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TESTIMONY

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Honorable Cynthia Lummis
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Hearing On The Future Of Coal: Utilizing America's Abundant Energy Resources

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Chairman Lummis, Ranking Member Swalwell and members of the Subcommittee I am Donald Collins, CEO of the Western Research Institute located in Laramie, Wyoming on the campus of the University of Wyoming. On behalf of WRI, we deeply appreciate the opportunity to provide testimony on the vital role that coal research and development activities can play to ensure a diverse energy resource portfolio that relies on our abundant coal resources. WRI has dedicated its extensive capabilities and experience to drive our use of coal in technologically efficient, environmentally responsible and cost effective manner.

INTRODUCTION

As a matter of background, WRI employs a team of 83 scientists, engineers, technicians and management professionals working on both basic and applied research, development, and technology demonstration and deployment (RDD&D). Our scientists for the past four decades have developed solutions and technologies to advance energy exploration, recovery and utilization. We also have used our expertise in the energy sector to address the needs of the public and private sectors in the fields of environmental remediation, ecosystem protection and public safety. I provide additional information on WRI and our work as background and overview about WRI is provided in Attachment A.

COAL RESEARCH ACTIVITIES

At Western Research Institute (WRI), we are focusing our coal utilization research and technology development activities to enhance the sustainability of coal through improvements in (1) utilization and energy efficiency, (2) environmental cleanliness and (3) sustainability. Below are brief paragraphs about each.

Enhancing Coal Utilization Energy Efficiency – Several process technologies were devised to increase the energy efficiency of coal power plants while also lowering criteria pollution emissions.

Enhancing Coal Environmental Cleanliness – An added benefit to enhancing coal utilization energy efficiency is the ability to address criteria pollution emissions, including carbon dioxide (CO_2). This is accomplished by lowering such pollutant emissions per megawatt hour (MWhr) delivered to the grid. WRI recognizes that knowledge has evolved regarding environmental and health ramifications associated with human activities of all types, including extraction and utilization of energy resources. We view this knowledge as valuable and help us develop appropriate priorities for research and technology development and more importantly deployed. This ensures development of a portfolio of cost-effective and sustainable technology solutions.

Enhancing Coal's Sustainability – The challenge for coal from a sustainability perspective is that coal resources removed carbon dioxide from the atmosphere hundreds of millions of year ago when the naturally occurring processes of that era resulted in the creation of coal from biomass. This ancient age of coal relative to conventional biomass energy systems presents a great challenge to any notion that coal can contribute to sustainability within the much shorter time spans considered appropriate for sustainable clean energy models.

To tackle this timing challenge of energy system CO_2 recycle ability and to achieve sustainable energy systems, WRI is focused on the opportunity to invent ways to recycle all carbonaceous forms of energy to include coal. To date, humans have devised solutions to recycle many products such a paper, plastic, metals, batteries, etc. to extract and reuse the materials and in turn achieve economic and environmental benefits. Now via biological sciences applied to our fossil energy resources we are at the forefront of achieving the capacity to recycle carbonaceous energy.

At their core biomass, coal, petroleum, and natural gas are energy resources that contain two primary energy carriers – carbon and hydrogen. By conventional wisdom, burning wood is viewed as "carbon neutral" from a sustainability perspective based upon the amount of CO_2 emitted through burning equaling the amount of CO_2 trees took from the atmosphere to grow. This leads to the conventional view that burning wood is a sustainable carbon neutral energy system[1] that does not result in a net increase in atmospheric levels of CO_2 (a greenhouse gas) as does the combustion of traditional fossil fuels such as coal and natural gas. From a sustainability systems view, burning coal yields a net increase in atmospheric CO_2 inventory is ultimately a timing and rate/speed issue due to the fact the original biomass, from which coal is created, is about 300 millions old and trees living today do not consume atmospheric CO_2 at a rate fast enough to recycle the amount of CO_2 produced from burning coal, natural gas, and petroleum transportation fuels.

WRI is conducting research to quicken the conversion of CO_2 emissions from coal, natural gas and cement plants into a more timely useable form of energy – biological crude oil (biocrude). Our primary research activity involves developing two biotechnology related

[1] The Partnership for Policy Integrity (PFPI) life cycle analysis work challenges the notion that burning wood in commercial and utility scale energy plants is a carbon neutral sustainable energy system. In a review of the Manomet Biomass Sustainability and Carbon Policy Study performed for the Clean Air Task Force comparing carbon emissions between biomass and fossil fuel power plants, PFPI concluded, "**For utility-scale generation, net emissions are higher from biomass than fossil fuels.** When biomass is used to generate electricity in utility-scale plants, the net emissions after 40 years, even taking forest regrowth into consideration, are still higher than if the power had been generated with natural gas or coal." In discussing the Manomet study assumptions, PFPI stated, "To the extent that these assumptions are not warranted, the Manmet study has underestimated the net carbon emissions of biomass power, and policy-makers should be extremely cautious about accepting the study's optimistic conclusions concerning the point in time when biomass can start providing a carbon dividend."

processes to capture and convert CO_2 using chemoautotrophic (CAT™) bacteria. CAT™ bacteria continuously consume CO_2 without requiring light. Bench-scale research results are extremely promising, and system-level modeling and simulation estimate synthetic diesel production costs a $3 to $5/gallon. By changing our mindset away from conventional thinking in which CO_2 is viewed solely as a threat to our planet and human life we were able to explore ideas to utilize CO_2 that provide societal and economic value.

Our endeavor was to devise a technological solution that consumed significantly less energy and financial resources compared to carbon capture and underground sequestration (CCS). We also discovered that it would be possible to produce chemical feedstock to provide an alternative to petrochemicals that can help meet growth in global consumption. Our aim is to avoid expenditure of valuable energy and limited financial resources for underground CCS for which no additional societal benefits beyond containing atmospheric CO_2 inventory levels are achieved. Applying the WRI CAT™ Process as a CO_2 recycle accelerator we see the potential to achieve the goal of anthropogenic CO_2 emission reduction via a societal integrated and economically sustainable systems approach.

Our preliminary assessment of net societal/national CO_2 emission reduction is based primarily upon the integration opportunity for two existing large societal sector CO_2 emitters: (1) the power sector and (2) the transportation sector. Applied to the power sector, the CAT™ process can reduce CO_2 power plant emissions which are then converted into a synthetic diesel fuel for the transportation sector. The integrated societal energy system CO_2 reduction results when the synthetic diesel is used to displace conventional diesel consumption – achieving a second use of the carbon within coal prior to the eventual CO_2 emission from vehicle exhaust pipes. While the transportation sector CO_2 emissions are not directly reduced, the fact that the CAT™ biodiesel fuel prevented power plant CO_2 emission from entering the atmosphere we achieve an integrated societal system reduction in CO_2. A descriptive formula comparison of Today (without CAT™) and a Future (with CAT™) illustrates the how an integrated societal energy system achieves lower net CO_2 emissions:

Today's Total CO_2 (without CAT™) =Power Sector CO_2 + Transportation Sector CO_2 + Other CO_2 Emitters

Future Total CO_2 (with CAT™) =Power Sector CO_2 <u>lowered by 80% to 90%</u> + Transportation Sector CO_2 + Other CO_2 Emitters

A calculation performed in 2011 based upon the U.S. coal fleet at that time estimated a potential net national CO_2 emission reduction of 40% to 50%. On the economy and domestic jobs front, WRI's CAT™ process can help build a new component within the domestic petrochemical sector that could create long-term career jobs in every state.

The large financial investments made to build the coal power plant fleet in the United States provides an opportunity to leverage the sustainability goal with lower new financial investments and lessens diversion of limited funds away from other state and national needs. WRI's research includes evaluation of biomass blended with coal to aid farm and forestry states with significant amounts of refuse biomass to maximize their clean energy mix and to provide new market opportunities to the farming and forestry industries by leveraging existing coal plant financial assets.

One technology developed with an industry partner to dry and upgrade the energy value of low-rank coals is now being commercialized to enhance the utilization of woody biomass for energy plant feedstock. This WRI coal drying process applied to biomass is called torrification and produces charred wood pieces that possess an equivalent grindability index performance as coal. Grindability is critical if a material is going to be used in the production of energy through gasification. The result is that biomass can be blended with coal and used to leverage existing coal power plant investments.

A yet to be realized environmental benefit lies in the opportunity to leverage coal power plant emission capture systems to capture criteria hazardous air pollutants (HAPs) such as mercury and arsenic that exist within the biomass energy resources. Yes, biomass does possess several criteria pollutants. In addition, as reported by the Partnership for Policy Integrity (PFPI) paper, "Air pollution from biomass energy" updated April 2011, biomass energy plants emit greater amount of certain criteria HAPs than is emitted from coal power plants. PFPI identified, "The HAPs emitted in the greatest quantities by burning biomass include the organic HAPs styrene, acrolein, and formaldehyde, and acid rain gases hydrofluoric acid and hydrochloric acid...Even "clean wood" – that is forestry-derived wood, as opposed to construction and demolition debris – emits these chemicals when burned. Burning clean wood also emits non-negligible amounts of heavy metals." A copy of the paper by the Partnership for Policy Integrity is attached at the end of this written testimony.

On July 12, 2013, the Partnership for Policy Integrity reported on the United State Court of Appeals ruling against the United States Environmental Protection Agency (EPA) that the EPA could no longer allow exempting CO_2 emissions from biomass power plants for purposes of Clean Air Act permitting. The Partnership for Policy Integrity provided expert testimony for the case and reported, "Most new biomass power plants are fueled with wood, and emit 40 – 50% more carbon dioxide than a coal plant, per megawatt-hour electricity generated. The court's decision could affect how states choose to incentivize biomass energy in the future. Massachusetts has already made low-efficiency biomass power plants ineligible for subsidies, based on the large amount of CO_2 they emit."

We see a substantial opportunity via the combined utilization of biomass with coal power plants to lessen human and wildlife health risks by lowering the inventories of HAPs such mercury and arsenic existing in the environment and food-chain. We view this as a very worthy goal given that it is ***the existing quantity of mercury in the ecosystem that has been deemed a human and wildlife health hazard***. We believe this allows policies to explore and implement solutions to reduce the quantity existing in the ecosystem in addition to reducing new emission contributions.

Just as happened with coal, biomass accumulates various elements and compounds. Both produce HAPs during combustion. By working with these processes of nature in which coal and biomass accumulate hazardous substances such as mercury and arsenic and co-feeding this contaminated biomass with coal we can assist in lowering the quantity of mercury and arsenic already existing in the ecosystem and food-chain. This presents an opportunity to integrate biological based environmental remediation for mercury and arsenic via biomass and thereby leverage the investment in multi-HAPs capture control technology installed on coal power plants. The result being an integrated clean energy solution that not only reduces new emissions of mercury and arsenic but perhaps more importantly combines to lessen the existing human and wildlife health risk by cleaning up the unsafe levels already in the ecosystem.

Given that 50% or more of the annual mercury deposition quantity in the U.S. is from foreign sources, we believe that lessening the human health risks will require some means to reduce ecosystem mercury levels in addition to lowering domestic mercury emissions. Integrating the natural process of biomass to uptake contaminants within the ecosystem with existing and coordinated emissions control investments to coal power plants we see an opportunity to achieve lower health risks by lowering the quantity of contaminants within the environment and food-chain. Utilizing the existing coal power fleet provides readily available asset investments to which to retrofit additional emissions control technologies.

WRI recommends that the efficient utilization of energy and financial resources is a key to achieving sustainability goals and energy security. This includes:

1. Coal Upgrading/Drying with added benefits of criteria pollutant removal and lower/elimination of coal fines during rail transport
2. Coal and Coal/Biomass Gasification
3. Coal to Alcohols and Chemicals

4. Hydrogen and CO_2 Capture/Separation
5. WRITECoal emission management and water utilization for low-rank coals
6. Secondary Biogenic Coalbed Methane
7. Biological CO_2 Capture and BioCrude Oil production
8. Mercury Continuous Emission Monitoring (CEM)

KEY CHALLENGES

- investment uncertainty and risk due to unstable regulations;
- large investment amount required to support pilot-scale and demonstration scale technology de-risking stages of technology advancement;
- new large energy process "game changing" technology takes decades from research conception through pilot, demonstration and commercial scale deployment;
- biomass energy density is significantly low compared to coal such that its applicability for all states as a sustainable energy resources is constrained by the fact that long distance transportation energy consumption beyond 80 to 100 miles can exceed the energy contain within the young biomass; and,
- the segregated nature of the coal and power industry business components results in a lack of integrated strategic planning and implementation from resource extraction, to conversion (i.e., electricity) to power transmission and distribution, and integration of distributed energy resource (DER) utilization technologies, especially intermittent DER technologies.

UTILIZATION OF LOW-RANK COALS

- **Chemoautotrophic (CAT™)** carbon capture bacteria create a biological crude oil that can effectively recycle CO_2 through production of alternative petrochemicals for use in the chemical industry or even as fleet biodiesel fuel. We started our research looking for ways to lower the energy consumption and financial investment resources estimated to be required for conventional underground CCS approaches. Our goals were to provide a lower cost approach that also had geographical flexibility by not being limited to the available geological formations capable of sequestering carbon dioxideation. As WRI advanced this technology we came to understand that it could change the entire perspective about CO_2 being solely a negative planetary and human health hazard and think about CO_2 as a beneficial resource to aid sustainability and energy security national strategic goals. A summary of the WRI's CAT™ process technology is provided in Attachment B.

- **Recycling Energy:** The U.S. Department of Energy (DOE), Energy Information Administration (EIA) and the International Energy Agency (IEA) estimate large growth in world energy consumption through 2035. A key contributor to the growth is the increasing economic expansion in emerging country economies that is moving existing populations from subsistence living conditions to middle class consumerism life styles. This global economic megatrend is a major factor in projections of accelerated consumption of all natural resources on our planet and emissions from extraction and utilization of energy. Attachment C provides a summary of the EIA and IEA projections.

This has motivated WRI to increase our research focus aimed at increasing energy efficiency and devising practical technologies that recycle energy similar to the growth in recycling of paper, plastic, metals, asphalt pavement, etc. Carbon-containing molecules are a key output from both fossil and biomass energy plants that we can work with to invent energy recycle technologies such as our research on WRI's chemoautotrophic process technology described above. By capturing and utilizing CO_2 emissions from large CO_2 emitters such as coal power plants and in turn producing bio-based petrochemical alternative feedstock it is possible to reduce foreign oil imports and their associated emissions. Applied to the current coal power plant capacity within the U.S. a national CO_2 emission reduction of 40% to 50% is estimated. This could achieve a national carbon footprint comparable to natural gas electric power generation plants. An energy systems integration approach creates opportunities to establish a new component within the energy sector that supports jobs nationwide. This provides opportunities to lower the U.S. foreign trade deficit enabled by lower manufacturing costs, retaining domestic cement production, and increasing domestic transportation fuel production.

WRI helped to create a Zero Carbon Data Plant demonstration occurring in Cheyenne, Wyoming. This public-private partnership project, including Microsoft, FuelCell Energy, the City of Cheyenne, the University of Wyoming, Cheyenne Light Fuel and Power, Wyoming Business Council and WRI, leverages a bio-chemical carbon recycle system within nature to achieve a carbon neutral power plant for a Microsoft modular data and computational server. This Zero Carbon Data Plant demonstration facility is designed to use biogas from the Cheyenne Board of Public Utility's Dry Creek Water Reclamation Facility using a molten carbonate fuel cell plant from FuelCell Energy to produce clean power for a Microsoft server module. Future research opportunities include testing and evaluating utilization of CO_2 emitted from the fuel cell and recycling CO_2 through the WRI CAT™ process thereby increasing societal economic sustainability and environmental benefits.

Such opportunities allow us to use innovation to create solutions to pressing issues and needs. As is the essential nature of research we strive to find opportunities where problems are identified. Our thinking therefore must be unconventional so that we may create positive step changes in technological possibilities. By applying unconventional thinking about the problem of CO_2 as an environmental and health hazard to be treated and disposed of as a hazardous substance, we are opening our minds to invent ways to turn CO_2 from an underutilized resource into a key energy portfolio resource to achieve great gains toward sustainable societal goals.

- **WRITECoal™** enhances the value and utilization of low-rank (high water content) coals by extracting the water at power plant input for later use within the plant. This results in lower local water consumption to supply plant makeup water with an estimated 50% to 60% lower water consumption. We think that this is important for water stressed regions of the U.S. The technology was first developed to remove mercury (Hg) prior to feeding coal into the plants thereby simplifying the Hg capture. We project Hg capture of 90% or better depending upon the quantity of Hg locked in the pyrite rock existing within the coal feed. The coal-bound Hg is easily removed whereas the Hg in pyrite is physically locked into the rock material and is not readily liberated for capture. Jigging equipment can be used to remove the pyrite, thereby achieving very high Hg emission capture percentages.

  WRI, also, sees substantial capture of arsenic and selenium and developed multi-pollutant capture technologies to increase the effectiveness of capturing more than just one pollutant. Most capture technologies tend to be highly selective and quickly saturate with one pollutant thereby allowing the other pollutants to flow out the stack with negligible capture percentages. Attachment D provides a summary of WRITECoal™.

  While increasing coal power plant efficiency 3 to 4%, capturing >90% of the mercury and lower CO_2 capture cost, WRI's technology turns the water in PRB coal from a price limiter into a valuable asset. WRI's WRITECoal™ pretreatment utilizes waste heat from coal power plants to evaporate the water which is collected for later use in the plant, thereby delivering usable water with low-rank coals. This is especially important in arid and drought stricken regions of the U.S. where water shortages are increasing.

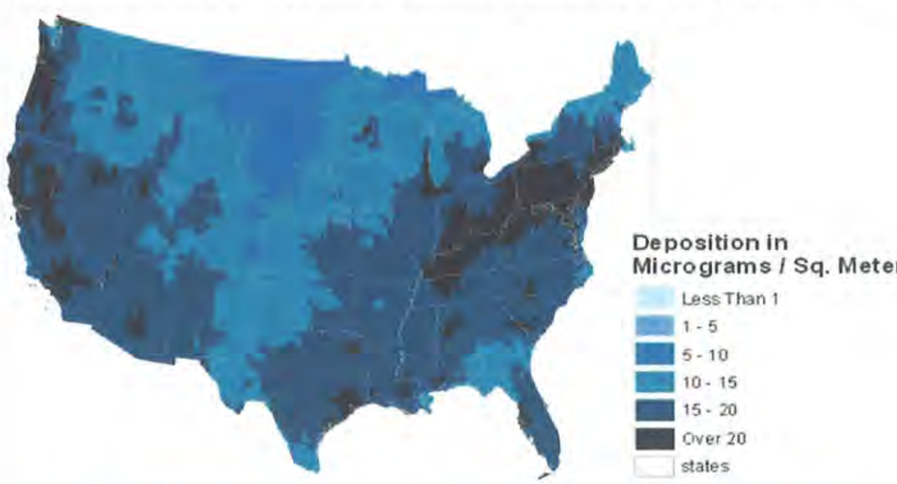
- **In-Situ Biogenic Coal Extraction** technology developed by WRI entails an advanced system for in-situ enhanced biogenic methane production from coal using naturally occurring microorganisms that normally live in coal. This technology extends the life of current coal bed methane well and pipeline investments, and allows the revitalization of abandoned, played-out wells. Additionally, this technology can produce methane from low-rank coal deposits and high-rank "stranded" coal deposits that are currently beyond the reach of financially viable mining technologies. This in-situ biogenic extraction technology, summarized further in Attachment E, is designed to increase domestic methane reserves beyond what is currently estimated by the DOE EIA.

- **Coal Dryer Energy Enhancer** technology increases the energy value of low-rank coals from approximately 8,200 to 11,500 British Thermal Unit/pound (BTU/lb) while also significantly lowering mercury (Hg) content and removing coal fines prior to transport. This is essentially a mine-mouth process that enables removing Hg at the mine site for safe disposal during mine back fill and site restoration to high quality wildlife habitats. A benefit sought by commercial deployment of this technology is to enable a near-zero mercury coal for export that would help lower Hg deposition in the U.S. (mainly western states) from the burning of coal in Asian countries and emissions carried by trade winds to the western U.S.

- Another four projects represent a second integrated program aimed at moving Wyoming up the value chain in energy with technologies to produce liquid fuels, industrial chemicals, and hydrogen while also lowering the cost of CO_2 capture. One of the technologies miniaturizes reactor size through delivering 4 to 5-times better thermal and chemical reaction performance. Another technology substantially improves mercury capture efficiency.

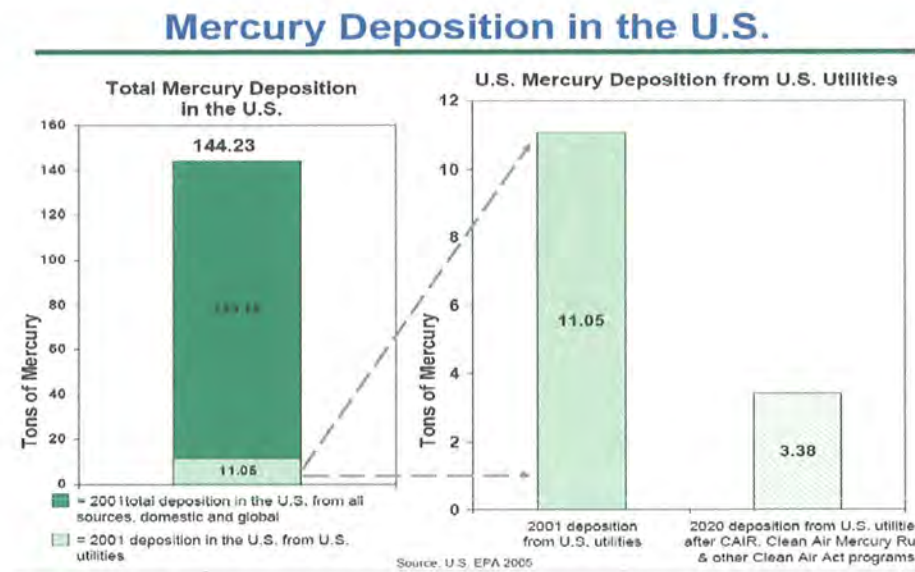
LOWERING MERCURY CONTENT

Understanding Mercury Human and Wildlife Health Risks – As shown in the next figure, high levels of mercury exist in the ecosystem of western states and the Upper Ohio Valley.



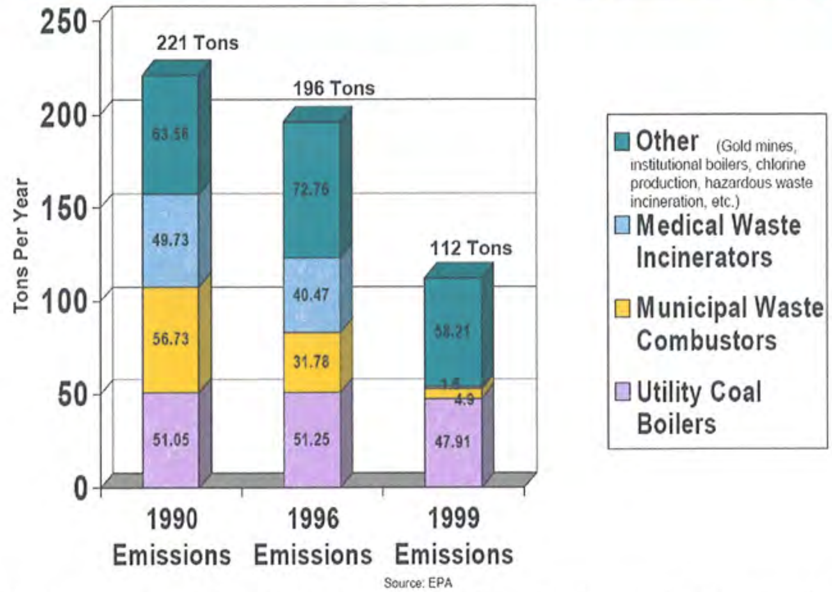
Source: US EPA 2005 using Community Multiscale Air Quality model.

Another key piece of factual data published by the U.S. EPA in 2005 illustrated in the next chart is that of the 144.23 tons of mercury deposited in the U.S. in 2001 only 11.05 tons (7.7%) came from U.S. utilities. Furthermore, mercury emissions for U.S. utilities were projected to decline to 3.38 tons by 2020 as shown in the chart below.

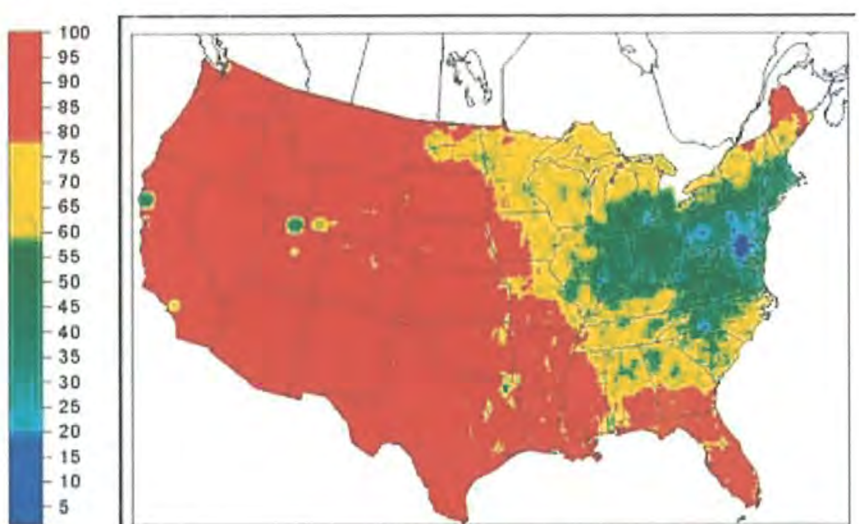


Also, reported by the U.S. EPA is a breakout of domestic mercury emitters illustrated in the next bar chart. U.S. Utility Coal Boilers represented about one-fourth the total domestic mercury emissions prior to 1999. A key policy question worthy of consideration is, "What is the cumulative contribution by various sources to the mercury existing in the U.S. ecosystem?" Based upon the three EPA data charts regarding mercury, it seems apparent that the majority of mercury existing within the ecosystem and deemed a human and wildlife health hazard are primarily attributable to sources other than the U.S. Utility Coal Boilers. This begs the next questions, "Could combined policy that includes removal of mercury from the ecosystem and reducing new emissions best achieve lowering of the human and wildlife health hazard?"

Mercury Emissions Have Dropped 45% Since 1990



Presently, a large percentage of new mercury depositing in the western states is attributable to coal burning power plants and cement production in Asia. The figure below from the Electric Power Research Institute (EPRI) illustrates the percentage of mercury from foreign sources depositing in the U.S. The amount of mercury depositing in these states is expected to increase over the next few decades due in large part to predicted economic growth in Asia. The WRI Coal Drying Energy Enhancer technology described above provides a means to remove nearly all mercury from low-rank coals prior to export to Asian markets. This provides an U.S. developed technological solution to protect western states from growth in future mercury deposits while dealing with the practical reality of environmental and economic policies in other countries.



Percent of mercury deposition originating outside the United States {Source: EPRI}

Continuous Emission Monitoring for Mercury we worked with the Electric Power Research Institute (EPRI) and the National Institute for Standards and Technology (NIST) with funding support from the U.S. DOE and the Environmental Protection Agency (EPA) to advance Continuous Emission Monitoring (CEM) protocols and evaluate/improve the CEM equipment.

CARBON CAPTURE AND SEQUESTRATION (CCS) TECHNOLOGIES

Our thinking has evolved to consider CO_2 as an economically productive and valuable resource that facilitates national security and competitiveness in the global economy. We are focusing our ingenuity to maximize "Sustainability for Living in a Carbon-Rich World." In addition, to using biotechnology to convert CO_2 into a chemical feedstock for U.S. manufacturers to produce higher value products, there is significant economic potential to utilize the domestic supply of CO_2 to increase domestic oil production using CO_2 enhanced oil recovery techniques. Creating the infrastructure and connecting the various business opportunities could enable energy intensive industries, such as manufacturing and data centers, by providing an income stream from sale of their CO_2 emissions to other industries that can recycle/reuse the CO_2. Our view is that creating the market demand for CO_2 will be far more effective and beneficial for the overall U.S. economy than solely implementing a CO_2 emission reduction policy approaches.

Our colleagues within the University of Wyoming, Wyoming Geological Survey, Wyoming Pipeline Authority and Governor Matt Mead's office are implementing long-term strategies to manage carbon dioxide. For example, the state of Wyoming has developed a strategy to expand the CO_2 pipeline network throughout the state to maximize enhanced oil recovery over the next couple of decades while preparing the infrastructure for delivering CO_2 to underground sequestration facilities. Full implementation of this strategy will form a long-term public-private partnership to address the concerns for CO_2 emissions while providing economic wealth creating business and job opportunities for the oil sector. In addition, the state of Wyoming has provided approximately $70,000,000 for clean energy research and development to advance environmentally safe coal utilization, oil, natural gas, wind, nuclear, solar, geothermal and hydropower technologies. The state is pursuing an "All-of-the-Above" energy research and technology development portfolio strategy that includes integration across traditionally segregated energy sectors and within sectors, such as coal. Coal is perhaps one of the most segregated vertical subsectors with the energy sector. This has essentially blocked strategic investment in research across the subsector due to lack of a single entity positioned to coordinate long-term strategic planning and investments to resolve environmental concerns.

The WRI chemoautotrophic (CAT™) CO_2 utilization technology mentioned earlier is a biotechnology invention that creates economically beneficial uses for CO_2. WRI is bringing forth a technology that allows thinking about CO_2 as a long-term beneficial resource that can facilitate achieving economic sustainability and energy security while increasing wealth creation to bolster economic prosperity in all states.

RECOMMENDATIONS

Based on WRI's experiences and expertise, I recommend that Congress take the following actions:

- Formulate a flexible integrated clean energy technology research investment portfolio and priorities to achieve best performance within local and regional constraints.
- To affect a Best-Portfolio National Approach, a national strategy for "All-of-the-Above" energy resources and utilization technologies needs to accommodate:
  - the real-world substantial differences in local energy resources,
  - weather, altitude, water availability, wildlife and infrastructure assets,
  - differences in local energy consumption and the purpose of that consumption,
  - consumption of energy locally and the associated emission footprint to supply end-use energy for consumption by other states necessitates that Federal mandates for states should provide goals to energy producing states that differ from energy consuming states,
- Consider policies that allow exploring solutions for Living in a Carbon-Rich World in addition to Living in a Carbon-Constrained World,
- Consider allocating increased funding to support the utilization of carbon dioxide to stimulate the transformation of this abundant compound from something to be avoided to something which can be used to increase chemical feedstocks, biofuels and support national energy self-sufficiency,
- Allocated resources for research to support the sustainable and environmentally safe use of fossil fuels, especially energy efficiency advancements.
- Federal government take the leadership role of strategically planning and advancing energy efficiency improvements and environmental impact reductions across the entire coal sector.

CLOSING REMARKS

WRI has taken an integrated approach to provide sustainable solutions that bring down the costs of energy production and utilization of coal and other traditional resources by combining our knowledge base with emerging technologies. The many boom and bust cycles that we have experienced in the energy sector are a function of the marketplace. The way in which we can minimize the downside of this fact of life is through an aggressively innovative partnership between industry, research entities and the federal and state governments. This will ensure that our energy technology portfolio will deliver benefits to the U.S. consumer and protect the environment.

I would note , for example, that the state of Wyoming is investing in and implementing a long-term strategic plan to maximize the entire energy portfolio within Wyoming while positioning infrastructure to address CO_2 long-term storage. This is precisely the kind of activity the federal government should encourage. Making the best use of limited financial investment resources in addition to efficient utilization of energy resources is a key to achieving national sustainability goals and energy security.

In closing, a strong commitment to this kind of portfolio approach that avoids a one size fits all solution, will facilitate innovation and sustainable economic growth. Continued Federal funding of scientific research and technology development is essential to enable maximizing energy efficiency and productivity of our country in the most environmentally and economically sustainable ways.

Again, thank you for the opportunity to appear before you. I would be pleased to answer any questions the Subcommittee may have.