Biological Electron Transfer and Catalysis
Energy Frontier Research Center

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Abstract: Scientists affiliated with the BETCy EFRC have used a phototropic bacterium as a biocatalyst to generate methane from carbon dioxide.

Scientists from BETCy EFRC describe light-driven conversion of greenhouse gas to fuel

Researchers funded by the Department of Energy Office of Science's Energy Frontier Research Center program have used a phototropic bacterium as a biocatalyst to generate methane from carbon dioxide in one enzymatic step. The team says the break-through puts them one step closer to cleanly converting harmful carbon dioxide emissions from fossil fuel combustion into usable fuels.

The lead scientists, who are located at Utah State University and the University of Washington, are part of the multi-institutional Center for Biological Electron Transfer and Catalysis (BETCy) EFRC, a seven-institution collaboration that is housed at Montana State University.

Using an engineered strain of the phototropic bacterium *Rhodopseudomonas palustris* as a biocatalyst, the researchers generated methane from carbon dioxide in one enzymatic step. A key feature was that cells expressed large amounts of a remodeled form of the enzyme nitrogenase and the catalysis was driven by light.

Their findings were published in the *Proceedings of the National Academy of Sciences.* Co-authors are BETCy principal investigators Lance Seefeldt (Utah State University) and Caroline Harwood (University of Washington) along with members of their research team Kathryn Fixen and Yanning Zheng of UW; Derek Harris, Sudipta Shaw and Zhi-Yong Yang of USU; and Dennis Dean of Virginia Tech.

"It's a baby step, but it's also a big step," said Seefeldt, a professor of chemistry and biochemistry at USU. "Imagine the far-reaching benefits of large-scale capture of environmentally damaging byproducts from burning fossils fuels and converting them to alternative fuels using light, which is abundant and clean."

In an article about the discovery published Aug. 23 in *Scientific American*, Harwood, a professor of microbiology, said the report blossomed from her work studying an enzyme called nitrogenase.

“We’re really interested in the enzyme nitrogenase because it does a phenomenally difficult reaction,” she said.

“Use of phototrophs opens a new world of possibilities,” said Seefeldt, “These kinds of bacteria could be used to make not only fuel, but all kinds of materials we use in everyday life, without the use of environmentally harmful energy sources. The future of this research is incredible.”

Their work falls under the BETCy EFRC’s research thrust two: Electron Transfer for CO_2 Reduction Catalyzed by Nitrogenase in a Phototrophic Microbe.

The BETCy EFRC was established in June 2014.

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The original paper was published in the Proceedings of the National Academies of Science of the USA (PNAS): Light-driven carbon dioxide reduction to methane by nitrogenase in a photosynthetic bacterium doi: 10.1073/pnas.1611043113

http://www.pnas.org/content/early/2016/08/16/1611043113.abstract