

September 18, 2024



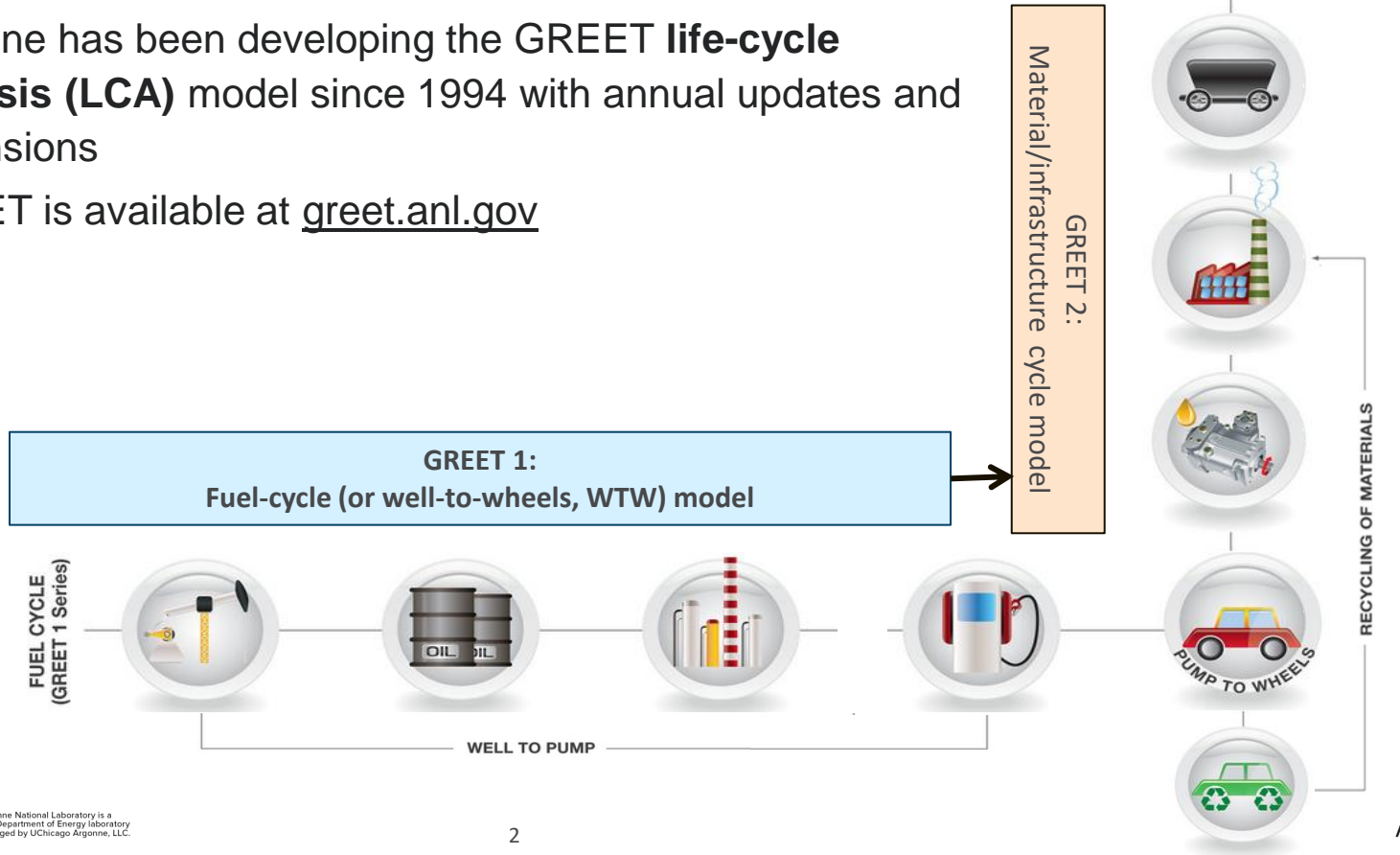
Life Cycle Analysis of E-Fuels with the GREET Model

Michael Wang

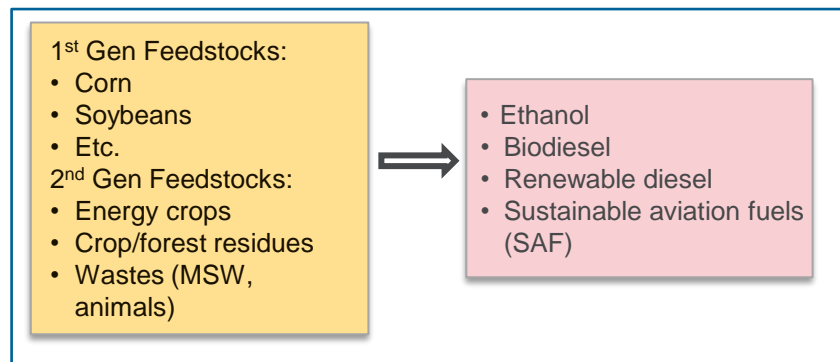
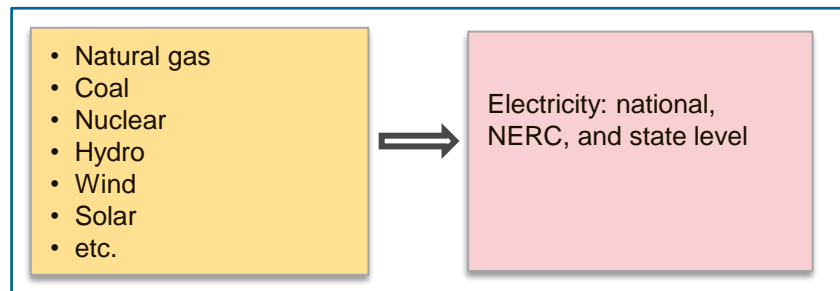
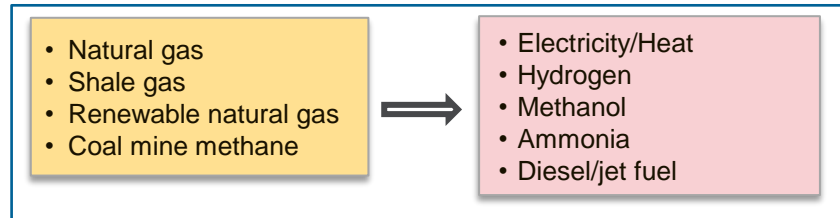
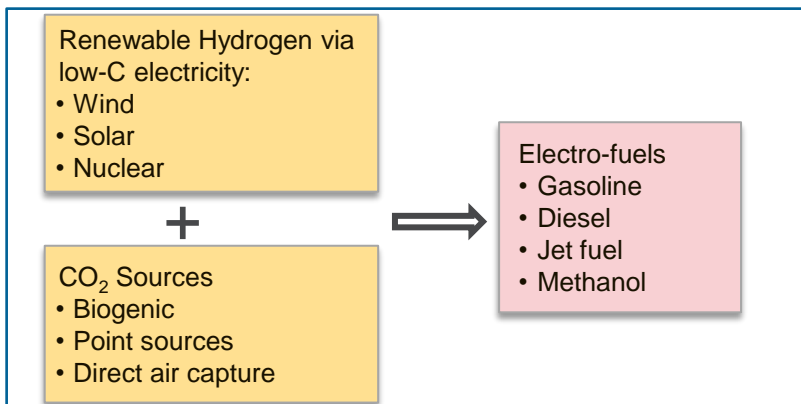
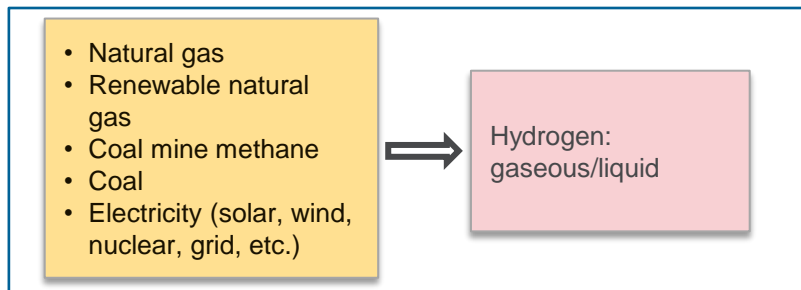
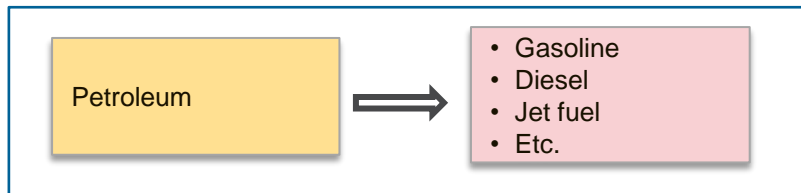
Systems Assessment Center
Energy Systems and Infrastructure Analysis Division
Argonne National Laboratory

The **GREET** (**G**reenhouse gases, **R**egulated **E**missions, and **E**nergy use in **T**echnologies) model framework

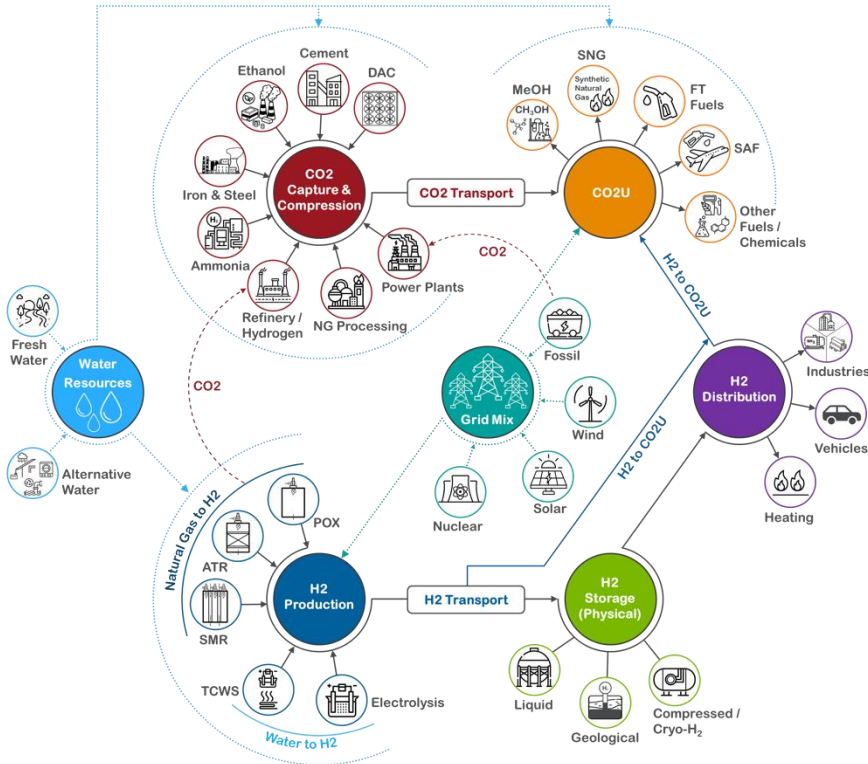
- Argonne has been developing the GREET life-cycle analysis (LCA) model since 1994 with annual updates and expansions
- GREET is available at greet.anl.gov



GREET covers an extensive list energy systems

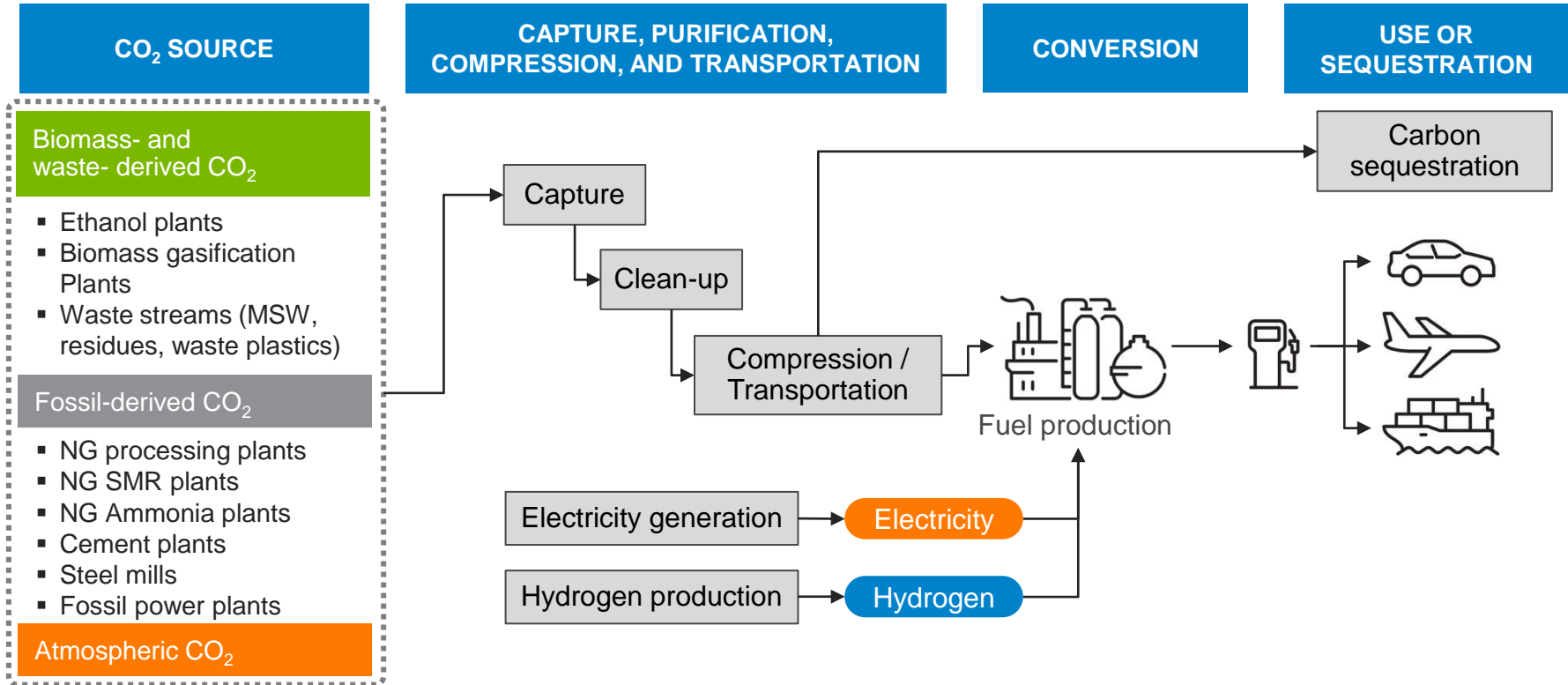


ARGONNE HAS BUILT COMPREHENSIVE SYSTEM ASSESSMENT CAPABILITY FOR CCUS

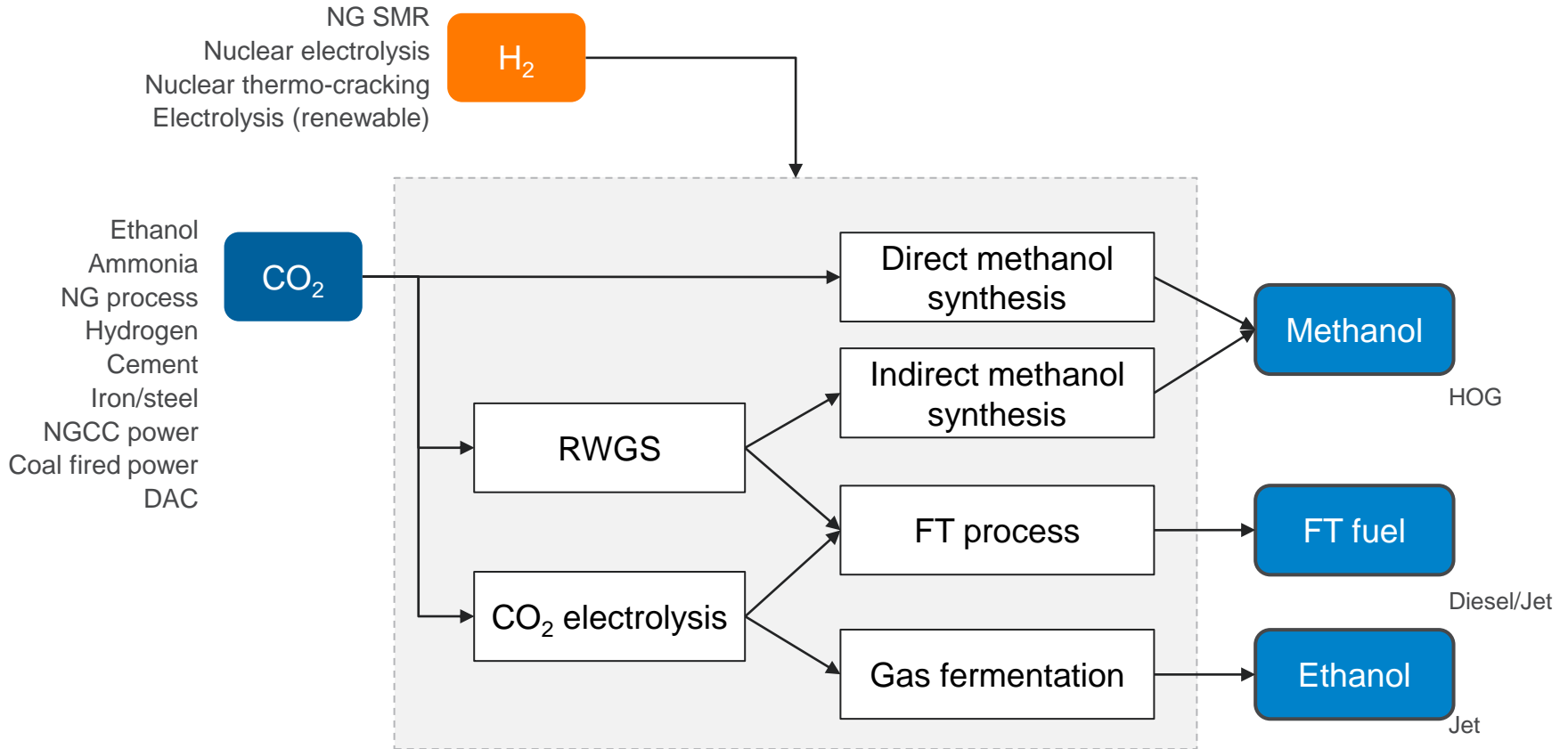


CCUS Topics	Current Research
CO₂ Capture & Compression	Process Modeling, TEA and LCA of CC technologies
CO₂ Transport	CO ₂ pipeline transportation cost
CO₂ Utilization	Process modeling, TEA and LCA of CO ₂ U
H₂ Production	H ₂ production technologies and market analysis TEA and LCA
H₂ Transport	TEA and LCA of H ₂ liquefaction, compression, delivery and fueling infrastructure
H₂ Storage	TEA and LCA of H ₂ storage
Electricity Supply	TEA and LCA of electric power supply by technology and region
Water Resources	Regional water availability, footprint, and stress of CO ₂ U technology deployment

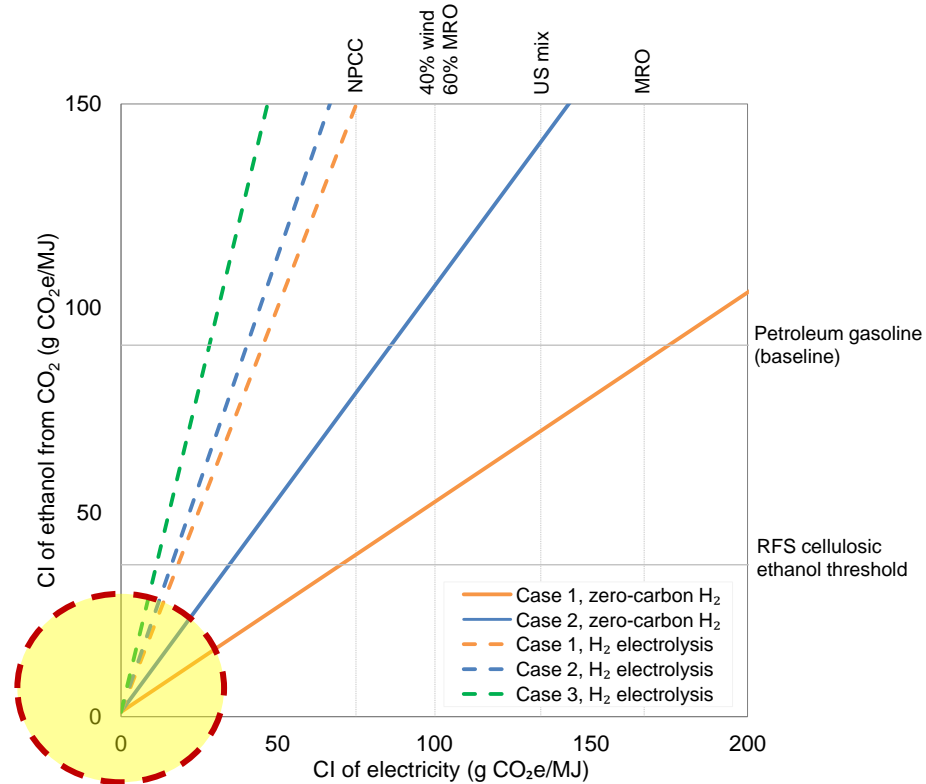
GREET CCUS life cycle analysis includes all the supply chains



CCUS for e-fuel technologies in GREET



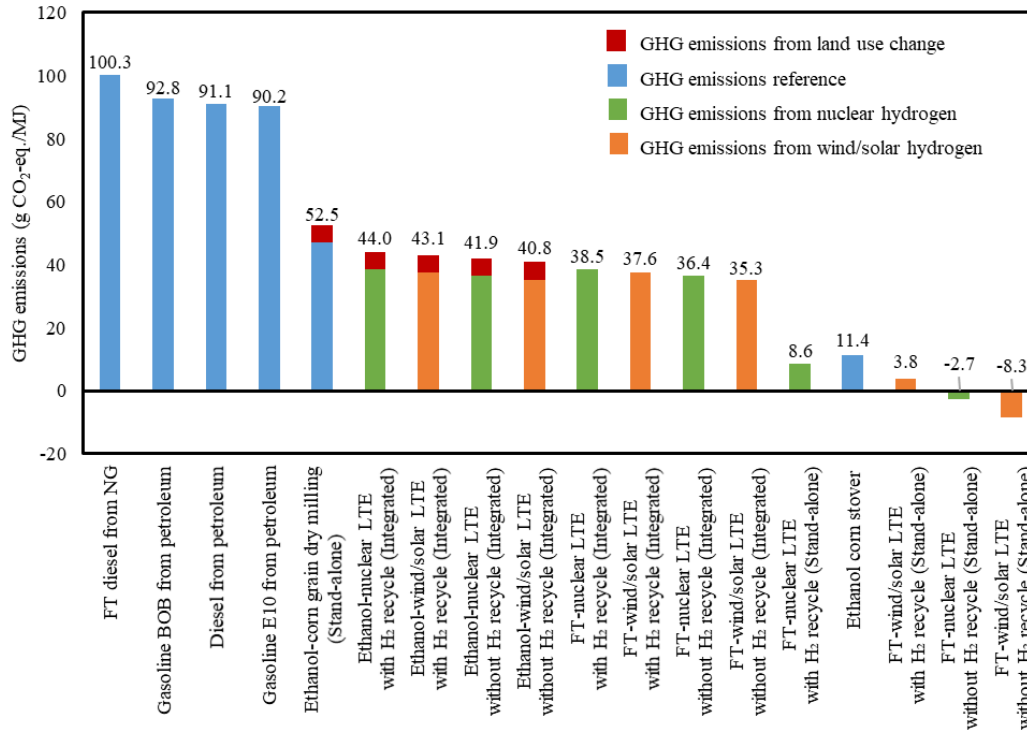
Renewable electricity and H₂ are key for low-carbon e-fuels



Lee, U., R Hawkins, T., Yoo, E., Wang, M., Huang, Z., & Tao, L. (2021). Using waste CO₂ from corn ethanol biorefineries for additional ethanol production: life-cycle analysis. *Biofuels, Bioproducts and Biorefining*, 15(2), 468-480.

Life-cycle GHG emissions of Fischer-Tropsch fuels

- E-FT fuels show significant GHG reduction benefits coupled with renewable H₂.



Zang, G., Sun, P., Elgowainy, A., Bafana, A., & Wang, M. (2021). Life Cycle Analysis of Electrofuels: Fischer-Tropsch Fuel Production from Hydrogen and Corn Ethanol Byproduct CO₂. *Environmental Science & Technology*, 55(6), 3888-3897.

Summary

- Outstanding LCA issues for CCUS fuel production
 - Handling of different CO₂ sources (biogenic, fossil, DAC)
 - Intermittent renewable electricity: need for energy storage?
 - Infrastructure impact: embodied GHG emissions for solar and wind power?
- Regional resource availability: CO₂, electricity, and water for H₂, logistics

Questions?

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Visit <https://greet.anl.gov/>