Breaking Energy

CLIMATE CHANGE, COAL, INNOVATION

Carbon Conversion is Key to Solving Climate Change Problems

By ED DODGE on February 05, 2014 at 2:00 PM

In 1990, President George H.W. Bush signed into law an amendment to the Clean Air Act that mandated emissions reductions of the harmful pollutant sulfur dioxide, SO2, from coal-fired power plants. The government did not instruct industry how they were to achieve the reductions, but merely that they were required to. A novel system called 'cap and trade' was implemented for the first time that allowed polluters some flexibility in how they met the targets by trading credits.

Cap and trade was a market based policy innovation that broke with the typical 'command and control' methods for reducing pollution. The market-based approach led to a wave of innovation in exhaust scrubber technologies and created a profitable market for sulfur products that was not anticipated. There is now a large market for sulfur commodities derived from coal, particularly in agrochemicals, a market that reached 41.1 million metric tons in 2012. The cap and trade model was so successful that SO2 pollution was reduced by 50% far faster than predicted and at one-fourth of the expected costs according to EDF (Environmental Defense Fund), one of the original architects of the plan.

The current model generally promoted for reducing carbon dioxide emissions is 'carbon capture and sequestration', taking CO2 that has been extracted from exhaust streams and injecting it underground into geological formations such as saline aquifers for disposal. There are serious flaws in this model, in particular that it fails to recognize the market mechanism that made SO2 reductions so successful, conversion of the polluting element into a marketable commodity.

Underground CO2 sequestration treats carbon dioxide as a waste product to be disposed of in a post-modern landfill. By definition this process is an economic liability for someone, whether it is the power plant owners or the taxpayers, someone has to pay the bill for all the work. Once disposed of the CO2 deposits must be monitored for leakage into eternity because concentrated CO2 is very dangerous, it is an invisible and odorless asphyxiant that is heavier than air and stays low to the ground. The Lake Nyos tragedy in Cameroon in 1986 saw the deaths of 1,700 people and 3,500 livestock when a natural carbon dioxide formation suddenly released and killed nearly everyone in a 25 km path. Under these circumstances there is no economic rationale to engage in large scale carbon sequestration underground, it could only be imposed by law.

There is another way forward. Convert the carbon dioxide into useful products, just as was done with sulfur dioxide. This is a big challenge as the volume of CO2 that needs to be sequestered is incredibly large, a single coal power plant can produce millions of tons of CO2 per year and global estimates are in the billions of tons per year. But there is proof this model can work, as the only successful carbon sequestration projects so far have been those that sell CO2 for use in oil drilling such as the Dakota Gas Synfuels plant or the new Kemper County, MS coal gasification plant. Drillers inject CO2 into old oil wells in a process called 'enhanced oil recovery' (EOR), CO2 reacts with petroleum to make it less viscous and flow better allowing continued production after the initial phase has tapered off. Denbury Resources specializes in tertiary oil recovery using CO2 and owns hundreds of miles of CO2 pipelines. But the market for EOR is not nearly large enough to consume all the CO2 being produced and there are logistical challenges in locating pipelines to move the CO2, so this is not a complete solution but it points us in the right direction. Make CO2 into a commodity and the market will take care of it.

CO2 is a useful molecule and a basic building block of life. CO2 can be polymerized (turned into plastics), mineralized (turned into stone such as calcium carbonate), used to grow plants or put to work in a variety of industrial and scientific applications. CO2 can be converted into fuels as well, but it requires energy to break the molecular bonds so there is a tricky energy balance that must be worked out for any CO2 to fuels process to be effective. With that in mind there are a number of firms seeking to take advantage of cheap forms of energy such as industrial waste heat or desert solar to produce CO2 fuels.

Many entrepreneurs see the opportunity in this emerging market and the science has leaped forward in recent years. Examples include Novomer, a small chemicals firm that has developed novel catalysts that convert CO2 into polymers and plastics. Joule is a biotech startup that is using waste CO2 to feed bacteria that produce ethanol and diesel. Skyonic and Calera corporations are mineralizing CO2 for use in construction materials.

The challenge of finding a market for billions of tons of carbon dioxide is undoubtedly enormous, but so are the consequences of not succeeding. Climate change caused by excessive CO2 pollution is an existential problem gripping humanity. Yet coal consumption is growing globally by leaps and bounds as China, India and the rest of the developing world seek to raise the standard of living for billions of people. Energy is needed to lift the poor up out of poverty and coal is the world's dominant form of energy. Despite all the advances in alternatives and renewable energy, coal is still king. An effective solution is needed to reduce the carbon emissions from coal burning and simply ordering people to change, or attempting to appeal to them through moral persuasion is inadequate.

The lesson learned from reducing SO2 can apply to CO2, yes the problem is bigger and tougher, but the same rules apply. Convert pollution from a liability into an asset by putting a price on carbon and let the market handle it. Treating CO2 as toxic waste ensures that it ends up as toxic waste, complete with a huge bill and long-term liabilities. But if we can treat CO2 as a misallocated asset and develop a market for it then we can solve the problem. We can convert CO2 into a family of useful products, create new industries and hopefully solve climate change in one fell swoop.

Topics: Cap and Trade, Carbon Capture, Carbon Capture and Sequestration, Carbon Capture and Storage, Carbon Dioxide, Climate Change, Energy Policy, GHG Emissions, GHG Emissions Mitigation, GHG Gases, Global Warming, Greenhouse Gas Emissions, Technology