3. “CLEAN COAL” - AN OXYMORON

DEFINITION

The term “clean coal” is not an easy term to define.

A. In Pre-War II, it meant that it was high-quality “smokeless coal” that could be burned in the home.

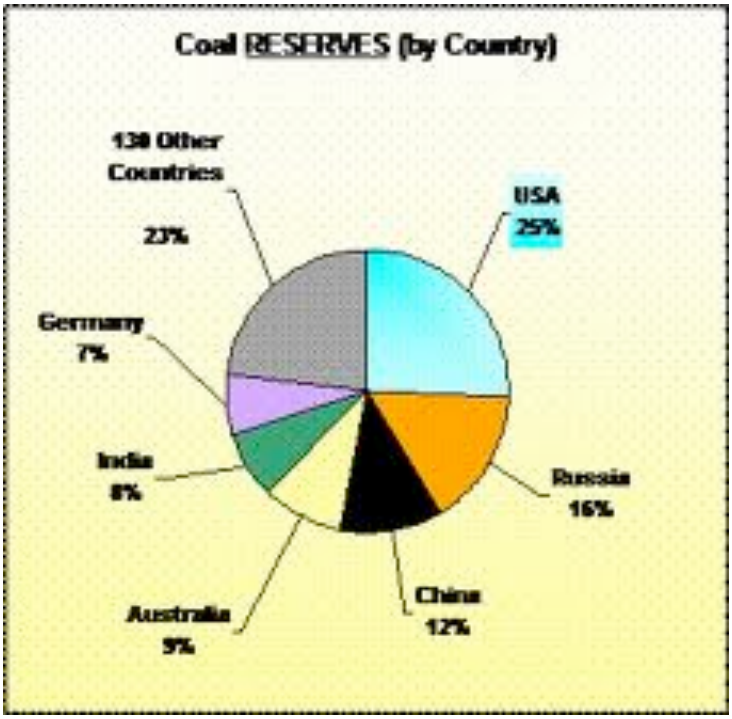
B. The last major amendment to the Clean Air Act was enacted by Congress in 1990 which defined clean coal technologies as “those that achieve ‘significant reductions in air emissions’ of sulfur dioxide and nitrogen oxides, pollutants that contribute to the formation of acid rain.”

C. The utilities and coal mining industry prefer this definition: “Any technology to reduce pollutants associated with the burning of coal that was not in widespread use prior to the Clean Air Act Amendments of 1990.” <http://www.csmonitor.com/Environment/Bright-Green/2008/1017/what-is-clean-coal-anyway>

D. In general, as indicated in this paper, coal can be “cleaned” in many ways by numerous techniques, but each technique makes coal just a little cleaner. In the final analysis, if coal is burned it will release more products than can be economically removed. There are just too many byproducts from the burning of coal.

ABUNDANCE OF COAL

United States has a quarter of the world’s coal reserves; more than any other country.



The above graph and more images for the world's coal reserves can be found at: Images for world's coal reserves

"Using current mining techniques, some 275 billion tons are considered to be recoverable out of a demonstrated reserve base of 491 billion tons. With an annual production rate of 1.2 billion tons, nearly 250 years of use is currently available. This, however, could be greatly extended by generation electric power with plentiful nuclear fuel instead of using 86 percent of coal production for that purpose.

Commercial coal mines operate in 26 states, with 1,331 mines east of the Mississippi and 93 west of the river. Most eastern mines are underground while western mines are almost entirely high-production surface mines allowing the West to 'outstrip' the East by 672 million tons to 490 million tons per year." - Ed Hiserodt <http://www.thenewamerican.com/tech-mainmenu-30/energy/238-coal-in-your-cars-tank>

WHAT'S THE PROBLEM?

See Position Paper "Too Dangerous To Burn" <http://www.wisconsinipl.org/assets/whatwedo/Too%20Dangerous%20to%20Burn.pdf> where you can find a long list of pollutants and their estimated quantities that are emitted from burning coal including most of these:

1. Carbon dioxide (CO_2);
2. Sulfur dioxide (SO_2);
3a. Small airborne particles;
3b. Black Carbon (soot);
4. Nitrogen oxide (NOx);
5. Carbon monoxide (CO);
6. Hydrocarbons, volatile organic compounds (VOC);
7. Mercury (Hg);
8. Arsenic (As);
9. Lead (Pb);
10. Asbestos (about 15% of mines are contaminated with asbestos)
11. Cadmium (Cd);
12. Uranium (U); and
13. Highly toxic Thallium (Tl). <http://www.pnas.org/content/105/34/12140.full>
14. Other toxic heavy metals;

In 1990 Title IV of the Clean Air Act laid plans to reduced acid rain by targeting only sulfur dioxide (SO_2) emissions. It took time, but the plan worked because an effective regulatory cap was placed on the total number of tons of sulfur dioxide emissions that had to be reduced.

In 2004 eleven states joined eight northeastern states and the District of Columbia to form the NOx Budget Trading Program (NBP) to reduce emissions of nitrogen oxides (NOx). Nitrogen oxides are the key ingredients in the formation of ground-level ozone, commonly called "smog." The NBP is a market-based cap and trade program and it is anticipated, when fully implemented, NOx emissions will be reduced.

In the 21st century other environmental concerns emerged:

1. health impacts of mercury;
2. effects of microscopic particles causing respiratory problems; and
3. effect of greenhouse gases and global climate changes.

In 2009, "the U.S. Department of Energy (DoE) announced that it will invest a total of $27.6 million in 19 projects to evaluate the potential risks of storing carbon dioxide (CO_2) in geologic formations. This report includes advanced coal cleaning, combustion, gas separation, and the CO_2 capture & sequestration technologies, markets and forecasts." <http://www.prnewswire.com/news-releases/reportlinker-adds-clean-coal-us-emerging-technologies-rd-and-next-generation-equipment-67262372.html>

HOW WELL ARE THE FEDS DOING ON CLEAN COAL?

In 2003, eight projects were selected under the first round Clean Coal Power Initiatives (CCPI) solicitation, only three have been completed.

In 2004, four projects were selected from the second round CCPI solicitation. Only one has been completed. Another has begun construction to demonstrate advanced Integrated Gasification Combined Cycle (IGCC) technology.

Presently, a third round Clean Coal Power Initiatives solicitation is underway and is focused on developing projects that utilize **carbon sequestration** technologies and/or beneficial reuse of carbon dioxide.

Researchers are attempting to determine what "the actual reduction in global warming potential (GWP) would be to maintain power generation capacity" while capturing and sequestering CO_2. Their analysis included emissions from coal mining, transportation, and power plant operation.

Several greenhouse gases (GHG) were considered in their study. CO_2, produced in the largest quantity has the greatest effect on global warming even though, "According to the Intergovernmental Panel on Climate Change (IPCC), the contribution to atmospheric warming by CH_4 and N_2O is 21 and 310 times higher than CO_2, respectively, for a 100 year time frame." <http://www.netl.doe.gov/publications/proceedings/01/carbon_seq/p4.pdf>

"The Clean Coal Power Initiative is providing government co-financing for new coal technologies that can help utilities cut **sulfur**, **nitrogen** and **mercury** pollutants from power plants. Also, some of the early projects are showing ways to reduce greenhouse gas emissions by boosting the efficiency by which coal plants convert coal to electricity or other energy forms." <http://www.fossil.energy.gov/programs/powersystems/cleancoal>

Plans are presently being made to construct a plant for producing "Liquid Coal" which is actually gasoline, or some other liquid fuel, that is made from coal. This sounds like a good idea, but it releases twice the amount of heat-trapping gases as traditional oil.

The Department of Energy is on the verge of using our tax dollars to subsidize liquid coal production in Carbon County, Wyoming. In Wyoming the project is called The Medicine Bow Methanol Project located near a low-sulphur coal mine to produce both methanol and gasoline. The process will be similar to the Fischer Tropsch method for making diesel fuel from coal carried out be Germany and Japan during World War II because neither country had access to

petroleum. <http://www.chemicals-technology.com/projects/medicinebow>

According to the Friends of Earth: “Not only does its production cost a fortune and consume vast quantities of fresh water, liquid coal also releases twice as much heat-trapping gas as traditional oil. Worse yet, liquefying coal would open the door to running cars, planes and other vehicles on the dirtiest fuel available, a coal industry dream -- but a nightmare for people and the climate.” - Friends of the Earth <http://www.foe.org/energy/liquid-coal>

IF COAL WERE PURE CARBON...

And if it were burned, it would basically produce only carbon monoxide (CO) and carbon dioxide (CO_2). Small amounts of nitrogen oxides (NOx) would also be produced because at high temperatures oxygen (20+%) from the air will combine with nitrogen (78%) also from the air. But in addition to CO, CO_2 and NOx, there are loads of other impurities in coal that, without controls, are sent into the atmosphere to be spread away from its source. That is one of the purposes of constructing tall smokestacks - to dissipate these products into the atmosphere we breathe.

TECHNOLOGIES FOR CLEANING-UP COAL

“There are four common ways to try to eliminate effluents of combustion:

1. by precombustion technology;
2. by combustion technology;
3. by postcombustion technology; or
4. by use of a combined cycle gas turbine at low cost to try to avoid the installation of a whole host of treatment technologies.”

<http://www.physics.ohio-state.edu/~wilkins/energy/Companion/E14.1.pdf.xpdf>
These are discussed in another position paper titled: 4. “Clean Coal” - Production.

THE PROBLEM IS...

The major problem is in the definition of the term “clean coal.” Apparently the term “clean coal” is used as soon as a new technology is developed to control another emission. For example: the term “Clean Coal” has been applied when we use:

1. low sulfur coal from most of our western states - typically Wyoming;
2. water or other solvents to wash the coal to remove soluble impurities;
3. electrostatic precipitators in the smokestacks;
4. scrubbers to wash dust and gases from the emissions;
5. a cyclone system to spin dust out of the emissions;
6. bag collectors to remove mercury;
7. a limestone slurry to neutralize acids;
8. “in-situ gasification” of coal (in ground);
9. “fracking” of coal and convert it into a burnable gas or liquid;
10. fluidized-bed combustion technology;
11. circulating fluidized-bed technology (cleaner than 10 above);
12. integrated gasification combined-cycle (IGCC) gas turbines;
13. sequestering, capturing, and storing of carbon dioxide which reduces the efficiency of a power plant. (Capturing and compressing CO_2 requires much energy and would increase the

fuel needs of a coal-fired plant with Carbon Capture and Sequestration by 25%-40%). <http://www.netl.doe.gov/publications/proceedings/01/carbon_seq/p4.pdf>

It can be said that each of the methods listed above provides “clean coal” technology but each is only a partial treatment.

If we were to use all of the above “Clean Coal” techniques in one plant:

1. some polluting emissions would still be release since none of them is 100 % efficient.
2. it would require additional energy to run the equipment;
3. more energy means more burning of coal;
4. more coal burning means more emissions;
5. more coal burning also means a faster depletion of our valuable natural resource;
6. the cost of total cleanup would be too expensive - probably resulting in one of the most expensive energy sources;
7. NOTE: to date there is no commercial sequestration, capture and storing of CO_2! The National Energy Technology Laboratory (NETL) does not expect to have safe, cost-effective, commercial-scale greenhouse gas capture, storage, and mitigation technologies until 2020. <http://www.netl.doe.gov/about/index.html>

WIPL’S POSITION

Millions of years ago clean solar energy helped produce the plants that, under proper conditions, formed into coal beds that we harvest today. No matter how we treat coal in an attempt to clean it up, we will never be able to burn coal without producing emissions that are harmful to our environment. “Clean Coal” is an oxymoron.