Slowing climate warming may require geoengineering

October 6 2010, By Krishna Ramanujan

Geoengineering could prevent the potentially catastrophic climate-change tipping points that loom just ahead, reports a new Cornell study.

Cornell earth system scientist Charles Greene, the lead author of the study published in the September-October issue of *Solutions* magazine (Vol. 1, No. 5), says time is running out, yet governments have done little to reverse rising carbon dioxide (CO_2) levels.

Many scientists warn that to avoid excessive warming, sea level rise and extreme weather, CO_2 in the atmosphere needs to be reduced to 350 parts-per-million (ppm) by the end of this century from the current level of around 390 ppm.

If actions aren't taken soon, ocean acidification and greenhouse warming in the atmosphere will reach a tipping point this century that will take more than 1,000 years to reverse, the paper warns.

It suggests that one way to reduce atmospheric CO_2 by the end of the century is by setting up fields of air-capture devices that absorb CO_2, very similar to the carbon capture and storage technology being developed for coal plants. The devices would use algal bioenergy as a power source to capture, extract and pipe CO_2 for storage or industrial use. Algae provide a preferred bioenergy source relative to land plants because they are more productive, more efficient in their use of nutrients and do not need to compete with food crops for prime agricultural land, Greene said.

The price tag for using this technology over the remainder of the century? Some $85.5 trillion to remove the 855 gigatons of carbon needed to bring atmospheric CO_2 down to 350 ppm.

Although $85.5 trillion seems high, it is comparable to the estimated cost of using carbon emission reduction strategies to reduce atmospheric CO_2 down to a lesser goal of 450 ppm, according to the paper. Corresponding to less than 1 percent of the global GDP for the rest of the century, such a cost is considered affordable compared with the alternative consequences of catastrophic climate change.

Still, it will take decades to develop air capture and algal bioenergy systems, scale up prototypes, prepare underground carbon repositories and deploy such systems on a global scale.

"In an ideal case, we could have full deployment on a global scale by 2050," said Greene.

To buy time, another geoengineering strategy that many scientists are exploring involves altering the Earth's radiation budget by injecting sulfate aerosols into the atmosphere and blocking the sun's rays, mimicking what happens after a volcanic eruption, says the paper. Other strategies involve injecting seawater droplets into clouds and deploying shades or mirrors in space, all to block the sun's rays from reaching Earth's surface.

Such solar radiation management strategies "can be done quickly, but should only be considered as a last resort to buy ourselves some time" since they simply "cover up the problem without doing anything about the CO_2," said Greene.

The paper's co-authors include Bruce Monger, a senior research associate in earth and atmospheric sciences at Cornell, and Mark

Huntley, the chief scientific officer for Cellana LLC in Kona, Hawaii.

Provided by Cornell University