Carbon Negative Power Plants

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Global Thermostat LLC (GT) (*www.global thermostat.com*) was formed in 2006 to develop and commercialize a unique technology for the direct capture of carbon dioxide from the atmosphere and other sources. The GT process "co-generates" carbon capture with other industrial processes—such as power production—by using the process heat from those processes to drive its carbon capture technology. By combining CO_2 capture from air along with capture from the flue gas of an electrical power plant, and using the power plant's low cost process heat to provide the energy needed for the air capture process, GT technology has the capability of transforming power plants into net carbon sinks. Global Thermostat technology also can work with renewable power plants, because it captures carbon directly from air using the plant's process heat. For example, heat from a Concentrated Solar Plant (CSP) can be used by Global Thermostat to drive its capture process.

CO_2 capture from air is different from other forms of carbon capture in that it extracts CO_2 directly from the atmosphere at low temperatures and at a concentration of about 400 parts per million (ppm). Other carbon capture technologies typically extract CO_2 only from flue gases at higher temperatures and ppm. Global Thermostat technology also can work very economically in conjunction with standard capture technology by combining air and the flue as its sources of carbon.

The US Department of Energy recently announced $2.3 billion in funding in carbon capture technologies. Additionally, China has built into its Twelfth Five Year plan a 17 percent reduction of CO_2 per unit of GDP output and is funding a number of its own initiatives to accomplish this goal.

GT's technology has multiple advantages. The most important are: (i) GT's plant location flexibility allows CO_2 capture where CO_2 can be used as a product, thereby reducing transportation and distribution costs, (ii) GT technology has the ability to make a power plant carbon negative, and (iii) GT technology uses low cost process heat to provide the energy needed for the air capture process.

CO_2 air capture has gained momentum on the policy front and in the business community as a viable and economic solution for reducing carbon emissions and is now being introduced commercially with pilot demonstration plants. The first GT pilot plant erected at SRI International in Menlo Park, CA, captures 1,000 tpy (tons per year) of CO_2 and was co-developed with Corning and BASF. The CO_2 captured at plants like this is available for use in applications such as enhanced oil recovery, greenhouses, production of industrial grade formic acid, producing bio-fuels from algae, and, when combined with hydrogen, for producing hydrocarbons such as high octane gasoline.

According to the International Energy Agency, over 41 percent of all human based emissions of CO_2 are generated by power plants and 89 percent of electricity production around the world is powered by fossil fuels. This represents an energy infrastructure valued in excess of $55 trillion dollars. As this cannot easily be replaced, CO_2 emissions will be around for some time to come. However, with CO_2 air capture, much of this emitted CO_2 can be recovered and molecularly tied up, thereby lowering the CO_2 loading in the atmosphere. With GT's technology, the more electricity one produces, the more CO_2 one can reduce from the atmosphere. This reverses the paradigm that links fossil fuel based power production with carbon emissions. A GT plant utilizing process heat in its process can capture up to twice the CO_2 that a coal power plant emits, leading to carbon negative electrical power production.

Here is a snapshot of how GT's technology works. Air and/or the flue gas mixture are moved by fans over a wall of Corning's honeycomb monoliths, which are coated with a proprietary 'sorbent' (amine based chemical) produced by BASF. The coated monoliths adsorb the CO_2. Process steam is then used to desorb the CO_2 from the wall. High purity CO_2 is recovered and the process heat that the plant does not use drives the GT process, making it more cost effective. A CSP plant can be used to drive the process.

The purity level of the CO_2 gas recovered by GT's process can be as high as 98–99 percent, and the stream can be further purified and/or liquefied using standard "compression" techniques.

Transportation costs for large volume gaseous CO_2 is significant and can run as high as $1.5 million per mile for a pipeline, plus compression. With the GT process, these costs are drastically reduced or eliminated; a CO_2 air capture plant can be located anywhere, needing only air and heat to operate. A GT plant can be built next to an oil field or a food processor, eliminating the need to pipe the CO_2 over a long distance.

Global Thermostat technology can reduce emitted CO_2 by 200 percent (it is carbon negative) and also can operate alongside other conventional methods of CO_2 capture. GT's technology enhances the efficiency, capture rates, and CO_2 purity levels generated by conventional processes, which typically only reduce 90 percent of the emitted CO_2. Global Thermostat has a number of commercialization discussions underway in the US and China and believes that its process holds significant value in reducing environmentally damaging CO_2 emitted by the two countries, while creating economic value for its CO_2 consuming industries. ■

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