

The Fertilizer Factory that Makes Electricity: PurGen

---Peter Montague, PhD

The PurGen application to NJ DEP for an air permit offers us some interesting insights into the proposed coal plant. (A PDF copy of the air permit can be found here: <http://goo.gl/dmDa>; page numbers within this memo refer to that PDF document.)

The 750 megawatt power plant will send "up to 450 MW [megawatts] of electrical power to the PJM Interconnect* market." (pg. 9) (PJM Interconnection is an electricity wholesaler that serves New Jersey but not New York.) This means that 300 megawatts (or 40%) of PurGen's 750 megawatts will be doing something besides generating electricity.

It will be doing two things: powering the carbon sequestration apparatus, and making urea fertilizer for sale.

PurGen will use 7000 tons of coal per day (pg. 9), though pg. 10 says Purgen will use 40,000 tons of coal every 5 days, which is 8000 tons per day. In this memo, I'll use the lower figure, 7000 tons per day. At 7000 tons per day, PurGen will use 2.6 million tons of coal per year. Of this, 40%, or one million tons of coal (in round numbers), will be mined, shipped and combusted each year for purposes other than making electricity.

On pg. 17 we learn that Purgen will produce 40,000 tons of urea every 11 days, or 1.3 million tons per year. Urea is the most nitrogen-rich fertilizer in common use (it's 46.7% nitrogen), and it currently sells for about \$500 per ton, thus bringing Purgen \$650 million per year. (See Table 7 at <http://goo.gl/3blT>)

According to U.S. Department of Agriculture, the U.S. used 5.7 million tons of urea in 2007 (Table 4 at <http://goo.gl/3blT>). So PurGen's annual urea production will be large -- 23% of annual U.S. urea use.

Nitrogen is an unusual element. It makes up 78% of the atmosphere, yet in the air it is inert, meaning that it does not combine chemically with other substances. Two natural agents "fix" atmospheric nitrogen into chemically reactive forms -- lightning and bacteria in soils. See <http://goo.gl/zRxB>

Plants and animals require nitrogen for their metabolism, eventually returning it to the atmosphere. As early as 1970 scientists expressed concern that humans were interfering with the global nitrogen cycle on a massive scale[1] -- humans were fixing the same

amount as natural processes -- thus doubling the amount of reactive nitrogen cycling through the biosphere.

Since 1970, human production of reactive nitrogen has continued to grow, and scientific concern about the consequences has grown apace. In September 2009, a group of European scientists described nine ecological "boundaries" that they believe humans must not transgress. Of the nine, three have been transgressed already -- and one of these three is human use of nitrogen fertilizers. See <http://goo.gl/NGeN> and <http://goo.gl/8iwK> and <http://goo.gl/l9NF>.

This group of scientists calculated that human use of reactive nitrogen must be cut to one-quarter of where it is today, in order to achieve a sustainable level of use. <http://goo.gl/8iwK>

Thus the PurGen coal plant will be manufacturing 1.3 million tons of a fertilizer that ecologists tell us is already ruining the biosphere. Nitrogen is creating "dead zones" in the world's oceans, and killing corals, among other negative effects.

One might argue that making more electricity is a good thing, but it is hard to argue that making more inorganic nitrogen fertilizer is a good thing. The biosphere cannot tolerate more inorganic nitrogen fertilizer. I believe this is our most potent environmental argument against the PurGen proposal.

Urea has the chemical formula $\text{CH}_4\text{N}_2\text{O}$. After it is spread onto agricultural land, urea hydrolyses into ammonia and carbon dioxide -- thus reducing PurGen's overall carbon capture and sequestration efficiency. We need a chemist or ecologist to help us quantify this aspect of Purgen's urea production, to learn the extent to which it will prevent Purgen from achieving its goal of capturing 90% of its CO₂ emissions.

We also need help understanding how much money PurGen will make selling electricity. My guess is that, economically, PurGen is really a fertilizer factory that also produces some electricity, rather than an electric power plant that also produces some fertilizer. ☹

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