

# Recycling Carbon Dioxide

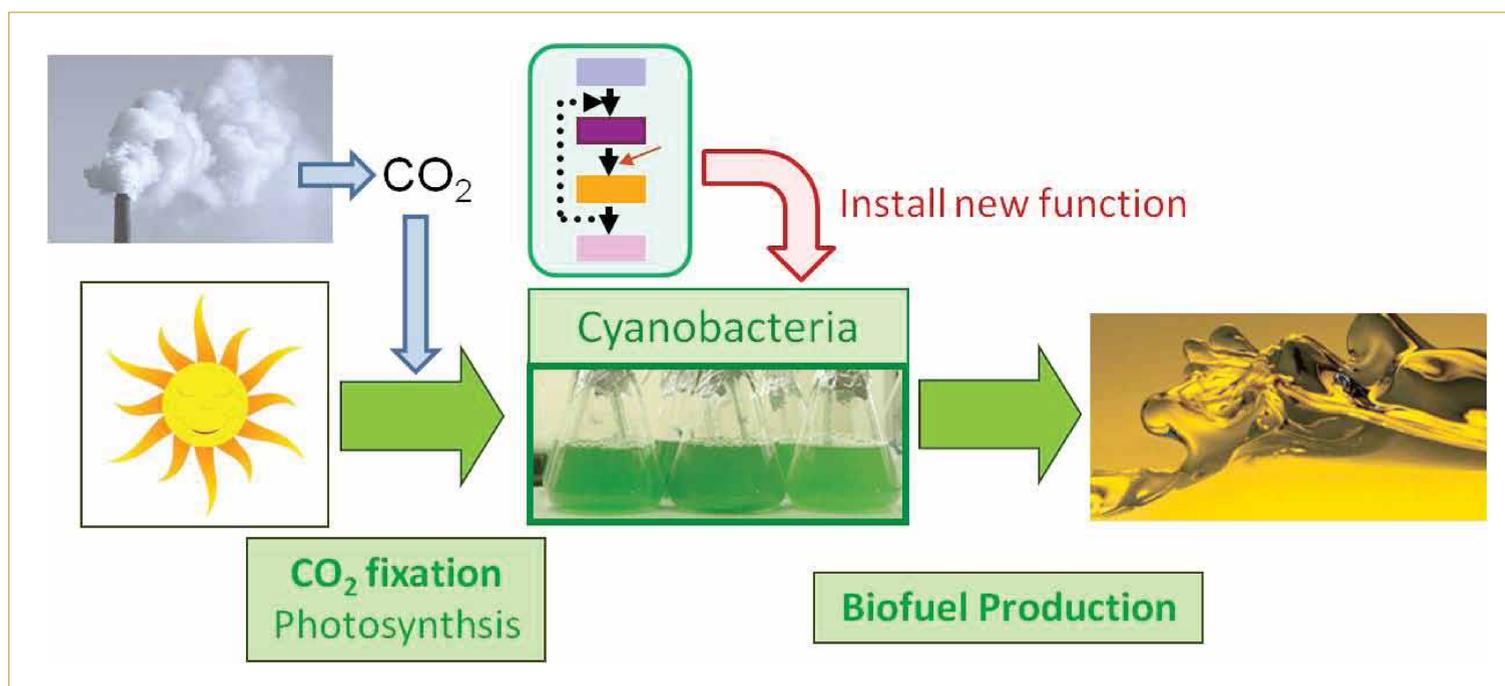
Through the genetic modification of photosynthetic bacteria, carbon dioxide could be recycled into cleaner sources of fuel.

GLOBAL CLIMATE CHANGE HAS STIMULATED EFFORTS to reduce net CO<sub>2</sub> emissions. One potential approach to address this problem is to recycle CO<sub>2</sub> as a backbone for producing fuels or chemicals using photosynthesis. Photosynthetic organisms use solar energy to incorporate atmospheric CO<sub>2</sub> into organic molecules, but none of these organisms produce any molecules that are suitable for use as a liquid fuel. We aim to genetically modify photosynthetic bacteria to build CO<sub>2</sub> into C<sub>4</sub>-C<sub>5</sub> alcohols, which have great potential as an alternative to petroleum based fuels. Additionally, extracting the final product from the production mix is a simple process as the fuel is easily vaporized. This new strategy possesses two advantages for the long-term, global-scale goal of achieving a cleaner and more sustainable energy economy.

The benefits of this process include:

- The recycling of CO<sub>2</sub>, which reduces net greenhouse gas emissions compared to the burning of fossil fuels;
- The use of solar energy to directly convert CO<sub>2</sub> into a liquid fuel that is compatible with existing infrastructure and technology—including in most automobiles.

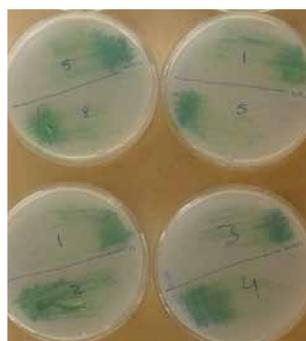
In addition, the need for biomass deconstruction—either in the case of cellulosic or algal biomass—is avoided, relieving a major economic barrier for biofuel production. An ideal place for this system would be next to existing power plants that emit concentrated CO<sub>2</sub>, potentially allowing the flue gas to be scrubbed and recycled directly into liquid fuel.



◀ This system recycles CO<sub>2</sub> to reduce greenhouse gas emissions resulting from the burning of fossil fuels.

It uses solar energy to convert CO<sub>2</sub> into a liquid fuel that can be used in the existing energy infrastructure, including in most automobiles.

Atsumi et al. *Nature* 451, 86-89 (2008)  
Atsumi et al. *Nat Biotechnol* 27, 1177-1180 (2009)



**GENETIC  
MODIFICATION**



**PRODUCTION**



## CREDITS:

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