities themselves have taken the lead in curbing the new coal plant construction. In each instance, the decisions made were done with an eye towards concerns over public health and climate change. While the list below is not exhaustive, it provides insight into the recent decisions the could be implemented elsewhere.*

**Colorado: Colorado's Xcel Energy Agreed to Supplement its Coal Power Generated Electricity With Wind**

Power. Even in states where coal projects are going forward, they are happening more often with a nod to environmental concerns. Xcel Energy, through its Public Service of Colorado unit, agreed to obtain 775 megawatts worth of wind power to supplement the power that will come from a 750 megawatt coal plant it is building near Pueblo. It also has agreed to install more pollution controls at existing units, and to cut energy demand by more than 300 megawatts in coming years. "It will change their portfolio in a fundamental way," says Vickie Patton, senior attorney for Environmental Defense in Colorado. [Wall Street Journal, 7/25/07]

**Florida: Florida Governor Charlie Crist Celebrated the Cancellation of a Key Coal Plant Project.**

Florida Governor Charlie Crist backed up the symbolism of his meeting on global climate change in Miami with a stern rebuke to the future of coal-powered energy plants in the state. After Florida's Public Service Commission turned down an application for a coal plant in Glades County, Crist said the future of coal plants in the state is "not looking good." Crist said followed with "We're moving in a different direction." [Sarasota Herald-Tribune, 7/4/07]

**Florida Governor Charlie Crist Said Utilities Must Stop Relying on Coal and Natural Gas**

Plants. After the Public Service Commission denied Florida Power and Light Co.'s request to build a coal-fired plant in Glades County, Governor Charlie Crist hailed the decision and said that utilities must stop relying on coal and natural gas plants that generate carbon dioxide, a probable cause of global warming. [Palm Beach Post, 7/4/07]

**Kansas: Because of Colorado's Newly Enacted Renewable Energy Mandate, a Two Utility Companies Have Canceled a Coal Plant Project.**

One of the most ambitious proposals for new coal power plants in 2006 was to construct three units with a total generating capacity of 2,100 megawatts in western Kansas. The two cooperatives involved, Tri-State in Colorado and Sunflower Electric Power in Kansas, have scaled down the project to two units. One reason was that Colorado adopted a law requiring rural electric co-ops to get 10 percent of their power from renewable resources. [Washington Post, 9/4/07]

**North Carolina: Due to Rising Costs Duke Energy Was Forced By the NC Utilities Commission to Cancel a Coal Plant Project.**

Duke Energy Inc. created a stir last year when it announced that the expected cost of a new twin-unit power plant in North Carolina had ballooned to about \$3 billion, up 50% from about 18 months earlier. That run up in cost and other factors compelled the North Carolina Utilities Commission to nix one of the two proposed units. According to a recent press report, the plant that was approved is expected to cost more than \$1.8 billion. [Wall Street Journal, 7/25/07; Baltimore Sun, 9/4/07]

**Oklahoma: Oklahoma Corporation Commission Rejected Application For Coal-Fired Plant, Opponents Argue Their Decision Will Save Rate Payers Money.**

The Oklahoma Corporation Commission rejected a request from the state's three largest public utilities to proceed with plans to build a coal-fired power plant. The commission turned down the proposal by Oklahoma Gas & Electric, American

Electric-Power Service Company of Oklahoma and the Oklahoma Municipal Power Authority. The \$1.8 billion dollar plant would have been built in Red Rock in Noble County, about 80 miles north of Oklahoma City. Chesapeake Energy Corp. was one of the most ardent campaigners against the coal plant. Aubrey McClendon, the company's chairman and chief executive officer, said the decision will save consumers money in the long run. "This is a win for Oklahoma ratepayers," McClendon said. "Coal is cheap today, but we believe it won't always be cheap. It's only logical that there will be a day when something that's as detrimental to the environment and to public health is priced in a different

way. Coal has done wonderful things for our national economy in the 19th and 20th centuries, but this is the 21st century. Oklahoma needs to show leadership here. It is a great first step from these courageous Oklahoma Corporation commissioners to say no to what we think was an ill-conceived idea for the 21st century." Oklahoma Treasurer Scott Meacham also came out publicly against the

proposal, saying he was concerned with the plant's potential impact on global warming. [Daily Oklahoman, 9/11/07]

**Texas: In Order to Be Bought Out By Private Investors, Texas Utility Corporation Was Forced to Cancel Eight Coal Plant Projects.**

TXU Corp, the Texas energy giant, was faced with attacks from environmentalists after it proposed building 11 new coal plants in the state. The resulting legal skirmishes and investor concerns about the high cost of the

plants sent its share price plummeting. As a result, a weakened TXU agreed in February to reduce the number of coal plants it planned to build from 11 to three as part of a deal to sell itself to two large private equity firms for \$45 billion. [Baltimore Sun, 9/4/07]

**Washington: One Western Utility Took it Upon Itself to Shift From Coal to Renewable Energy Sources.**

Avista Utilities planned to sell more electricity generated by natural gas plants and giant windmills rather than investing in new coal power plants, according to a long-term power plan released by the company. Clint Kalich, the company's resource planning manager, said he agrees with the assessment of Puget

Sound Energy that the future of Northwest energy will be more "gassy, windy." Washington utilities submit 20-year power plans every other year to state regulators. The studies predict population and business growth and future energy needs. While the Northwest has long relied on river dams for generating ample megawatts, the future lies in underground gas stores and the wind. In a change from power planning in 2005, Avista this time around is ruling out new megawatts from coal plants. The company has also determined that building and partnering in a nuclear power plant is too expensive and too unpredictable. [Spokesman-Review, 9/5/07]

Source: <http://www.reid.senate.gov/pdfs/Coal%20Report%20-%20New%20Plant%20Construction.pdf>