



## Carbon fixing bacteria

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### Principal investigator

**Ron Milo**

Faculty of Biochemistry  
Department of Plant and Environmental Sciences

## Overview

Prof. Ron Milo and his team have engineered a bacteria (*E. coli*) to fix atmospheric CO<sub>2</sub>, converting it into organic biomass. This breakthrough synthetic biology approach enables *E. coli* to use CO<sub>2</sub> as its sole carbon source by harnessing energy from formate, offering a potential solution to the major global challenge of reducing atmospheric CO<sub>2</sub> levels and a potentially unique platform for precision fermentation.

## Applications

- Potential Precision Fermentation Platform: A modular platform for producing various chemicals with net negative CO<sub>2</sub> emissions by integrating synthetic metabolic pathways.
- Research Tool: Useful for studying and improving enzymes in the Calvin-Benson-Bassham (CBB) cycle, contributing to advancements in crop efficiency.

## Advantages

- Sustainable: Provides a way to sequester atmospheric CO<sub>2</sub>.
- Genetic Engineering Compatibility: *E. coli*-based standard laboratory techniques can be applied for genetic modification.

## Stage of Development

The Milo team has developed and characterized carbon-fixing strains of *E. coli*, demonstrating autotrophic growth through continuous laboratory evolution. These strains have been validated via carbon economy assessments and genomic sequencing to identify the mutations that support autotrophy.

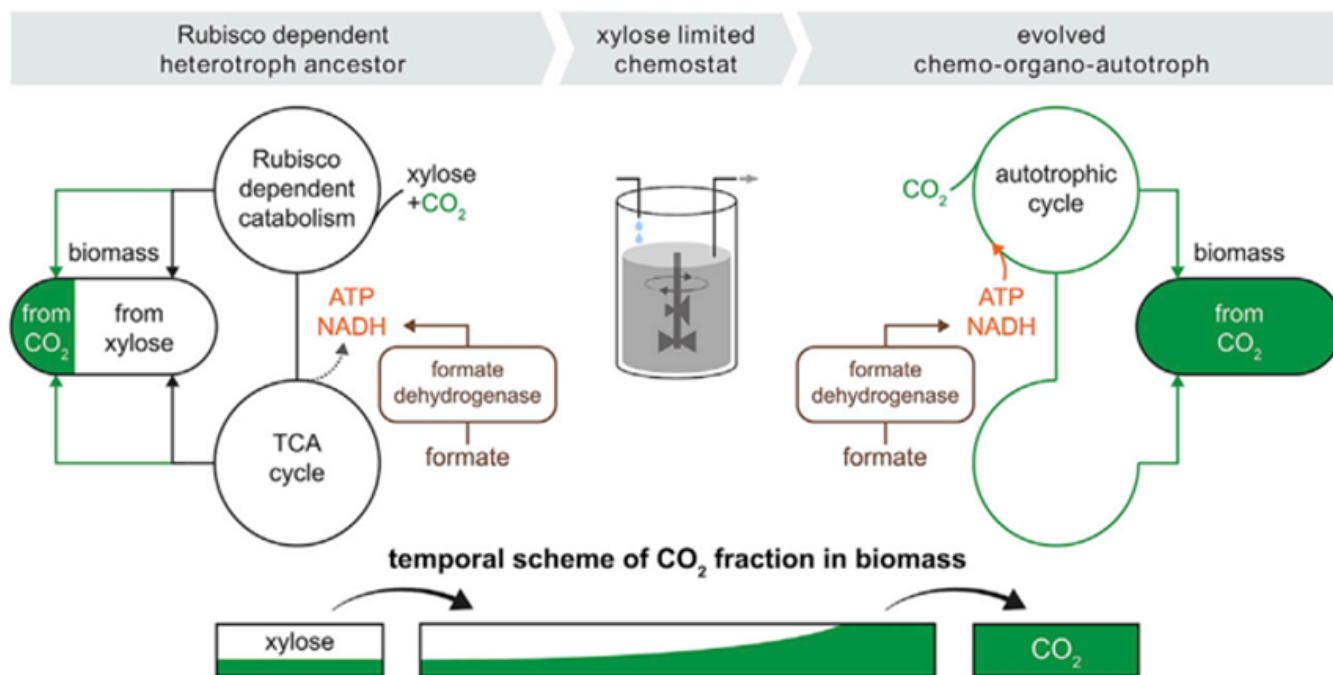


Figure 1: The experimental workflow begins from the left, where the *E. coli* strain is engineered for xylose catabolism (*pfkA*, *pfkB*, *Zwf* deleted; *Rubisco*, *Prk*, *CA*, *FDH* overexpressed) but is unable to grow in autotrophic conditions. As the limited amount of xylose is consumed in the chemostat, and with an excess of formate and  $\text{CO}_2$ , the cells are under a strong selection pressure to use  $\text{CO}_2$  as the only carbon source while using formate oxidation by *FDH* as the energy source. Evolved clones with a fully autotrophic phenotype were then produced (right), as they achieved a fitness advantage over xylose-dependent strains and became the dominant population in the chemostat.

## Patent Status

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