Primordial Soup for the Soul: CO_2 to Protein

Main source: Katharine Greco, ARPA-E Fellow, *Primordial Soup for the Soul: CO_2 to protein*
Supplementary reading: Greco, K. V. "Hot potato: Force-multiplying technological innovation for food and agricultural decarbonization," *MIT Science Policy Review*, 2024.

Summary

· The presentation argues that conventional agriculture, especially animal protein production, wastes large amounts of energy.
· Climate change and population growth may make traditional food production less reliable.
· CO_2-to-protein offers a possible alternative: using CO_2, renewable energy, H_2 and NH_3 to produce proteins or amino acids.
· The broader vision is to **decouple food production from land-intensive agriculture**.
· Protein is highlighted as the most difficult macronutrient to synthesize, making it a high value but challenging target.

Key Results

- **Energy inefficiency:** Current agriculture loses large amounts of energy between sunlight, crops, livestock and human food.
- **Food security pressure:** Future population growth and climate disruption may challenge conventional food systems.
- **Three technical pathways:**
    1. Microbial biosynthesis
    2. Enzymatic catalysis
    3. Electrochemical catalysis
- **Potential impact:** CO_2-to-protein could greatly reduce land use and emissions compared with conventional animal protein.
- **Policy relevance:** Greco's later article argues that these early-stage technologies need stronger public R&D support to become scalable.

Discussion Questions

1. Is CO_2-to-protein mainly a food technology, a carbon-utilization technology, or an energy technology?
2. Which pathway seems most promising: microbial, enzymatic or electrochemical?
3. Should the first target product be human food, animal feed, amino acids or emergency food?