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Hearing on Benefits and Challenges of Producing Liquid Fuel from Coal

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Thank you for the opportunity to testify today on the subject of producing liquid fuels from coal. 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, Chicago and Beijing, China.

Today's energy use patterns are responsible for two growing problems that require action now to keep them from spiraling out of control—oil dependence and global warming. Both are serious but most important, both problems must be addressed together. Designing strategies that address only oil dependence and ignore global warming would be a huge and costly mistake.

Proposals to use coal to make liquid fuels for transportation need to be evaluated in the context of the compelling need to reduce global warming emissions starting now and proceeding continuously 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 critical to examine the implications of a substantial liquid coal program on these values as well. The first role for federal research should be to identify through comprehensive studies the types of vehicles and fuels that hold the best promise of reducing both oil dependence and global warming pollution by the amounts required to preserve a climate that allows us and others to achieve our environmental, economic and security objectives.

Reducing oil dependence

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 dependence: 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 and its industry allies are seeking government subsidies to create a coal to synfuels industry as large as 2.6 million barrels per day of liquid fuel from coal by 2025, about 10% of forecasted oil demand in that year. According to the industry, using coal to produce that much synfuel would require construction of 33 very large liquid coal 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.[1]

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

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 global greenhouse gas emissions need to be cut in half from today's levels by 2050. To accommodate unavoidable increases in emissions from developing countries this will require industrialized countries, including the U.S., to cut emissions by about 80% from today's levels between now and 2050.

Achieving emissions reductions of this scale in the U.S. will require deep reductions in all sectors, especially in the power generation and transportation sectors, which together account for over two-thirds of U.S. carbon dioxide (CO_2) emissions. Achieving large reductions in transportation emissions will require action on three fronts: improved vehicles; lower carbon fuels; and smarter metropolitan area planning to reduce

[1] The coal industry's program is set forth in a March 2006 National Coal Council report, "Coal: America's Energy Future. The industry's full "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.

congestion and growth in vehicle miles. This is the frame we must have in mind in evaluating the viability of alternative fuels for the transportation sector. The fuel industry we build must be capable of producing fuels that contain substantially less fossil carbon than is in today's petroleum-based gasoline and diesel fuel. To help achieve the overall reductions we need by 2050 will require transportation fuels with 50-80% lower fossil carbon emission potential than today's fuels.

To assess the global warming implications of a large liquid coal program we need to examine the total life-cycle or "well-to-wheel" emissions of this type of synfuel. Coal is a carbon-intensive fuel, containing double the amount of carbon per unit of energy compared to natural gas and about 50% more than petroleum. When coal is converted to liquid fuels, two streams of CO_2 are produced: one at the liquid coal production plant and the second from the exhausts of the vehicles that burn the fuel. As I describe below, even if the CO_2 from the synfuel production plant is captured, there is no prospect that liquid fuel made with coal as the sole feedstock can achieve the significant reductions in fossil carbon content that we need to protect the climate.

Two authoritative recent studies conclude that even if liquid coal synfuels plants fully employ carbon capture and storage, full life-cycle greenhouse gas emissions from using these fuels will be worse than conventional diesel fuel. There is a straightforward reason for this. Vehicle tailpipe CO_2 emissions from using liquid coal would be nearly identical to those from using conventional diesel fuel. Any CO_2 emissions released from the synfuels production facility have to be added to the tailpipe emissions. The residual emissions from a liquid coal plant employing CO_2 capture and geologic storage (CCS) are still somewhat higher than emissions from a petroleum refinery, hence life-cycle emissions are higher.

EPA's April 2007 analysis of life-cycle greenhouse gas emissions of different fuels was released in conjunction with publishing its final rule to implement the Renewable Fuels Standard enacted in the Energy Policy Act of 2005. EPA's analysis finds that without carbon capture life-cycle greenhouse gas emissions from coal-to-liquid fuels would be more than twice as high as from conventional diesel fuel (118% higher). Assuming carbon capture and storage EPA finds that life-cycle greenhouse gas emissions from coal-to-liquid fuels would be 3.7% higher than from conventional diesel fuel.[2]

In May 2007 Michael Wang of Argonne National Laboratory, the developer of the most widely used transportation fuels life-cycle emissions model, presented the results of his more detailed analysis of liquid coal fuels to the Society of Automotive Engineers conference. The Argonne analysis shows that liquid coal fuels could have life-cycle greenhouse gas emissions as much as 2.5 times those from conventional diesel fuel. Even assuming a high-efficiency liquid coal conversion process and 85% carbon capture and storage, Argonne finds that life-cycle greenhouse gas emissions from liquid coal fuel would still be 19% higher than from conventional diesel fuel (Figure 1)[3].

[2] http://www.epa.gov/otaq/renewablefuels/420f07035.htm

[3] M. Wang, M. Wu, H. Huo, "Life-cycle energy and greenhouse gas results of Fischer-Tropsch diesel produced from natural gas, coal,, and biomass," Center for Transportation Research, Argonne National Laboratory, presented at 2007 SAE Government/Industry meeting, Washington, DC, May 2007.

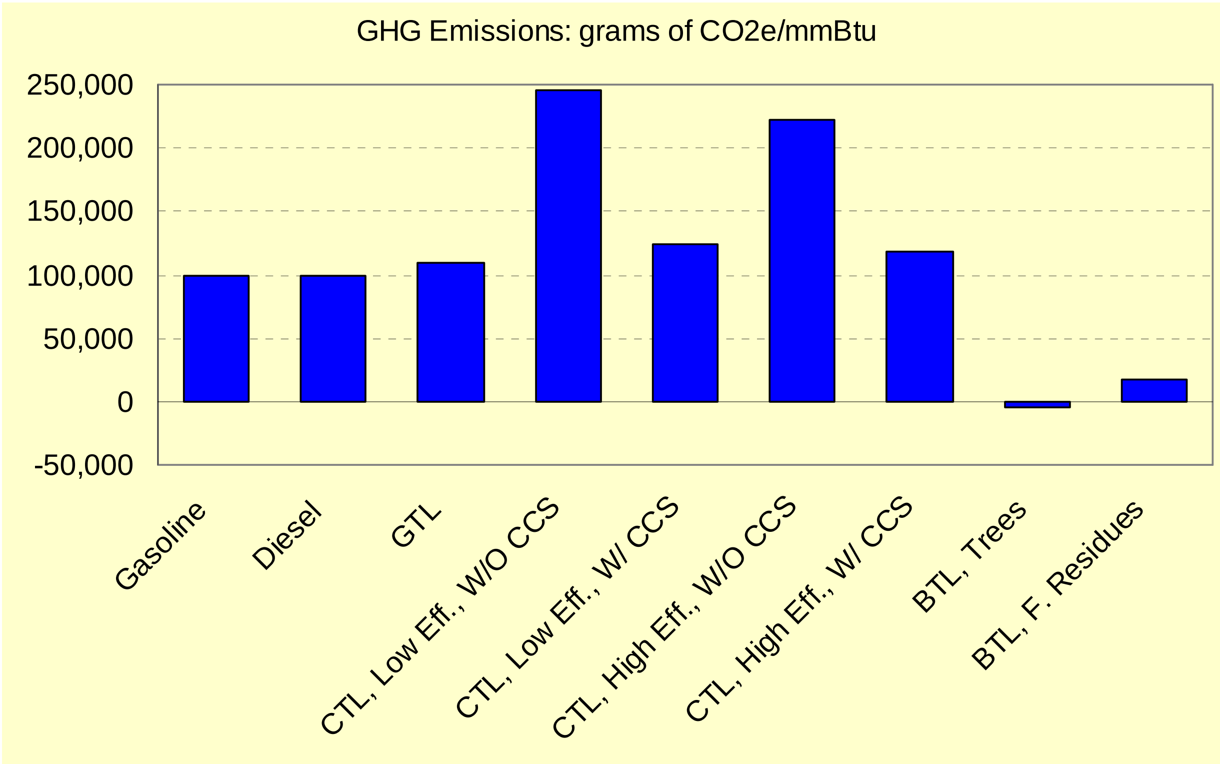

Figure 1. Life-cycle greenhouse gas results of Fischer-Tropsch diesel produced from natural gas, coal and biomass (GTL=gas-to-liquids, CTL=coal-to-liquids, CCS=carbon capture and sequestration, BTL=biomass-to-liquids, F=forest; emissions include CO_2, methane and N20). Wang et al., 2007.

These analyses show that using coal to produce a significant amount of liquid synfuel for transportation conflicts with the need to develop a low-CO_2 emitting transportation sector. The unavoidable fact is that liquid fuel made from coal contains essentially the same amount of carbon as is in gasoline or diesel made from petroleum. Given these results, it is not surprising that a recent Battelle study found that a significant coal-to-liquids industry is not compatible with stabilizing atmospheric CO_2 concentrations below twice the pre-industrial value. Battelle found that if there is no constraint on CO_2 emissions conventional petroleum would be increasingly replaced with liquid coal, but that in scenarios in which CO_2 concentrations are limited to 550 ppm or below, petroleum fuels are replaced with biofuels rather than liquid coal (Figure 2)[4].

Proceeding with liquid coal plants now could leave those investments stranded or impose unnecessarily high abatement costs on the economy if the plants continue to operate.

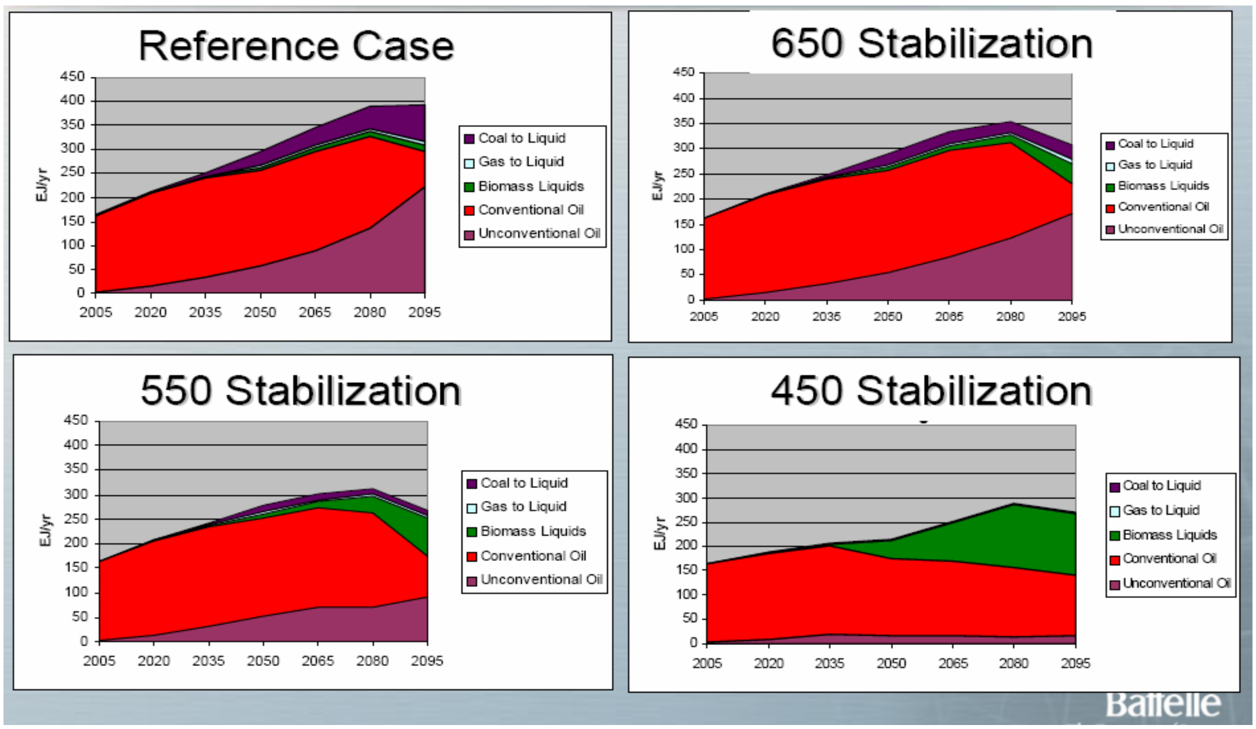

Figure 2. Conventional oil and alternative fuel supplies under four global warming emission limitation scenarios. Dooley et al., 2007.

Plug In Hybrid Electric Vehicles

While NRDC believes there are better alternatives than using coal to replace gasoline, it is worth noting that making liquid fuels from coal is far less efficient and dirtier even than burning coal to generate electricity for use in plug-in hybrid vehicles (PHEVs). In

[4] J. Dooley, R. Dahowski, M. Wise, and C. Davidson, "Coal-to-Liquids and Advanced Low-Emissions Coal-fired Electricity Generation: Two Very Large and Potentially Competing Demands for US Geologic CO2 Storage Capacity before the Middle of the Century." Battelle PNWD-SA-7804. Presented to the NETL Conference, May 9. 2007.

fact, a ton of coal used to generate electricity used in a PHEV will displace about twice as much oil as using the same amount of coal to make liquid fuels, even using optimistic assumptions about the conversion efficiency of liquid coal plants.[5] The difference in CO_2 emissions is even more dramatic. Liquid coal produced with CCS and used in a hybrid vehicle would still result in lifecycle greenhouse gas emissions of approximately 330 grams/mile, or **ten times** as much as the 33 grams/mile that could be achieve by a PHEV operating on electricity generated in a coal-fired power plant equipped with CCS.[6]

Coal and Biomass?

Some have proposed that a mixture of coal and biomass could be used to produce liquid fuel with a reduction in greenhouse gas emissions compared to today's fuels, assuming a high fraction of the CO_2 from the production plant is captured and permanently isolated in geologic formations. Proponents of this concept argue that using such a mixture of feedstocks to make liquid fuel could be compatible with cutting global warming emissions. It is important to recognize that such a combination does not actually reduce the emissions related to using coal; rather, the biomass component of the combination actually has negative net emissions that are deducted from the coal-related emissions to obtain low net emissions from the mixture. Moreover, even if the technical and economic challenges of making fuels with such a mixture could be met, a coal-biomass approach would still result in large amounts of additional coal mining and water

[5] Assumes production of 84 gallons of liquid fuel per ton of coal, based on the National Coal Council report. Vehicle efficiency is assumed to be 37.1 miles/gallon on liquid fuel and 3.14 miles/kWh on electricity.

[6] Assumes lifecycle greenhouse gas emission from liquid coal of 27.3 lbs/gallon and lifecycle greenhouse gas emissions from an IGCC power plant with CCS of 106 grams/kWh, based on R. Williams et al., paper presented to GHGT-8 Conference, June 2006.

requirements. With today's mining practices, mountaintop removal mining being the most egregious, launching a new fuel industry that depends on massive amounts of new mining without reform of our current practices would be a recipe for widespread environmental damage. As I discuss below, competition for water and even for low-cost coal supplies and geologic CO_2 storage reservoirs are additional factors that must be analyzed before we can conclude that any significant use of coal for liquid fuels would be viable. Federal research could support such analyses. If Congress is going to legislate on the subject of liquid coal, the only responsible action now is to require a comprehensive comparative assessment of the full life-cycle impacts and resource requirements of alternative approaches to reducing dependence on petroleum.

Conventional Pollution

Liquid coal fuel itself is expected to result in reduced emissions of conventional pollutants from vehicle exhausts. However, the same may not be true for liquid coal production plants. Conventional air emissions from liquid coal 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 liquid coal plants in South Africa demonstrates that liquid coal 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, liquid coal plants.[7]

Thus, we cannot say today that liquid coal 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. The industry's liquid coal vision advocates another 475 billion tons of coal production. To understand the implications of such an enormous expansion of coal production, it is important to have a detailed understanding of the impacts from today's level of coal production. The summary that follows makes it clear that we must find more effective ways to reduce these impacts before we follow a path that would result in even larger amounts of coal production and transportation.

Health and Safety

Coal mining is one of the U.S.'s most dangerous professions. The yearly fatality rate in the industry is 0.23 per thousand workers, making the industry about five times as hazardous as the average private workplace.[8] The industry had a low of 22 fatalities in

[7] The sulfur and nitrogen caps in EPA's "Clean Air Interstate Rule" ("CAIR") may cover emissions from liquid coal 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 liquid coal plants.

[8] Congressional Research Service, U.S. Coal: A Primer on the Major Issues, at 30 (Mar. 25, 2003).

2005 but in 2006 there were 47 deaths.[9] Fatalities to date in 2007 are 17.[10] Coal miners also suffer from many non-fatal injuries and diseases, most notably black lung disease (also known as pneumoconiosis) caused by inhaling coal dust. Although the 1969 Coal Mine Health and Safety Act seeks to eliminate black lung disease, the United Mine Workers estimate that 1500 former miners die of black lung each year.[11]

Terrestrial Habitats

Coal mining - and particularly surface or strip mining - poses one of the most significant threats to terrestrial habitats in the United States. The Appalachian region[12], for example, which produces over 35% of our nation's coal[13], is one of the most biologically diverse forested regions in the country. But during surface mining activities, trees are clearcut and habitat is fragmented, destroying natural areas that were home to hundreds of unique species of plants and animals. Even where forests are left standing, fragmentation is of significant concern because a decrease in patch size is correlated with a decrease in biodiversity as the ratio of *interior* habitat to *edge* habitat decreases. This is of particular concern to certain bird species that require large tracts of interior forest habitat, such as the black-and-white warbler and black-throated blue warbler.

After mining is complete, these once-forested regions in the Southeast are typically reclaimed as grasslands, although grasslands are not a naturally occurring habitat type in this region. Grasslands that replace the original ecosystems in areas that were surface

[9] U.S. Department of Labor, Mine Safety and Health Administration, Coal Daily Fatality Report, http://www.msha.gov/stats/charts/coaldaily.asp, (visited September 1, 2007)
[10] *Id.*
[11] http://www.umwa.org/blacklung/blacklung.shtml
[12] Alabama, Georgia, Eastern Kentucky, Maryland, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia.
[13] Energy Information Administration. Annual Coal Report, 2004.

mined are generally categorized by less-developed soil structure[14] and lower species diversity[15] compared to natural forests in the region. Reclaimed grasslands are generally characterized by a high degree of soil compaction that tends to limit the ability of native tree and plant species to take root. Reclamation practices limit the overall ecological health of sites, and it has been estimated that the natural return of forests to reclaimed sites may take hundreds of years.[16] According to the USEPA, the loss of vegetation and alteration of topography associated with surface mining can lead to increased soil erosion and may lead to an increased probability of flooding after rainstorms.[17]

The destruction of forested habitat not only degrades the quality of the natural environment, it also destroys the aesthetic values of the Appalachian region that make it such a popular tourist destination. An estimated one million acres of West Virginia mountains were subject to strip mining and mountaintop removal mining between 1939 and 2005.[18] Many of these mines have yet to be reclaimed so that where there were once forested mountains, there now stand bare mounds of sand and gravel.

The terrestrial impacts of coal mining in the Appalachian region are considerable, but for sheer size of the acreage affected, impacts in the western United States dominate the picture.[19] As of September 30, 2004, 470,000 acres were under federal coal leases or other authorizations to mine.[20] Unlike the East, much of the West– including much of the region's principal coal areas –is arid and predominantly unforested. In the West, as in

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[14] Sencindiver, et al. "Soil Health of Mountaintop Removal Mines in Southern West Virginia". 2001.
[15] Handel, Steven. Mountaintop Removal Mining/Valley Fill Environmental Impact Statement Technical Study, Project Report for Terrestrial Studies. October, 2002.
[16] *Id.*
[17] EPA. Mountaintop Mining/Valley Fills in Appalachia: Draft Programmatic Environmental Impact Statement. 2003
[18] Julian Martin, West Virginia Highlands Conservancy, Personal Communication, February 2, 2006.
[19] Alaska, Arizona, Colorado, Montana, New Mexico, North Dakota, Utah, Washington, and Wyoming.
[20] Bureau of Land Management, Public Land Statistics 2004, Table 3-18

the East, surface mining activities cause severe environmental damage as huge machines strip, rip apart and scrape aside vegetation, soils, wildlife habitat and drastically reshape existing land forms and the affected area's ecology to reach the subsurface coal. Strip mining results in industrialization of once quiet open space along with displacement of wildlife, increased soil erosion, loss of recreational opportunities, degradation of wilderness values, and destruction of scenic beauty.[21] Reclamation can be problematic both because of climate and soil quality. As in the East, reclamation of surface mined areas does not necessarily restore pre-mining wildlife habitat and may require scarce water resources be used for irrigation.[22] Forty-six western national parks are located within ten miles of an identified coal basin, and these parks could be significantly affected by future surface mining in the region.[23]

Water Pollution

Coal production causes negative physical and chemical changes to nearby waters. In all surface mining, the overburden (earth layers above the coal seams) is removed and deposited on the surface as waste rock. The most significant physical effect on water occurs from valley fills, the waste rock associated with mountaintop removal (MTR) mining. Studies estimate that over 700 miles of streams were buried by valley fills from 1985-2001, and 1200 miles were directly impacted by mountaintop removal and valley fills from 1992-2002.[24] Valley fills bury the headwaters of streams, which in the

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[21] See, e.g., U.S. Department of the Interior, Bureau of Land Management, 1985 Federal Coal Management Program/Final Environmental Impact Statement, pp. 210-211, 230-231, 241-242, 282 (water quality and quantity),, 241, 251, 257

[22] Bureau of Land Management. 3809 Surface Management Regulations, Draft Environmental Impact Statement. 1999

[23] National Park Service, DOI. "Coal Development Overview". 2003.

[24] EPA. Mountaintop Mining/Valley Fills in Appalachia: Draft Programmatic Environmental Impact Statement.

southeastern U.S. support diverse and unique habitats, and regulate nutrients, water quality, and flow quantity. The elimination of headwaters therefore has long-reaching impacts many miles downstream.[25]

Coal mining can also lead to increased sedimentation, which affects both water chemistry and stream flow, and negatively impacts aquatic habitat. Valley fills in the eastern U.S., as well as waste rock from strip mines in the west add sediment to streams, as does the construction and use of roads in the mining complex. A final physical impact of mining on water is to the hydrology of aquifers. MTR and valley fills remove upper drainage basins, and often connect two previously separate aquifers, altering the surrounding groundwater recharge scheme.[26]

Acid mine drainage (AMD) is the most significant form of chemical pollution produced from coal mining operations. In both underground and surface mining, sulfur-bearing minerals common in coal mining areas are brought up to the surface in waste rock. When these minerals come in contact with precipitation and groundwater, an acidic leachate is formed. This leachate picks up heavy metals and carries these toxins into streams or groundwater. Waters affected by AMD often exhibit increased levels of sulfate, total dissolved solids, calcium, selenium, magnesium, manganese, conductivity, acidity, sodium, nitrate, and nitrite. This drastically changes stream and groundwater chemistry.[27] The degraded water becomes less habitable, non potable, and unfit for recreational purposes. The acidity and metals can also corrode structures such as culverts

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[25] *Id.*
[26] Keating, Martha. "Cradle to Grave: The Environmental Impacts from Coal." Clean Air Task Force, Boston. June, 2001.
[27] EPA Office of Solid Waste: Acid Mine Drainage Prediction Technical Document. December, 1994.

and bridges.[28] In the eastern U.S., estimates of the damage from AMD range from four to eleven thousand miles of streams.[29] In the West, estimates are between five and ten thousand miles of streams polluted. The effects of AMD can be diminished through addition of alkaline substances to counteract the acid, but recent studies have found that the addition of alkaline material can increase the mobilization of both selenium and arsenic.[30] AMD is costly to mitigate, requiring over $40 million annually in Kentucky, Tennessee, Virginia, and West Virginia alone.[31]

Air Pollution

There are two main sources of air pollution during the coal production process. The first is methane emissions from the mines. Methane is a powerful heat-trapping gas and is the second most important contributor to global warming after carbon dioxide. Methane emissions from coal mines make up between 10 and 15% of anthropogenic methane emissions in the U.S. According to the most recent official inventory of U.S. global warming emissions, coal mining results in the release of 3 million tons of methane per year, which is equivalent to 68 million tons of carbon dioxide.[32]

The second significant form of air pollution from coal mining is particulate matter (PM) emissions. While methane emissions are largely due to eastern underground mines, PM emissions are particularly serious at western surface mines. The arid, open and frequently windy region allows for the creation and transport of significant amounts of

[28] EPA. Mountaintop Mining/Valley Fills in Appalachia: Draft Programmatic Environmental Impact Statement. 2003

[29] EPA. Mid-Atlantic Integrated Assessment: Coal Mining. http://www.epa.gov/maia/html/coal-mining.html

[30] EPA. Mountaintop Mining/Valley Fills in Appalachia: Final Programmatic Environmental Impact Statement. 2005

[31] *Id.*

[32] DOE/EIA, 2005. Emissions of Greenhouse Gases in the United States 2004. (December).

particulate matter in connection with mining operations. Fugitive dust emissions occur during nearly every phase of coal strip mining in the west. The most significant sources of these emissions are removal of the overburden through blasting and use of draglines, truck haulage of the overburden and mined coal, road grading, and wind erosion of reclaimed areas. PM emissions from diesel trucks and equipment used in mining are also significant. PM can cause serious respiratory damage as well as premature death.[33] In 2002, one of Wyoming's coal producing counties, Campbell County, exceeded its ambient air quality threshold several times, almost earning non-attainment status.[34] Coal dust problems in the West are likely to get worse if the administration finalizes its January 2006 proposal to exempt mining (and other activities) from controls aimed at meeting the coarse PM standard.[35]

Coal Mine Wastes

Coal mining leaves a legacy of wastes long after mining operations cease. One significant waste is the sludge that is produced from washing coal. There are currently over 700 sludge impoundments located throughout mining regions, and this number continues to grow. These impoundment ponds pose a potential threat to the environment and human life. If an impoundment fails, the result can be disastrous. In 1972 an impoundment break in West Virginia released a flood of coal sludge that killed 125 people. In the year 2000 an impoundment break in Kentucky involving more than 300 million gallons of slurry (30 times the size of the Exxon Valdez spill) killed all aquatic

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[33] EPA. Particle Pollution and Your Health. 2003
[34] Casper [WY] Star Tribune, January 24, 2005.
[35] National Ambient Air Quality Standards for Particulate Matter, Proposed Rule, 71 Fed. Reg. 2620 (January 17, 2006); Revisions to Ambient Air Monitoring Regulations, Proposed Rule, 71 Fed. Reg. 2710 (January 17, 2006).

life in a 20 mile diameter, destroyed homes, and contaminated much of the drinking water in the eastern part of the state.[36]

Another waste from coal mining is the solid waste rock left behind from tunneling or blasting. This can result in a number of environmental impacts previously discussed, including acid mine drainage. A common problem with coal mine legacies is the fact that if a mine is abandoned or a mining company goes out of business, the former owner is under no legal obligation to cleanup and monitor the environmental wastes, leaving the responsibility in the hands of the state.[37]

Effects on Communities

Coal mining can also have serious impacts on nearby communities. In addition to noise and dust, residents have reported that dynamite blasts can crack the foundations of homes[38], and many cases of subsidence due to the collapse of underground mines have been documented. Subsidence can cause serious damage to houses, roads, bridges, and any other structure in the area. Blasting can also cause damage to wells, and changes in the topography and structure of aquifers can cause these wells to run dry.

Transportation of Coal

Transporting coal from where it is mined to where it will be burned also produces significant quantities of air pollution and other environmental harms. Diesel-burning trucks, trains, and barges that transport coal release NOx, SOx, PM, VOCs (Volatile Organic Chemicals), CO, and CO2 into the earth's atmosphere. Trucks and trains (barge

[36] Frazier, Ian. "Coal Country." On Earth. NRDC. Spring, 2003.
[37] Reece, Erik. "Death of a Mountain." Harper's Magazine. April, 2005.
[38] *Id.*

pollution data are unavailable) transporting coal release over 600,000 tons of NOx, and over 50,000 tons of PM10 into the air annually.[39,40] In addition to health risks, black carbon from diesel combustion is another contributor to global warming.[41] Land disturbance from trucks entering and leaving the mine complex and coal dust along the transport route also release particles into the air.[42] For example, in Sylvester, West Virginia, a Massey Energy coal processing plant and the trucks associated with it spread so much dust around the town that "Sylvester's residents had to clean their windows and porches and cars every day, and keep the windows shut."[43] Even after a lawsuit and a court victory, residents – who now call themselves "Dustbusters" – still "wipe down their windows and porches and cars."[44]

Almost 60 percent of coal in the U.S. is transported at least in part by train and coal transportation accounts for 44% of rail freight ton-miles.[45] Some coal trains reach more than two miles in length, causing railroad-crossing collisions and pedestrian accidents (there are approximately 3000 such collisions and 900 pedestrian accidents every year), and interruption in traffic flow (including emergency responders such as police, ambulance services, and fire departments). Local communities also have concerns about coal trucks, both because of their size and the dust they can leave behind. According to one report, in a Kentucky town, coal trucks weighing 120 tons with their loads were used, and "the Department of Transportation signs stating a thirty-ton carrying capacity of each

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[39] DOT Federal Highway Administration. Assessing the Effects of Freight Movement on Air Quality, Final Report. April, 2005

[40] Energy Information Administration: Coal Transportation Statistics.

[41] Hill, Bruce. "An Analysis of Diesel Air Pollution and Public Health in America." Clean Air Task Force, Boston. February, 2005.

[42] EPA. Mountaintop Mining/Valley Fills in Appalachia: Draft Programmatic Environmental Impact Statement. 2003

[43] Michael Schnayerson, "The Rape of Appalachia," *Vanity Fair*, 157 (May 2006).

[44] *Id.*

[45] http://nationalatlas.gov/articles/transportation/a_freightrr.html

bridge had disappeared."[46] Although the coal company there has now adopted a different route for its trucks, community representatives in Appalachia believe that coal trucks should be limited to 40 tons.[47]

Coal is also sometimes transported in a coal slurry pipeline, such as the one used at the Black Mesa Mine in Arizona. In this process the coal is ground up and mixed with water in a roughly 50:50 ratio. The resulting slurry is transported to a power station through a pipeline. This requires large amounts of fresh groundwater. To transport coal from the Black Mesa Mine in Arizona to the Mohave Generating Station in Nevada, Peabody Coal pumped over one billion gallons of water from an aquifer near the mine each year. This water came from the same aquifer used for drinking water and irrigation by members of the Navajo and Hopi Nations in the area. Water used for coal transport has led to a major depletion of the aquifer, with more than a 100 foot drop in water level in some wells. In the West, coal transport through a slurry pipeline places additional stress on an already stressed water supply. Maintenance of the pipe requires washing, which uses still more fresh water. Not only does slurry-pipeline transport result in a loss of freshwater, it can also lead to water pollution when the pipe fails and coal slurry is discharged into ground or surface water.[48] The Peabody pipe failed 12 times between 1994 and 1999. The Black Mesa mine closed as of January 2006. Its sole customer, the Mohave Generating Station, was shut down because its emissions exceeded current air pollution standards.

[46] Erik Reece, Lost Mountain: A Year in the Vanishing Wilderness 112 (2006).
[47] Personal communication from Hillary Hosta and Julia Bonds, Coal River Mountain Watch (Apr. 7, 2006).
[48] NRDC. Drawdown: Groundwater Mining on Black Mesa.

Water Requirements for Liquid Coal

Liquid coal production requires large quantities of water. According to a USGS report, thermal electric generation accounted for 39 percent of the freshwater withdrawn from watersheds in the US in 2000[49]. The water use dedicated to liquid coal production will require water use above and beyond current uses, competing with other needs, including irrigation and public water supply. The withdrawal and consumption of water in areas with water shortages will be a major problem for this industry. Competing water uses, primarily for irrigation, will be a major problem in the West where water rights are established and water is considered a very valuable commodity. In the East, competing water uses, primarily from thermal electric cooling, and water shortages also are beginning to become an issue of concern.

There are three major uses of water in a coal-to-liquids plant, (1) process water, (2) boiler feed water and (3) cooling water. According to the Department of Energy's Idaho National Lab, approximately 12-14 barrels of water are used for every barrel of liquid coal[50]. Therefore the water requirement necessary to meeting the needs of an 80,000 BPD liquid coal plant could require sourcing about 40 million gallons of water per day (14 billion gallons per year). The 40 million gallons of water per day needed for an 80,000 BPD liquid coal facility is enough water to meet the domestic needs of more than 200,000 people[51], or the 1/5th the population of the State of Montana. There are already

[49] USGS 2004. "Estimated Use of Water in the United States in 2000" USGS Circular 126. Available at http://pubs.usgs.gov/circ/2004/circ1268/pdf/circular1268.pdf
[50] Boardman, Richard, Ph.D. "Gasification and Water Nexus," Department of Energy, Idaho National Laboratory Gasification Research, presented March 14, 2007 at the GTC, Workshop on Gasification Technologies
[51] Based on EPA's estimate of 200 gallons of water per person per day, http://www.epa.gov/watrhome/you/chap1.html

serious water supply problems in Western states such as Montana and Wyoming where most of our cheap coal supplies are located.

While alternative technologies exist that use less water in the liquid coal production process, many of them are more costly and some may be cost prohibitive. In addition, water must be of good quality for use in cooling towers and blow down operations and if water must be treated before use that will add additional costs to the plant operations Some research is suggesting the option of using coal bed methane water as an alternative water source and this is only possible if this water's salinity is low or if desalinization costs were low. According to NETL, much of the water produced from coal bed methane operations is very saline and needs to be treated prior to surface discharge or plant use[52]. Therefore, cost-effective sources of water and technologies that use water more efficiently in these processes are limited.

Coal Resource Requirements

While it is frequently said that America has more than 250 years of coal to use, these claims are based current coal production of about 1 billion tons per year. As the National Academy of Sciences (NAS) has concluded, even with current consumption rates, it is "not possible to confirm" the 250 year supply claim because this estimate is based on "methods that have not been reviewed or revised since their inception in 1974" and that

[52] DOE/NET-2006/1233 "Energy Issues for Fossil Energy and Water: Investigation of Water Issues Related to Coal Mining, Coal to Liquids, Oil Shale and Carbon Capture and Sequestration" June 2006

updated methods suggest that "only a small fraction of previously estimated reserves are actually minable reserves."[53]

These observations indicate we should reconsider proposals to legislate incentives and mandates for programs like liquid coal that would dramatically increase our rates of coal consumption. As mentioned above, if all of the coal industry's wish list for coal use were implemented, coal production would more than double. Apart from the environmental and health threats presented by this scenario, there are potentially large adverse economic impacts from a program to increase coal consumption on this scale.

Consider the following thought experiment. What would be the impact on U.S. recoverable coal reserves if we were to try to displace some significant fraction of U.S. oil imports with liquid coal? Current U.S. coal recoverable reserve estimates, using methods criticized by the NAS as possibly overstating actual minable coal, amount to just under 270 billion tons. Suppose the U.S. were to ramp up a liquid coal of size large enough to replace one-third to one hundred per cent of forecasted U.S. oil imports by 2030? U.S. EIA forecasts that net oil imports (crude and refined products) in 2030 will be about 16 million barrels a day.[54] Using the National Coal Council's estimate of conversion efficiency, to replace one-third of those imports would require consumption of nearly 1.2 billion tons of additional coal per year in 2030 and if oil import demand increased at 2% per year, by 2050 coal consumption to displace this same fraction of imports would grow to nearly 1.8 billion tons per year. When combined with continued use of coal for electric power, this rate of coal consumption would consume 40% of

[53] National Research Council, "Coal: Research and Development to Support National Energy Policy," Washington, DC, 2007 at 3.
[54] U.S. Energy Information Administration, "Annual Energy Outlook 2007."

currently estimated recoverable reserves by 2050 and would deplete all of those reserves by about 2080.[55] If liquid coal production were scaled to a level needed to replace one-half of forecasted oil imports, 49% of estimated recoverable reserves would be consumed by 2050 and 100% by the year 2074 and if we tried to replace all of our forecasted oil imports with liquid coal then two-thirds of recoverable reserves would be consumed by 2050 and 100% by the year 2060.

The above is a thought experiment, not a prediction that we would actually run out of coal by those dates. Economists will argue that more reserves will become "recoverable" as the price rises. But as the argument suggests, such new reserves will be more expensive than today's coal supplies.

The point we must recognize is that using coal to make liquid fuel will at a minimum raise coal prices substantially for all uses, including the electric power industry, which now depends on coal to produce over 50% of U.S. electricity. It is also worth noting that the massive amounts of CO_2 that would have to be injected into geologic formations to limit emissions from liquid coal production will also drive up the cost of coal use. While it appears the U.S. has large amounts of geologic storage capacity, as with all resources there is a supply cost curve and with the large demand for storage capacity created by a significant liquid coal industry those costs will escalate faster than if demand is more moderate.

In short, there is no basis to assume that liquid coal would be an economic bargain either, providing one more reason for us to look for a better way.

[55] For this calculation we assume a 1% per year growth rate in coal consumption in the power sector. This is not a sustainable scenario but is chosen to illustrate the implications of "business as usual" practices.

A Responsible Action Plan

The impacts that a large liquid coal program could have on global warming pollution, conventional air pollution and damage from expanded coal production are substantial—so substantial that using coal to make liquid fuel would likely create far worse problems than it attempts to solve.

Fortunately, the U.S. can have a robust and effective program to reduce oil dependence without embracing liquid coal technologies. A combination of efficiency, renewable fuels and plug-in hybrid vehicles can reduce our oil consumption more quickly, more cleanly and in larger amounts than liquid coal even on the massive scale advocated by the coal industry.

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 the coal industry.

The Securing America program is made up of these sensible steps that will cut oil dependence, cut global warming emissions, and reduce other harmful impacts of today's energy production and consumption patterns:

Accelerate oil savings in passenger vehicles by:

- establishing tax credits for manufacturers to retool existing factories so they can build fuel-efficient vehicles and engineer advanced technologies, and
- establishing tax credits for consumers to purchase the next generation of fuel-efficient vehicles; and raising federal fuel economy standards for cars and light trucks in regular steps.

Accelerate oil savings in motor vehicles through the following:

- requiring replacement tires and motor oil to be at least as fuel efficient as original equipment tires and motor oil;
- requiring efficiency improvements in heavy-duty trucks; and
- supporting smart growth and better transportation choices.

Accelerate oil savings in industrial, aviation, and residential building sectors through the following:
- expanding industrial efficiency programs to focus on oil use reduction and adopting standards for petroleum heating;
- replacing chemical feedstocks with bioproducts through research and development and government procurement of bioproducts;
- upgrading air traffic management systems so aircraft follow the most-efficient routes; and
- promoting residential energy savings with a focus on oil-heat.

Encourage growth of the biofuels industry through the following:
- requiring all new cars and trucks to be capable of operating on biofuels or other non-petroleum fuels by 2015; and
- allocating $2 billion in federal funding over the next 10 years to help the cellulosic biofuels industry expand production capacity to 1 billion gallons per year and become self-sufficient by 2015.

Technologically Achievable Oil Savings (million barrels per day)		
Oil Savings Measures	**2015**	**2025**
Raise fuel efficiency in new passenger vehicles through tax credits and standards	1.6	4.9
Accelerate oil savings in motor vehicles through		
fuel efficient replacement tires and motor oil	0.5	0.6
efficiency improvements in heavy-duty trucks	0.5	1.1
Accelerate oil savings in industrial, aviation, and residential sectors	0.3	0.7
Encourage growth of biofuels industry through demonstration and standards	0.3	3.9
Total Oil Saved	**3.2**	**11.2**

To cut our dependence on oil we should follow a simple rule: start with the measures that will produce the quickest, cleanest and least expensive reductions in oil 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.