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Testimony

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Hearing on the Future of Federal Coal

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Thank you for the opportunity to testify today on the subject of the future of coal and its environmental impacts. My name is David Hawkins. I am director of the Climate Center at the Natural Resources Defense Council (NRDC). NRDC is a national, nonprofit organization of scientists, lawyers and environmental specialists dedicated to protecting public health and the environment. Founded in 1970, NRDC has more than 1.2 million members and online activists nationwide, served from offices in New York, Washington, Los Angeles and San Francisco.

One of the primary reasons that the electric power, chemical, and liquid fuels industries have become increasingly interested in coal gasification technology in the last several years is the volatility and high cost of both natural gas and oil. Coal has the advantages of being a cheap, abundant, and a domestic resource compared with oil and natural gas. However, the disadvantages of conventional coal use cannot be ignored. From underground accidents and mountain top removal mining, to collisions at coal train crossings, to air emissions of acidic, toxic, and heat-trapping pollution from coal combustion, to water pollution from coal mining and combustion wastes, the conventional coal fuel cycle is among the most environmentally destructive activities on earth.

But we can do better with both production and use of coal. And because the world is likely to continue to usesignificant amounts of coal for some time to come, we must do better. Energy efficiency remains the cheapest, cleanest, and fastest way to meet our energy and environmental challenges, while renewable energy is the fastest growing supply option. Increasing energy efficiency and expanding renewable energy supplies must continue to be the top priority, but we have the tools to make coal more compatible with protecting public health and the environment. With the right standards and incentives we can fundamentally transform the way coal is produced and used in the United States and around the world.

In particular, coal use and climate protection do not need to be irreconcilable activities. While energy efficiency and greater use of renewable resources must remain core components of a comprehensive strategy to address global warming, development and use of technologies such as coal gasification in combination with carbon dioxide (CO_2) capture and permanent disposal in geologic repositories under certain circumstances could enhance our ability to avoid a dangerous build-up of this heat-trapping gas in the atmosphere while creating a future for continued coal use.

However, because of the long lifetime of carbon dioxide in the atmosphere and the slow turnover of large energy systems we must act without delay to start deploying these technologies. Current government policies are inadequate to drive the private sector to invest in carbon capture and storage systems in the timeframe we need them. To accelerate the development of these systems and to create the market conditions for their use, we need to focus government funding more sharply on the most promising technologies. More importantly, we need to adopt reasonable binding measures to limit global warming emissions so that the private sector has a business rationale for prioritizing investment in this area.

Congress is now considering proposals to gasify coal as a replacement for natural gas and oil. These proposals need to be evaluated in the context of the compelling need to reduce global warming emissions steadily and significantly, starting now and proceeding constantly throughout this century. Because today’s coal mining and use also continues to impose a heavy toll on America’s land, water, and air, damaging human health and the environment, it is also critical to examine the implications of a substantial coal gasification program on these values as well.

Reducing Natural Gas and Oil Demand

The nation's economy, our health and our quality of life depend on a reliable supply of affordable energy services. The most significant way in which we can achieve these national goals is to exploit the enormous scope to wring more services out of each unit of energy used and by aggressively promoting renewable resources. While c oal gasification technology has been touted as the technology solution to supplement our natural gas and oil supply and reduce our dependence on natural gas and oil imports, the most effective way to lower natural gas and oil demand, and prices, is to waste less. America needs to first invest in energy efficiency and conservation to reduce demand, and to second promote renewable energy alternatives to supplement supply. Gasified coal may have a role to play, but in both the short-term and over the next two decades, efficiency and renewables are the lead actors in an effective strategy to moderate natural gas and oil prices and balance our demand with reasonable expectations of supply.

Natural Gas

We know that today's natural gas prices have had a particularly significant impact on the agricultural sector by raising the cost of making fertilizer among other products. We agree that effective steps should be taken to fix this problem. In our view a package of measures to increase the efficiency of current gas uses, substitution of renewable energy for other gas uses, and judicious use of coal gasification with CO 2 capture and disposal would be the most effective program. With respect to the coal gasification component of this policy package, it is important to address and prevent the additional harmful impacts to land and water that would result if incremental coal production were carried out with current mining and production practices. As pointed out in Appendix A, current practices are causing unacceptable and avoidable levels of damage to land, water and mining communities.

Increasing energy efficiency is far-and-away the most cost-effective way to reduce natural gas consumption, void emitting carbon dioxide and other damaging environmental impacts. Technologies range from efficient lighting, including emerging L.E. D. lamps, to advanced selective membranes which reduce industrial process energy needs. Critical national and state policies include appliance efficiency standards, performance-based tax incentives, utility-administered deployment programs, and innovative market transformation strategies that make more efficient designs standard industry practice.

Conservation and efficiency measures such as these can have dramatic impacts in terms of price and savings. Moreover, all of these untapped gas efficiency "resources" will expand steadily, as a growing economy adds more opportunities to secure long-lived savings. California has a quarter century record of using comparable strategies to reduce both natural gas consumption and the accompanying utility bills. Recent studies commissioned by the Pacific Gas & Electric Company indicate that, by 2001, longstanding incentivesand standards targeting natural gas equipment and use had cut statewide consumption for residential, commercial, and industrial purposes (excluding electric generation) by more than 20 percent.

Renewables can also play a key role in reducing natural gas prices. Adoption of a national renewable energy standard (RES) can significantly reduce the demand for natural gas, alleviating potential shortages. The Energy Information Administration (EIA) has found that a national 10 percent renewable energy standard could reduce gas consumption by 1.4 trillion cubic feet per year in 2020 compared to business as usual, or roughly 5 percent of annual demand.

Studies have consistently shown that reducing demand for natural gas by increasing renewable energy use will reduce natural gas prices. According to a report released by the U.S. Department of Energy's Lawrence Berkeley National Laboratory, "studies generally show that each 1% reduction in national gas demand is ikelyto lead to a long-term (effectively permanent) average reduction in wellhead gas prices of 0.8% to 2%. Reductions in wellhead prices will reduce wholesale and retail electricity rates and will also reduce residential, commercial, and industrial gas bills." EIA found that increasing renewable energy to 10 percent by 2020 would result in $4.9 billion cumulative present value savings for industrial gas consumers, $1.8 billion to commercial customers, and $2.4 billion to residential customers. EIA also found that renewable energy can also reduce electricity bills. Lower natural gas prices for electricity generators and other consumers offset the slightly higher cost of renewable electricity technology.

Implementing effective energy efficiency measures is the fastest and most cost effective approach to balancing natural gas demand and supply. Renewable energy provides a critical mid-term to long-term supplement. Analysis by the Union of Concerned Scientists found that a combined efficiency and renewable energy cenariocould reduce gas use by 31 percent and natural gas prices by 27 percent compared to business as usual in 2020.

In contrast to these strategies, pursuing coal gasification implementation strategies that address only natural gas supply concerns, while ignoring impacts of coal, is a recipe for huge and costly mistakes. Fortunately, we have in our tool box energy resource options that can reduce natural gas demand and global warming emissions as well as protecting America's land, water, and air.

Oil

NRDC fully agrees that reducing oil dependence should be a national priority and that new policies and programs are needed to avert the mounting problems associated with today's dependence and the much greater dependence that lies ahead if we do not act. A critical issue is the path we pursue in reducing oil ependence: a "green" path that helps us address the urgent problem of global warming and our need to reduce the impacts of energy use on the environment and human health; or a "brown" path that would increase global warming emissions as well as other health and environmental damage. In deciding what role coal might play as a source of transportation fuel NRDC believes we must first assess whether it is possible to use coal to make liquid fuels without exacerbating the problems of global warming, conventional air pollution and impacts of coal production and transportation.

If coal were to play a significant role in displacing oil, it is clear that the enterprise would be huge, so the health and environmental stakes are correspondingly huge. The coal company Peabody Energy is promoting a vision that would call for production of 2.6 million barrels per day of synthetic transportation fuel from coal by 2025, about 10% of forecasted oil demand in that year. According to Peabody, using coal to achieve that mount of crude oil displacement would require construction of 33 very large coal-to-liquids plants, each plant consuming 14.4 million tons of coal per year to produce 80,000 barrels per day of liquid fuel. Each of these plants would cost $6.4 billion to build. Total additional coal production required for this program would be 475 million tons of coal annually—requiring an expansion of coal mining of 43% above today's level.

This testimony does not attempt a thorough analysis of the impacts of a program of this scale. Rather, it will highlight the issues that should be addressed in a detailed assessment.

Environmental Impacts of Coal

Some call coal "clean." It is not and likely never will be compared to other energy options. Nonetheless, it appears inevitable that the U.S. and other countries will continue to rely heavily on coal for many years. The good news is that with the right standards and incentives it is possible to chart a future for coal that is compatible with protecting public health, preserving special places, and avoiding dangerous global warming. It may not be possible to make coal clean, but by transforming the way coal is produced and used, it is possible to make coal dramatically cleaner - and safer - than it is today.

Global Warming Pollution

To avoid catastrophic global warming the U.S. and other nations will need to deploy energy resources that result in much lower releases of CO_2 than today's use of oil, gas and coal. To keep global temperatures from rising to levels not seen since before the dawn of human civilization, the best expert opinion is that we need to get on a pathway now to allow us to cut global warming emissions by 60-80% from today's levels over the decades ahead. The technologies we choose to meet our future energy needs must have the potential to perform at these improved emission levels.

Most serious climate scientists now warn that there is a very short window of time for beginning serious emission reductions if we are to avoid truly dangerous greenhouse gas reductions without severe economic impact. Delay makes the job harder. The National Academy of Sciences recently stated: "Failure to implement significant reductions in net greenhouse gases will make the job much harder in the future – both in terms of stabilizing their atmospheric abundances and in terms of experiencing more significant impacts."

In short, a slow start means a crash finish – the longer emissions growth continues, the steeper and more disruptive the cuts required later. To prevent dangerous global warming we need to stabilize atmospheric concentration at or below 450 ppm, which would keep total warming below 2 degrees Celsius (3.6 degrees Fahrenheit). If we start soon, we can stay on the 450 ppm path with an annual emission reduction rate that gradually ramps up to about 2.4% per year. But if we delay a serious start by 10 years and continue emission growth at the business-as-usual trajectory, the annual emission reduction rate required to stay on the 450 ppm pathway jumps almost 3-fold, to 6.9% per year. (See Figure 1, attached.) Even if you do not accept today that the 450 ppm path will be needed please consider this point. If we do not act to preserve our ability to get on this path we will foreclose the path not just for ourselves but for our children and their children. We are now going down a much riskier path and if we do not start reducing emissions soon neither we nor our children can turn back no matter how dangerous the path becomes.

In the past, some analysts have argued that the delay/crash action scenario is actually the cheaper course, because in the future (somehow) we will have developed breakthrough technologies. But it should be apparent that the crash reductions scenario is implausible for two reasons. First, reducing emissions by 6.9 percent per year would require deploying advanced low-emission technologies at least several times faster than *onventional* technologies have been deployed over recent decades. Second, the effort would require prematurely retiring billions of dollars in capital stock – high-emitting power plants, vehicles, etc. – that will be built or bought during the next 10-20 years under in the absence of appropriate CO_2 emission limits.

It also goes without saying that U.S. leadership is critical. Preserving the 450 ppm pathway requires other developed countries to reduce emissions at similar rates, and requires the key developing countries to dramatically reduce and ultimately reverse their emissions growth. U.S. leadership can make that happen faster.

To assess the global warming implications of a large coal gasification program we need to carefully examine the total life-cycle emissions associated with the end product, whether electricity, synthetic gas, liquid fuels or chemicals, and to assess if the relevant industry sector will meet the emission reductions required to be consistent with the “green” pathway presented in Figure 1.

Electricity Sector

More than 90 percent of the U.S. coal supply is used to generate electricity in some 600 coal-fired power plants scattered around the country, with most of the remainder used for process heat in heavy industrial and in steel production. Coal is used for power production in all regions of the country, with the Southeast, Midwest, and Mountain states most reliant on coal-fired power. Texas uses more coal than any other state, followed by Indiana, Illinois, Ohio, and Pennsylvania.

About half of the U.S. electricity supply is generated using coal-fired power plants. This share varies considerably from state to state, but even California, which uses very little coal to generate electricity within its borders, consumes a significant amount of electricity generated by coal in neighboring Arizona and Nevada, bringing coal’s share of total electricity consumed in California to 20 percent. National coal-fired capacity totals 330 billion watts (GW), with individual plants ranging in size from a few million watts (MW) to over 3000 MW. More than one-third of this capacity was built before 1970, and over 400 units built in the 1950s—with capacity equivalent to roughly 100 large modern plants (48 GW)—are still operating today.

The future of coal in the U.S. electric power sector is an uncertain one. The major cause of this uncertainty is the government’s failure to define future requirements for limiting greenhouse gas emissions, especially carbon dioxide (CO_2). Coal is the fossil fuel with the highest uncontrolled CO_2 emission rate of any fuel and is responsible for 36 percent U.S. carbon dioxide emissions. Furthermore, coal power plants are expensive, long-lived investments. Key decision makers understand that the problem of global warming will need to be addressed within the time needed to recoup investments in power projects now in the planning stage. Since the status quo is unstable and future requirements for coal plants and other emission sources are inevitable but unclear, there will be increasing hesitation to commit the large amounts of capital required for new coal projects.

Electricity production is the largest source of global warming pollution in the U.S. today. In contrast to nitrogen and sulfur oxide emissions, which have declined significantly in recent years as a result of Clean Air Act standards, CO_2 emissions from power plants have increased by 27 percent since 1990. Any solution to global warming must include large reductions from the electric sector. Energy efficiency and renewable energy are well-known low-carbon methods that are essential to any climate protection strategy. But technology exists to create a more sustainable path for continued coal use in the electricity sector as well. Coal gasification can be compatible with significantly reducing global warming emissions in the electric sector if it replaces conventional coal combustion technologies, directly produces electricity in an integrated manner, and most importantly captures and disposes of the carbon in geologic formations. IGCC technology without CO_2 capture and disposal achieves only modest reductions in CO_2 emissions compared to conventional coal plants.

A coal integrated gasification combined cycle (IGCC) power plant with carbon capture and disposal can capture up to 90 percent of its emissions, thereby being part of the global warming solution. In addition to enabling lower-cost CO_2 capture, gasification technology has very low emissions of most conventional pollutants and can achieve high levels of mercury control with low-cost carbon-bed systems. However, it still does not address the other environmental impacts from coal production and transportation discussed in more etail in Appendix A.

The electric power industry has been slow to take up gasification technology but two commercial-scale units are operating in the U.S.—in Indiana and Florida. The Florida unit, owned by TECO, is reported by the company to be the most reliable and economic unit on its system. Two coal-based power companies, AEP and Cinergy, have announced their intention to build coal gasification units. BP also has announced plans to build a petroleum coke gasification plant that will capture and sequester CO_2.

Liquid Fuels

To assess the global warming implications of a large coal-to-liquids program we need to examine the total life-cycle or "well-to-wheel" emissions of these new fuels. Coal is a carbon-intensive fuel, containing double the amount of carbon per unit of energy compared to natural gas and about 20% more than petroleum. When coal is converted to liquid fuels, two streams of CO_2 are produced: one at the coal-to-liquids production plant and the second from the exhausts of the vehicles that burn the fuel. With the technology in hand today and on the horizon it is difficult to see how a large coal-to-liquids program can be compatible with the low-CO_2-emitting transportation system we need to design to prevent global warming.

Today, our system of refining crude oil to produce gasoline, diesel, jet fuel and other transportation fuels, results in a total "well to wheels" emission rate of about 27.5 pounds of CO_2 per gallon of fuel. Based on available information about coal-to-liquids plants being proposed, the total well to wheels CO_2 emissions from such plants would be about 49.5 pounds of CO_2 per gallon, nearly twice as high as using crude oil, if the CO_2 from the coal-to-liquids plant is released to the atmosphere. Obviously, introducing a new fuel system with double the CO_2 emissions of today's crude oil system would conflict with the need to reduce global warming emissions. If the CO_2 from coal-to-liquids plants is captured, then well-to-wheels CO_2 emissions would be reduced but would still be higher than emissions from today's crude oil system.

This comparison indicates that using coal to produce a significant amount of liquids for transportation fuel would not be compatible with the need to develop a low-CO_2 emitting transportation sector unless technologies are developed to significantly reduce emissions from the overall process. But here one confronts the unavoidable fact that the liquid fuel from coal contains the same amount of carbon as is in gasoline or diesel made from crude. Thus, the potential for achieving significant CO_2 emission reductions compared to crude is inherently limited. This means that using a significant amount of coal to make liquid fuel for transportation needs would make the task of achieving any given level of global warming emission reduction much more difficult. Proceeding with coal-to-liquids plants now could leave those investments stranded or impose unnecessarily high abatement costs on the economy if the plants continue to operate.

Synthetic Gas

Another area that has received interest is coal gasification to produce synthetic natural gas as a direct method of supplementing our natural gas supply from domestic resources. However, without CO_2 capture and disposal this process results in more than twice as much CO_2 per 1000 cubic feet of natural gas consumed compared to conventional resources. From a global warming perspective this is unacceptable. With capture and disposal the CO_2 emissions can be substantially reduced, but still remain 12 percent higher than natural gas.

In Beulah, North Dakota the Basin Electric owned Dakota Gasification Company's Great Plains Synfuels Plant is a 900MW facility which gasifies coal to produce synthetic "natural" gas. It can produce a 150 million cubic feet of synthetic gas per day and 11,000 tons of CO_2 per day. However, it no longer releases all of its CO_2 to the atmosphere, but captures most of it and pipes it 200 miles to an oil field near Weyburn, Saskatchewan. There the CO_2 is pumped underground into an aging oil field to recover more oil. EnCana, operator of this oil field, pays $2.5 million per month for the CO_2. They expect to sequester 20 million tons of CO_2 over the lifetime of this injection project.

A potential use for coal-produced synthetic gas would be to burn it in a gas turbine at another site for lectricity generation. This approach would result in substantially higher CO_2 emissions than producing electricity in an integrated system at the coal gasification plant with CO_2 capture at the site (i.e., in an IGCC plant with carbon capture and disposal). Coal produced synthetic natural gas could also be used directly for home heating. As a distributed source of emissions the CO_2 would be prohibitive to capture with known technology.

Before producing synthetic pipeline gas from coal a careful assessment of the full fuel cycle emission implications and the emission reductions that are required from that sector must be carried out before decisions are made to invest in these systems.

Chemical Products

The chemical industry has also been looking carefully at coal gasification technology as a way to replace the natural gas feedstock used in chemical production. The motivator has been the escalating and volatile costs of natural gas in the last few years. A notable example in the U.S. of such a use is the Tennessee Eastman plant, which has been operating for more than 20 years using coal instead of natural gas to make chemicals and industrial feedstocks. If natural gas is replaced by coal gasification as a feedstock for the chemical industry, first and foremost CO_2 capture and disposal must be an integral part of such plants. In this case, the net global warming emissions will change relatively little from this sector. However, before such a transformation occurs a careful analysis of the life cycle emissions needs to be carried out along with an assessment of how future emissions reductions from this sector can be most effectively accomplished.

CO_2 Capture and Disposal

Methods to capture CO_2 from industrial gas streams have been in use for decades. In the U.S., for example, they are used to separate CO_2 from "sour gas" at natural gas processing plants and are even in use at a few coal-fired power plants to produce CO_2 for sale to the food and beverage industries. As previously mentioned, in North Dakota a large coal gasification plant captures CO_2 and ships it by pipeline to an oil field in Saskatchewan, where it is injected to produce additional oil. In Wyoming, a large gas processing plant captures CO_2 for sale to oil field operators in that state and in Colorado. Smaller plants in Texas do the same thing to serve oil fields in the Permian Basin.

Once captured, the CO_2 must be disposed of and the currently viable approach is to inject the CO_2 into deep geologic formations that are capable of permanently retaining it. Geologic injection of CO_2 has been underwayin the U.S. for a couple of decades as a method for producing additional oil from declining fields. Today, oil companies inject about 30 million tons annually into fields in the Permian Basin, Wyoming, Colorado and other states.

Because industrial sources can emit CO_2 for free under current U.S. policy, most of the injected CO_2 is supplied from natural CO_2 reservoirs, rather than being captured from emission sources. Ironically, due to the lack of emission limits and the limited number of natural CO_2 fields, a CO_2 supply shortage is currently constraining enhanced oil recovery from existing fields. There is, of course, a huge supply of CO_2 from power plants and other sources that would become available to supply this market, but that will not happen as long as CO_2 can be emitted at no cost.

Such enhanced oil recovery (EOR) operations are regulated to prevent releases that might endanger public ealth or safety but they are not monitored with any techniques that would be capable of detecting smaller leak rates. Small leak rates might pose no risk to the local surroundings but over time could undercut the effectiveness of geologic storage as a CO_2 control technique. Especially in EOR operations, the most likely pathways for leakage would be through existing wells penetrating the injection zone.

Much of the injected CO_2 is also brought back to the surface with the oil produced by this technique. That CO_2 is typically reinjected to recover additional oil, but when oil operations are completed it may be necessary to inject the CO_2 into a deeper geologic formation to ensure permanent storage.

In addition to these EOR operations, CO_2 is being injected in large amounts in several other projects around the world. The oldest of these involves injection of about 1 million tons per year of CO_2 from a natural gas platform into a geologic formation beneath the sea bed off the coast of Norway. The company decided to injectthe CO_2 rather than vent it to avoid paying an emission charge adopted by the Norwegian government—a clear example of the ability of emission policies to produce the deployment of this technology. The Norwegian operation is intensively monitored and the results from over seven years of operation indicate the CO_2 is not migrating in a manner that would create a risk of leakage. Other large-scale carefully monitored operations are underway at the Weyburn oil field in Saskatchewan and the In Salah natural gas field in Algeria.

While additional experience with large-scale injection in various geologic formations is needed, we believe enough is known to expand these activities substantially under careful procedures for site selection, operating requirements and monitoring programs. The imperative of avoiding further carbon lock-in due to construction of conventional coal-fired power plants and the capabilities of CO_2 capture and disposal technologies today warrant policies to deploy these methods at coal gasification plants without further delay.

Conventional Air Pollution

Dramatic reductions in power plant emissions of criteria pollutants, toxic compounds, and global warming emissions are essential if coal is to remain a viable energy resource for the 21st Century. Such reductions are achievable in integrated gasification combined cycle (IGCC) systems, which enable cost-effective advanced pollution controls that can yield extremely low criteria pollutant and mercury emission rates and facilitates carbon dioxide capture and geologic disposal. Gasifying coal at high pressure facilitates removal of pollutants that would otherwise be released into the air such that these pollutant emissions are well below those from conventional pulverized coal power plants with post combustion cleanup.

Conventional air emissions from coal-to-liquids plants include sulfur oxides, nitrogen oxides, particulate matter, mercury and other hazardous metals and organics. While it appears that technologies exist to achieve high levels of control for all or most of these pollutants, the operating experience of coal-to-liquids plants in South Africa demonstrates that coal-to-liquids plants are not inherently "clean." If such plants are to operate with minimum emissions of conventional pollutants, performance standards will need to be written—standards that do not exist today in the U.S. as far as we are aware.

In addition, the various federal emission cap programs now in force would apply to few, if any, coal-to-liquids plants.

Thus, we cannot say today that coal-to-liquids plants will be required to meet stringent emission performance standards adequate to prevent either significant localized impacts or regional emissions impacts.

Mining, Processing and Transporting Coal

The impacts of mining, processing, and transporting 1.1 billion tons of coal today on health, landscapes, and water are large. To understand the implications of continuing our current level of as well as expanding coal production, it is important to have a detailed understanding of the impacts from today's level of coal production. A summary is included in Appendix A. It is clear that we must find more effective ways to reduce the impacts of mining, processing and transporting coal before we follow a path that would result in even larger amounts of coal production and transportation.

"Carbon Capture Ready" and the "Energy Policy Act of 2005"

Among the various environmental concerns associated with coal use, the global warming emissions are particularly critical as coal fired power generation emits more carbon dioxide per unit of energy than any other ower generating process. It is clear that for coal to remain a major source of electricity generation within a carbon constrained world, carbon capture and disposal technologies will have to be deployed in conjunction coal fired power plants.

The required elements of a coal-based CO_2 capture and disposal (CCD) system have all been demonstrated at commercial scale in numerous projects around the world. But there is large potential for optimization of each element to bring down costs and improve efficiency. In addition, the experience with large scale injection of CO_2 into geologic formations is still limited.

In the "Energy Policy Act of 2005" (EPACT05), while there are myriad incentives for deploying coal gasification technology, there are no requirements to include CO_2 capture and disposal. Scattered throughout the Act is language referring to the *capability* of coal gasification technology to capture its carbon emissions or to be "carbon capture ready". However, nothing requires the facilities to actually capture and dispose of their CO_2 emissions. Several examples are the following:

- Title IV – Coal - section 413 (b)(3) Western Integrated Coal Gasification Demonstration Project: "Shall be capable of removing and sequestering carbon dioxide emissions."
- Title VIII - Hydrogen – section 805(e)(1)(A) "Fossil fuel, which may include carbon capture and sequestration;"
- Title X111 – Energy Policy Tax Incentives - section 1307(b) "Sec. 48A. (c) Definitions (5) GREENHOUSE GAS CAPTURE CAPABILITY- The term `greenhouse gas capture capability' means an integrated gasification combined cycle technology facility capable of adding components which can apture, separate on a long-term basis, isolate, remove, and sequester greenhouse gases which result from the generation of electricity."

"Sec. 48B. (c) Definitions (5) CARBON CAPTURE CAPABILITY- The term `carbon capture capability' means a gasification plant design which is determined by the Secretary to reflect reasonable consideration for, and be capable of, accommodating the equipment likely to be necessary to capture carbon dioxide from the gaseous stream, for later use or sequestration, which would otherwise be emitted in the flue gas from a project which uses a nonrenewable fuel."

- Title XVII – Incentives for Innovative Technologies – Section 1703(c)(1)(A)(ii) "that have a design that is determined by the Secretary to be capable of accommodating the equipment likely to be necessary to capture the carbon dioxide that would otherwise be emitted in flue gas from the plant;"

The issue I would like to address here is the definition of "carbon capture ready." Adding carbon capture capabilities to a coal gasification power plant is not a simple modification. Without any current regulatory or economic incentives for these facilities to capture and dispose of their carbon emissions the extent of the capture modifications that will be incorporated into the gasification facilities remains extremely unclear. I would, in fact, argue that due to the vagueness of this term the result will be a "race to the bottom", a minimal effort to incorporate the necessary design elements and equipment that would allow coal gasification plants to qualify for EPACT05 incentives.

What are the required technical details associated with coupling coal gasification plants with carbon capture and disposal? Carbon capture in a coal gasification plant occurs after the coal gasification process. I will focus on the case for electricity generation (an IGCC plant) where the syngas produced then enters a gas turbine. It is at this stage that the chemical process can be inserted to separate and capture the CO_2 and other pollutants from the syngas. Once the CO_2 is separated it can be transported to a disposal location.

In addition to adding the CO_2 separation and capture equipment, changes in other components are also necessary for electricity generation case. The removal of CO_2 prior to combustion in the turbine alters the composition of the gas to be burned, increasing the hydrogen content, which may affect the design or operational requirements of the turbine. In addition, the CO_2 capture process may alter the optimal design of the desulphurization and other gas clean-up processes. For these reasons, an IGCC plant built without consideration for CO_2 capture technology designed to produce power at a minimum cost and maximum efficiency will be significantly different than an IGCC plant designed to incorporate CO_2 capture technology.

"Three major technological components need to be added to a basic IGCC plant to allow for separation and capture of the CO_2: (1) the shift reactor to convert the CO in the syngas to CO_2, (2) the process to separate the CO_2 from the rest of the gas stream, and (3) a compressor to reduce the volume of separated CO_2 before it can be transported." Furthermore, other components will require modification, as previously mentioned, including the gas turbine that will have to be capable of operating with a hydrogen enriched gas stream, the timing of the sulphur removal process, plus some scaling up to accommodate the larger quantities of coal needed to generate the same amount of power.

A further consideration is the CO_2 transportation and disposal. Once the CO_2 is captured and compressed at the plant it must be transported and injected into an underground geologic formation. Therefore, the location ofthe plant can also become a significant factor in the ease of transformation.

What should be clear from this listing of requirements for integrating capture and disposal of CO_2 into an existing IGCC plant is that the term "carbon capture ready" could encompass a whole host of definitions. Does it simply mean that one builds an IGCC plant? Does it mean that you leave space in the design for separation, capture and compression equipment? Does it mean you include the appropriate turbine to burn a high H_2 gas stream? Does it mean you locate the plant within proximity to a geologic reservoir where the CO_2 can be disposed of? The list and variations of the possibilities could go on and on, calling into question whether the term "carbon capture ready " has any real meaning.

The likely result is that companies when taking advantage of the coal gasification incentives provided in the "Energy Policy Act of 2005" will follow the least cost option, i.e., build an IGCC plant with little or no design lements necessary for the future integration of CO_2 capture and disposal -- unless there is a clear policy to reduce CO_2 emissions or if it is required that they include all the necessary equipment to capture their CO_2.

NRDC strongly advocates that all government funds that leverage the building of coal gasification plants should only go to those facilities that actually capture their CO_2. Subsidizing gasification by itself wastes taxpayers' money by subsidizing the wrong thing. Gasification is commercial and needs no subsidy but capture and storage is the primary policy objective and is likely to require subsidies pending adoption of CO_2 emission control requirements.

The first proposed coal gasification plant that will capture and dispose of its CO_2 was recently announced on February 10, 2006 by BP and Edison Mission Group. The plant will be built in Southern California and its CO_2 emissions will be pipelined to an oil field nearby and injected into the ground to recover domestic oil. BP's roposal shows the technologies are available now to cut global warming pollution and that integrated IGCC with CO_2 capture and disposal are commercially feasible .

The Path Forward

The impacts that a large coal gasification program could have on global warming pollution, conventional air pollution and environmental damage resulting from the mining, processing and transportation of the coal are substantial. Before deciding whether to invest scores, perhaps hundreds of billions of dollars in deploying this technology, we must have a program to manage our global warming pollution and other coal related impacts. Otherwise we will not be developing and deploying an optimal energy system.

One of the primary motivators for pushing coal gasification technologies has been to reduce natural gas prices. Fortunately, the U.S. can have a robust and effective program to reduce natural gas demand, and therefore prices, without rushing to embrace coal gasification technologies. A combination of efficiency and renewables can reduce our natural gas demand more quickly and more cleanly.

Implementing effective energy efficiency measures is the fastest and most cost effective approach to reducing natural gas demand. Efficiency standards, performance-based tax incentives, utility-administered deployment programs, and innovative market transformation strategies will bring energy efficient technologies to market and make efficient designs standard industry practice.

Renewable energy provides a critical mid-term to long-term supplement to natural gas use. Potential renewable resources in the U.S. are significant and renewable electricity generation is expanding rapidly, with wind and biomass currently offering the most cost-effective power in both countries. Some 20 U.S. states have adopted renewable portfolio standards requiring electricity providers to obtain a minimum portion of their portfolio from renewable resources. Federal tax incentives have also played an important role, particularly for wind.

The other major motivator for the push to use coal gasification is to produce liquid fuels to reduce our oil dependence. The U. S. can have a robust and effective program to reduce oil dependence without rushing into an embrace of coal-to-liquids technologies. A combination of more efficient cars, trucks and planes, biofuels, and “smart growth” transportation options outlined in report “Securing America,” produced by NRDC and the Institute for the Analysis of Global Security, can cut oil dependence by more than 3 million barrels a day in 10 years, and achieve cuts of more than 11 million barrels a day by 2025, far outstripping the 2.6 million barrel a day program being promoted by Peabody. For further details see Appendix B.

To reduce our dependence on natural gas and oil we should follow a simple rule: start with the measures that will produce the quickest, cleanest and least expensive reductions in natural gas use; measures that will put us on track to achieve the reductions in global warming emissions we need to protect the climate. If we are thoughtful about the actions we take, our country can pursue an energy path that enhances our security, our economy, and our environment.

With current coal and oil consumption trends, we are headed for a doubling of CO_2 concentrations by mid-century if we don’t redirect energy investments away from carbon based fuels and toward new climate friendly energy technologies.

We have to accelerate the progress underway and adopt policies in the next few years to turn the corner on our global warming emissions, if we are to avoid locking ourselves and future generations into a dangerously disrupted climate. Scientists are very concerned that we are very near this threshold now. Most say we must keep atmosphere concentrations of CO_2 below 450 parts per million, which would keep total warming below 2 degrees Celsius (3.6 degrees Fahrenheit). Beyond this point we risk severe impacts, including the irreversible collapse of the Greenland Ice Sheet and dramatic sea level rise. With CO_2 concentrations now rising at a rate of 1.5 to 2 parts per million per year, we will pass the 450ppm threshold within two or three decades unless we change course soon.

In the United States, a national program to limit carbon dioxide emissions must be enacted soon to create the market incentives necessary to shift investment into the least-polluting energy technologies on the scale and timetable that is needed. There is growing agreement between business and policy experts that quantifiable and enforceable limits on global warming emissions are needed and inevitable. To ensure the most cost-effective reductions are made, these limits can then be allocated to major pollution sources and traded between companies, as is currently the practice with sulfur emissions that cause acid rain. Targeted energy efficiency and renewable energy policies are critical to achieving CO_2 limits at the lowest possible cost, but they are no substitute for explicit caps on emissions.

A coal integrated gasification combined cycle (IGCC) power plant with carbon capture and disposal can also be part of a sustainable path that reduces both natural gas demand and global warming emissions in the electricity sector. Methods to capture CO_2 from coal gasification plants are commercially demonstrated, as is the injection of CO_2 into geologic formations for disposal. On the other hand, coal gasification to produce a significant amount of liquids for transportation fuel would not be compatible with the need to develop a low-CO_2 emitting transportation sector. Finally, gasifying coal to produce synthetic pipeline gas or chemical products needs a careful assessment of the full life cycle emission implications and the emission reductions that are required from those sectors before decisions are made to invest in these systems.

In the absence of a program that requires limits on CO_2 emissions IGCC systems with carbon capture and disposal will not be brought to market in time. We need to combine CO_2 limits with financial incentives to start building these integrated plants now, because industry is already building and designing the power plants that we will rely on for the next 40-80 years.

David Hawkins, Testimony before the Senate Energy and Natural Resources Committee, “Coal Liquefaction and Gasification”, April 24th, 2006. http://docs.nrdc.org/globalwarming/glo_06042401a.pdf; Antonia Herzog, Testimony before the Senate Energy and Natural Resources Committee, “Coal Gasification”, May 1, 2006.

American Council for an Energy-Efficient Economy (ACEEE), Fall 2004 Update on Natural Gas Markets, November 3, 2004. *See also* Consumer Federation of America, “Responding to Turmoil in Natural Gas Markets: The Consumer Case for Aggressive Policies to Balance Supply and Demand,” December 2004, pp. 28, 11 (“[V]igorous efforts to improve efficiency” should be the first policy option pursued, because even small reductions in natural gas consumption can have a significant downward impact on prices.)

EIA, Impacts of a 10-Percent Renewable Portfolio Standard, SR/OIAF/2002-03, February 2002. EIA, Analysis of a 10-

Percent Renewable Portfolio Standard, SR/OIAF/2003-01, May 2003. Union of Concerned Scientists, *Clean Energy Blueprint: A Smarter National Energy Policy for Today and the Future*, October 2001.

U.S. Department of Energy, Lawrence Berkeley National Laboratory, *Easing the Natural Gas Crisis: Reducing Natural Gas Prices Through Increased Deployment of Renewable Energy and Energy Efficiency*, January, 2005, p. 13.

EIA, Impacts of a 10-Percent Renewable Portfolio Standard, SR/OIAF/2002-03, February 2002.

Id. at Figure 3.

UCS, *Renewable Energy Can Help Alleviate Natural Gas Crisis*, June 2003, at 2.

UCS, *Clean Energy Blueprint: A Smarter National Energy Policy for Today and the Future*, October 2001.

Peabody's "Eight-Point Plan" calls for a total of 1.3 billion tons of additional coal production by 2025, proposing that coal be used to produce synthetic pipeline gas, additional coal-fired electricity, hydrogen, and fuel for ethanol plants. The entire program would more than double U.S. coal mining and consumption.

National Academy of Sciences, *Understanding and Responding to Climate Change: Highlights of National Academies Reports*, p.16 (October 2005), http://dels.nas.edu/dels/rpt_briefs/climate-change-final.pdf.

http://www.eia.doe.gov/cneaf/coal/page/acr/table26.html

California Energy Commission, 2005. 2004 Net System Power Calculation (April.) Table 3: Gross System Power. http://www.energy.ca.gov/2005publications/CEC-300-2005-004/CEC-300-2005-004.PDF

Calculated well to wheel CO 2 emissions for coal-based "Fischer-Tropsch" are about 1.8 greater than producing and consuming gasoline or diesel fuel from crude oil. If the coal-to-liquids plant makes electricity as well, the relative emissions from the liquid fuels depends on the amount of electricity produced and what is assumed about the emissions of from an alternative source of electricity.

Capturing 90 percent of the emissions from coal-to-liquid plants reduces the emissions from the plant to levels close to those from petroleum production and refining while emissions from the vehicle are equivalent to those from a gasoline vehicle. With such CO 2 capture, well to wheels emissions from coal-to-liquids fuels would be 8 percent higher than for petroleum.

The National Coal Council, "Coal: America's Energy Future," March 22, 2006. This report actually assumes a less efficient coal to synthetic gas conversion process of 50% leading to three times as much CO 2 per 1000 cubic feet of natural gas consumed compared to conventional resources.

The sulfur and nitrogen caps in EPA's "Clean Air Interstate Rule" ("CAIR") may cover emissions from coal-to-liquids plants built in the eastern states covered by the rule but would not apply to plants built in the western states. Neither the national "acid rain" caps nor EPA's mercury rule would apply to coal-to-liquids plants.

Jennie Stephens, "Coupling CO 2 capture and Storage with Coal Gasification: Defining "Sequestration-Ready" IGCC", BCSIA Discussion Paper 2005-09, Energy technology Innovation Project, Kennedy School of Government, Harvard University, 2005.

Id. p.3.

"Securing America: Solving our Oil Dependence through Innovation", NRDC and IAGS report, February 2005. http://www.nrdc.org/air/transportation/oilsecurity/plan.pdf.