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Air Capture Touted as Alternative to CCS, But Costs Are High

As doubts rise about the ability of carbon capture and storage (CCS) to gain traction, several start-up companies are exploring a bold new approach: air capture, a technology aimed at directly extracting carbon dioxide from the atmosphere (NE Dec.13'12). While CCS focuses on curbing emissions from thermal power stations and heavy industries, air capture could achieve the same result from diffuse sources such as vehicles and household boilers. The US' Global Thermostat has been running a 1,000 ton per year pilot plant since 2010, the UK's Air Fuel Synthesis (AFS) recently presented a demonstrator, and several other projects -- by Canada's Carbon Engineering, Switzerland's Climeworks and Global Thermostat -- are due for commissioning in 2013-14. CCS and air capture are based on similar well-known chemical engineering technologies, but face significant cost issues. For air capture, these are particularly challenging, as CO2 is about 300 times less concentrated in the air than in a power plant's flue gas.

Rather than just storing CO2, developers are targeting specific markets -- including the food and drinks industry and enhanced oil recovery (EOR) -- to generate revenue and make up for the initially very high cost of capture. After running tests in 2011-12, Carbon Engineering is moving on to its first 1,000 ton/yr plant targeted at EOR. This will have "surprisingly good economics" compared with a conventional natural gas boiler with CO2 scrubber, making air capture a competitive option where natural CO2 is not available, says company scientist Geoffrey Holmes. That includes California, where Global Thermostat is negotiating with a local oil company to develop a test plant. CO2 can also be used to enrich air for greenhouses and algal biofuel production -- Climeworks' first 200 ton/yr plant will feed a greenhouse in Zurich, while Global Thermostat has partnered with US company Algae Systems to build a $15 million biofuel-oriented air capture unit in Alabama.

AFS, for its part, is focusing on synthetic fuels, where CO2 is combined with hydrogen to make methanol or synthetic gasoline. Although its demonstration project uses CO2 extracted from the air, the next plant is likely to use a concentrated source such as a brewery or bioethanol plant, due to the high capital and operating costs of air capture, AFS says.

Air capture technology uses chemicals to absorb CO2, which is later "desorbed" and collected for storage or further applications. Costs include electricity to drive fans moving air over the absorbing material, thermal or mechanical energy to extract the CO2 from that material, and significant capital costs, especially on the collection side of the process, as huge volumes of air need to be treated. While the American Physical Society argued in a 2011 report that air capture would cost around $600 per ton of CO2 using available equipment, advocates insist that proper optimization and high volumes would allow much lower costs. Carbon Engineering believes full-scale commercial units would come in at well below $200/ton.

Columbia University's Klaus Lackner argues that making millions of small air capture units would allow massive economies of scale and could slash the cost to $30-$50/ton. Installing 1 million units per year -- each the size of a car -- would result in a substantial capture rate of 3.6 billion tons/yr of CO2, he says, and could be achieved in a decade or two based on the automotive industry's experience. Graciela Chichilnisky, another Columbia University professor and Global Thermostat's managing director, claims the company achieved $50/ton at its Californian pilot plant and could rapidly reach $20/ton or less through optimization. This would make air capture a credible alternative to buying emissions credits in countries and regions with strong carbon policies, and potentially a better choice than CCS, where multibillion-dollar projects are difficult to finance and the breakeven cost is still about $60-$65/ton of CO2, according to *EI New Energy* estimates (NE May24'12).

However, most experts, such as Princeton University's Robert Socolow, say it is bound to be more expensive capturing CO2 from the air than from concentrated sources, and that the world should focus on the latter first. Once those emissions are eliminated, sometime in the second half of the century, air capture may allow the world to start gradually reducing CO2 concentrations in the atmosphere, Socolow says. It could also have a role to play earlier in countering emissions from decentralized sources such as buildings and vehicles, which account for roughly half of current emissions. The oil and automobile industries could be particularly interested in supporting air capture to reduce their carbon footprint, some sources say, especially Mideast producers that could use desert areas to build massive air capture facilities for EOR or storage in depleted oil and gas fields.

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Selected Air Capture Players			
Company	**Country**	**Markets**	**Status**
Air Fuel Synthesis	UK	Synthetic fuel	Demonstrator
Carbon Engineering	Canada	EOR	Developing pilot
Climeworks	Switzerland	Synthetic/biofuel	Developing pilot
Global Thermostat	US	EOR, synthetic/ biofuel	Pilot, developing commercial
Kilimanjaro Energy	US	NA	Demonstrator

Source: Energy Intelligence