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Taming Coal: The Imperative for Rapid Demonstration and Scale-Up Of Advanced Coal Gasification and Carbon Sequestration and the Reform of Coal Mining and Waste Disposal Practices

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The Current and Future Footprint of Coal

Coal-fired power generation is today one of the planet's most environmentally destructive activities. It is responsible for most of the nation's sulfur dioxide emissions which, even after recent regulatory reductions, will still take 15,000 lives prematurely in the US each year by EPA's own estimate. It contributes substantially to nitrogen oxides, which add to smog, haze, and crop and ecological damage. It emits most of the nation's manmade mercury. Current coal mining practices have scarred land and threatened water and habitat. Coal power generation consumes and discharges enormous quantities of water, while generating nearly 100 million tons of toxic wastes each year, the disposal of which is not regulated by the federal government. Finally, coal power generation is responsible for nearly 40% of the planet's man-made emissions of CO2 that contribute to global warming.

Despite these problems, coal fired power generation is likely to be relied on for decades to come and is projected to expand dramatically. World electric demand is expected to triple by 2050, coming largely from developing countries like China and India. Most analyses agree that this underlying demand growth will substantially outpace even the most aggressive energy efficiency policies. Renewable energy, while it should and will be widely deployed, faces significant physical, environmental and economic challenges that will practically limit its share of total electrical supply for several decades. Natural gas is relatively expensive and its reserves far more limited than coal. Finally, nuclear power faces considerable hurdles of scale, economics and environmental opposition. For these reasons, China is building as much new coal capacity each year as the entire UK power grid, and coal power generation in India is projected to grow rapidly - matching current US coal consumption by 2020 and China's current coal consumption by about 2030. The United States faces both growing demand for electricity and an aging power plant fleet; coal will remain economically attractive to meet some portion of electricity demand growth and to replace some existing power plants.

Turning to climate, numerous analyses performed or commissioned by such bodies as the Intergovernmental Panel on Climate Change, the European Union, the National Commission on Energy Policy, academic institutions such as Harvard, MIT, and

Princeton University as well as environmental organizations such as Friends of the Earth-UK have concluded that, even with aggressive energy efficiency, renewable energy development and in some cases nuclear expansion, coal fired power generation is likely to remain a significant part of any 2030-2050 global power supply. Accordingly, each of these studies has identified the critical importance of transitioning coal use to technologies that minimize health-related air emissions and allow for the removal and storage of carbon dioxide, and to begin to demonstrate and scale up those technologies on a commercial basis as soon as possible.

In short, the planet is unlikely to be able to live *without* coal for some time to come. But, at the same time, the planet, from an environmental standpoint, can't stand to live *with* coal as it is currently used to produce electricity. This leaves only one path forward: we need to change how we *use* it – and we need to do so as quickly as possible.

What Is to Be Done?

An environmentally responsible coal policy would do the following:

- Ban the construction of new coal combustion plants due to their inherently unacceptable air, water, solid waste and climate impacts.
- Rapidly commercialize the use of integrated coal gasification combined cycle (IGCC) for electric power generation, because it has a much smaller environmental footprint for air emissions and waste than does coal combustion.
- Rapidly demonstrate the feasibility of large scale geologic storage of carbon dioxide and then require all new coal power plants to capture and sequester at least 90% of their coal carbon content.
- Demonstrate and deploy advancements such as underground coal gasification, that could further shrink IGCC's environmental footprint by substantially minimizing mining impacts and waste management
- Reform coal mining practices worldwide, impose effective federal regulation of coal plant solid waste disposal and reduce coal generation water use and associated impacts to the minimum practical levels.
- Increase the energy efficiency of IGCC power generation to the maximum practical levels over time.

Commercializing IGCC is of special importance. Because it is an inherently cleaner process – the gas it produces from coal must be free of most contaminants to power a gas turbine – IGCC reduces deadly sulfur and nitrogen oxide emissions to very low levels – approaching those achievable by natural gas combined cycle power plants. Gasification is the *only* coal power generation technology that can virtually eliminate mercury air emissions and capture most of the coal mercury content in a concentrated form that can potentially be sequestered from environmental release; IGCC is the only way we can continue to use coal to produce power without adding significantly to the global mercury burden. Total solid waste from gasification is typically half the volume generated by conventional coal plants and gasification water use is substantially lower as well.

Further advancements in IGCC, such as underground coal gasification, would gasify the coal directly within the deep unmineable formations. This process holds the promise of

potentially eliminating the environmental impacts of current mining practices and significantly reducing the challenge of coal waste management.

Finally, IGCC is the key enabling technology for capture and storage of carbon dioxide from coal power generation and will be essential to meeting any reasonable climate stabilization target. While it is possible to retrofit a coal combustion plant with carbon capture technology, it is expensive and inefficient to do so today, costing twice as much as capturing carbon from a IGCC plant and reducing plant efficiency by as much as 40%. While development of more cost-effective coal-combustion carbon capture alternatives is important, current efforts are very early in the technology development stage, and it is unclear whether and when cost-effectiveness will be fully demonstrated for this technology. *If we are to turn the world coal tide to a near-zero carbon footprint in the next 20 years, IGCC power generation is likely to be the most availing path forward based on current information*.

Despite the fact that coal gasification has been widely deployed around the world in the refining and chemical industries, only a few IGCC power generation plants have been developed. Only two IGCC power plants have been developed in the US – both in the context of government-supported demonstration programs and both using much less advanced designs than those being proposed today. As with any new energy technology, it will be necessary to build and operate many gasification plants *on a commercial basis* to demonstrate the technology's reliability and reduce costs before gasification will become widely accepted – much as occurred with the combined cycle gas turbine in the 1980's. At present, there is widespread resistance to deployment of this technology in the United States by many utilities and regulators, who cite its untested status and high costs relative to new coal combustion plants. This is even truer in countries such as China and India; those nations will be far more likely to adopt this technology if developed nations like the United States do so first on a commercial basis. In short, building the necessary "reference" plants in the United States as soon as possible will substantially accelerate adoption of this technology worldwide.

Large scale demonstration of geologic storage is needed to support development of national carbon sequestration programs. The Intergovernmental Panel on Climate Change recently found that appropriately selected and managed geological reservoirs are likely to retain more than 99% of stored carbon over 1,000 years. But carefully planned, large scale demonstration projects will be needed to address technical issues and the standards that must be developed to support a national geologic carbon sequestration program. These projects will require substantial federal financial support. Enhanced oil recovery from CO2 injection is the most likely near-term prospect for carbon capture and storage projects that could occur in parallel with the large-scale demonstration projects, due to economics, industry experience, and existing regulatory structures.

It is desirable to include some form of carbon capture and sequestration as part of IGCC power generation projects moving forward today to begin developing operational carbon capture and sequestration expertise and to produce some of the knowledge needed to support a national geologic sequestration program. However, due to the absence of a US limit on carbon emissions, jurisdictions will likely vary in their willingness to support full-scale sequestration from the start. This tension between the two independent goals of advancing gasification commercialization and eventual full capture of carbon from gasification plants will need to be addressed on a case-by-case basis.

Finally, public policy and private action must be taken to drastically reduce the life cycle impacts of coal use. In addition to developing technology advancements such as underground coal gasification, damage from coal extraction must be limited by strengthening standards (such as banning of mountaintop removal practices, and requiring stronger reclamation standards for other surface mines) and ensuring that all standards are diligently enforced. Likewise, coal combustion and gasification wastes must be treated as what they are - toxic – and regulated by federal law. And water use impacts should be minimized – to potentially include applying such technologies as dry cooling to reduce water use to very low levels.

CATF's Objectives in Proceedings Concerning IGCC Proposals

To advance the above goals, CATF will intervene in regulatory proceedings – where appropriate - to support domestic IGCC projects that show promise of advancing the technology in a constructive way. CATF's intervention will aspire to the following goals:

- Highlighting the importance of commercial projects being built today to demonstrate the viability of the coal gasification pathway worldwide to meet carbon limits;
- Advocating for maximum control of non-CO2 air emissions, including but not limited to oxides of sulfur and nitrogen, through the most advanced available technologies;
- Advocating for 1) reducing mercury air emissions to 1% or less of coal mercury content; and 2) capture of most coal mercury content in a concentrated form that can be permanently sequestered from future environmental release;
- Bringing forward evidence and proposed conditions to reduce the mining, water use and solid waste disposal impacts of the plant;
- Encouraging use of carbon capture and storage on an "early adopter" basis in connection with the project;
- Developing options to economically incorporate these environmental advances into the project, recognizing that the environment is not protected if proposed gasification projects become so expensive that they are abandoned.