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The Pathways to Net Zero by 2050 in the United States

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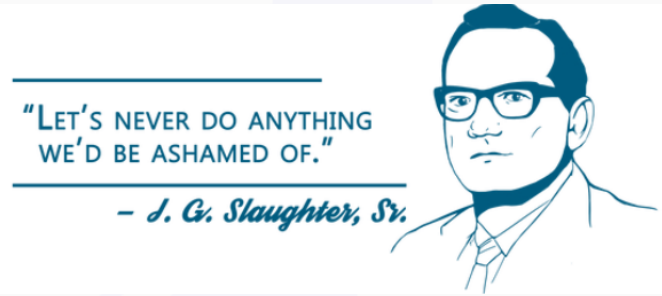


- **Representative Concentration Pathway (RCP) :**

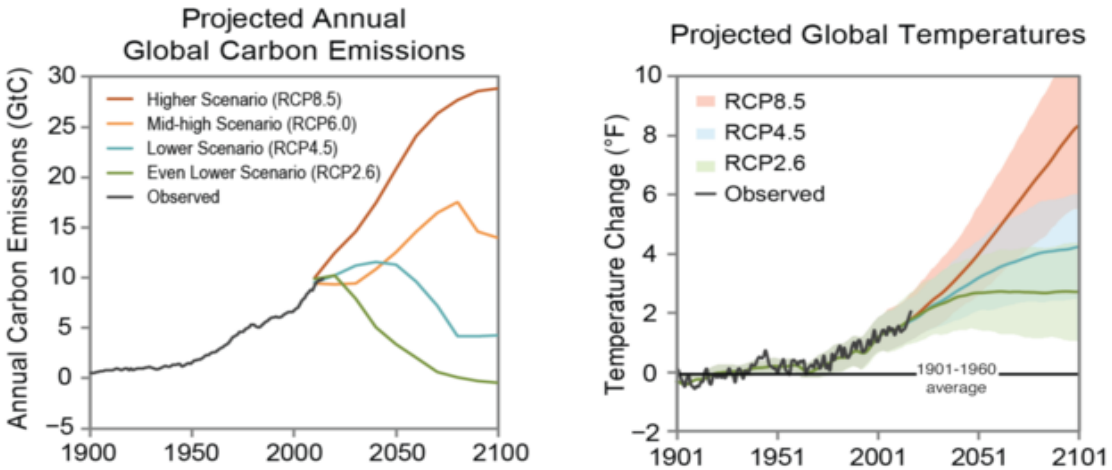
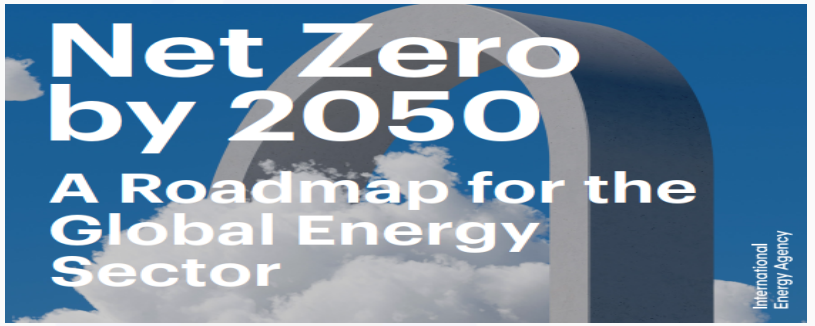


Image by Katharine Hayhoe, from the *2017 Climate Science Special Report* by the U.S. Global Change Research Program.



- **NET ZERO BY 2050: limit** Global warming preferably to **1.5 degrees** compared to pre-industrial levels. (NZE)

Energy Efficiency, Behavioral changes, Electrification ,Renewables, Hydrogen and Hydrogen-based fuels, Bioenergy, Carbon Capture

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THE LONG-TERM STRATEGY OF THE UNITED STATES

Pathways to Net-Zero Greenhouse Gas Emissions by 2050

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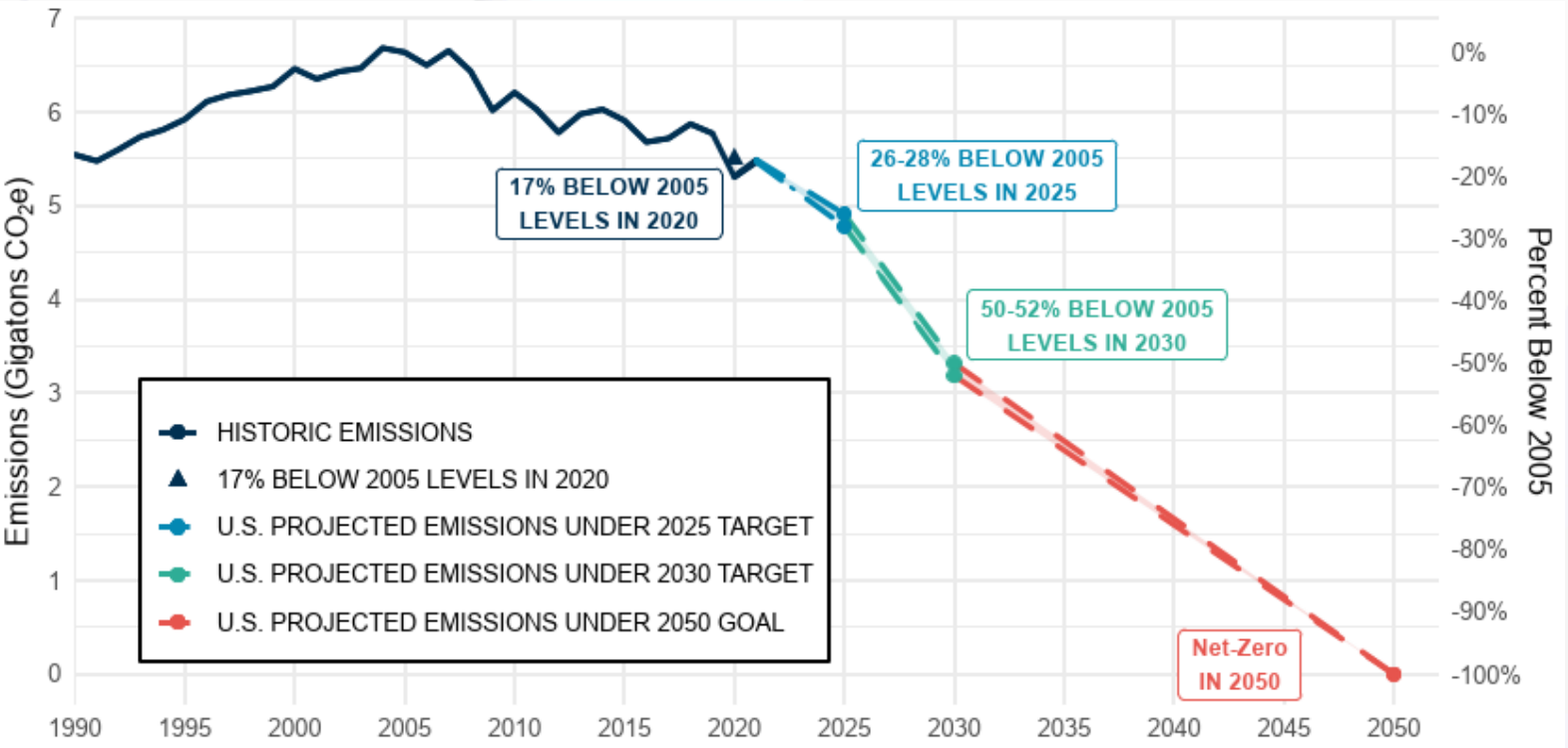
"THE UNITED STATES HAS SET A GOAL OF NET-ZERO GREENHOUSE GAS EMISSIONS BY NO LATER THAN 2050."



United States historic emissions and projected emissions under the 2050 goal for net-zero.

The United States is simultaneously pursuing multiple climate mitigation goals:

- 2030 : 50-52% reductions below 2005 levels, covering all sectors and all gases
- by 2035 :The goal for 100% carbon pollution-free electricity
- The goal for net-zero emissions no later than 2050

THE 2050 NET-ZERO EMISSIONS GOAL IS ACHIEVABLE?

1. DECARBONIZE ELECTRICITY
2. ELECTRIFY END USES AND SWITCH TO OTHER CLEAN FUELS.
3. CUT ENERGY WASTE.
4. REDUCE METHANE AND OTHER NON-CO2 EMISSIONS.
5. SCALE UP CO2 REMOVAL.

"The 2030 NDC (Nationally Determined Contribution) target is ambitious but required to build a sustainable, resilient, and equitable economy. The 2030 targets put the United States on a faster track than a straight-line path to net-zero in 2050 would require."

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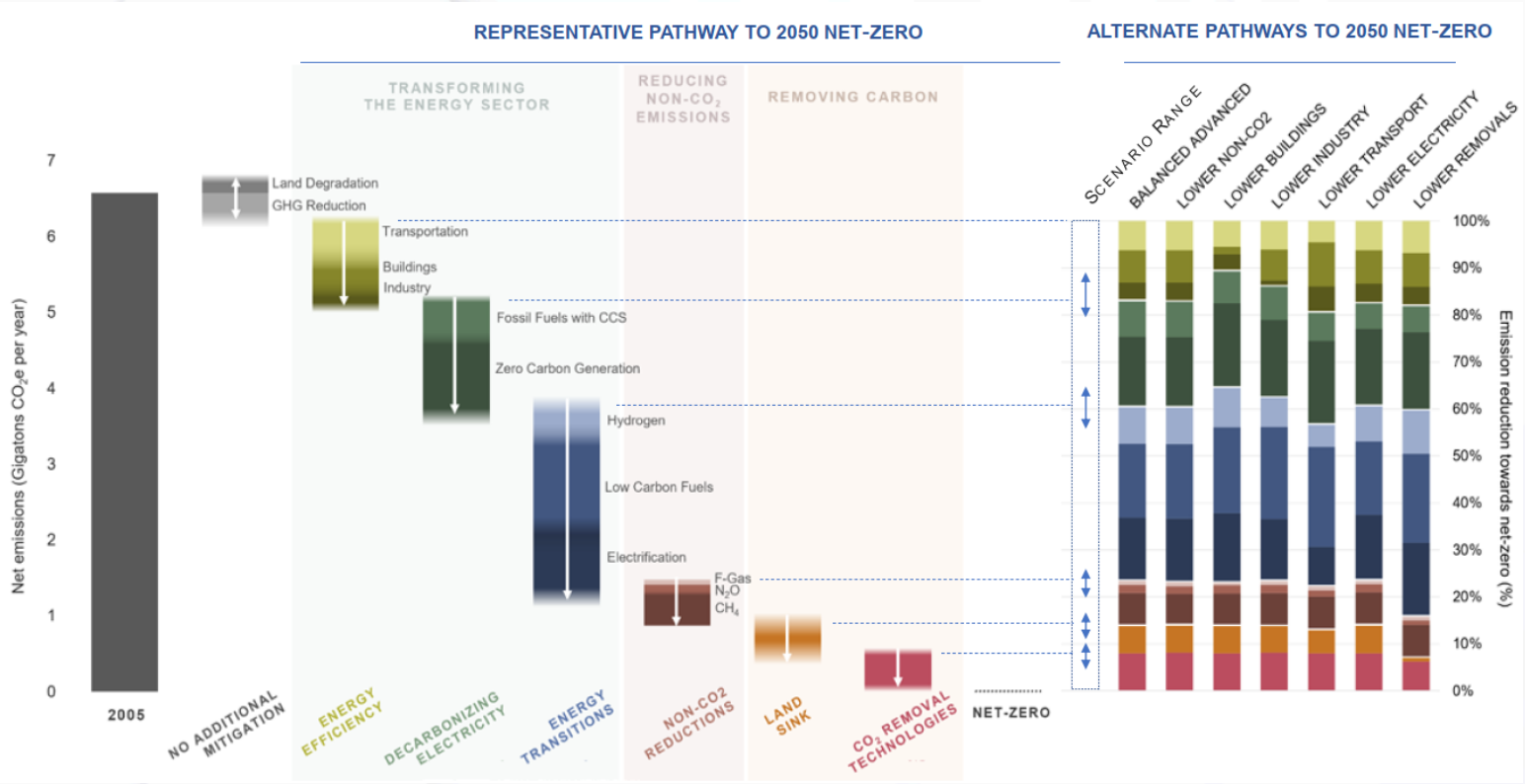
U.S Representative Pathway



1) Transforming the Energy Sector (80%)

- Increase Energy Efficiency and cut energy waste Sustainable Circular Economy
  (~1 GT/Y CO2 reduction)

- Decarbonize Electricity (~1.5 GT/Y CO2)
  - Zero Carbon Generation (Renewables)
  - Fossil Fuels with CCUS

- Energy Transition (~2.5 GT/Y CO2)
  Electrification, Hydrogen, Low Carbon Fuels,

2) Reducing non-CO2 Emission (10%)
(~0.5 GT/Y CO2)

3) Removing Carbon : CCUS , Land sink (10%)
(~0.5 GT/Y CO2)

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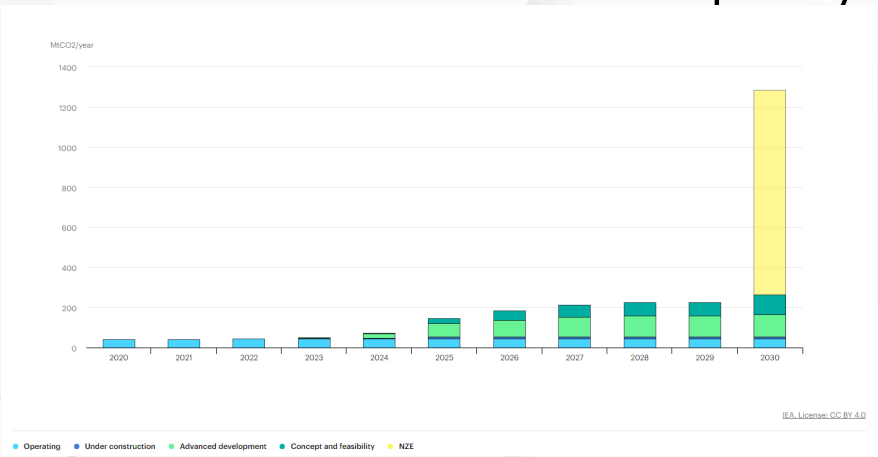
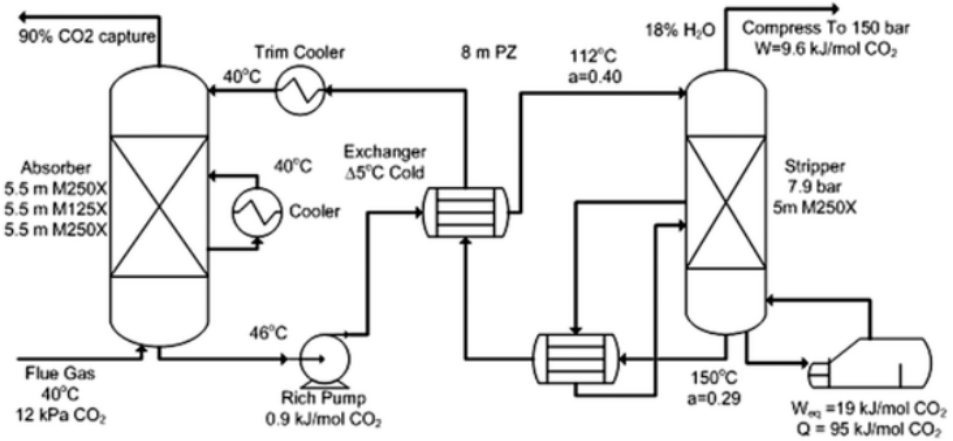
CCUS

- Growing recognition that CCUS is necessary for NZE 2050
- Growing interest in producing low-carbon hydrogen
- New policy incentives



Capacity of large-scale CO2 capture projects, current and planned vs. the NetZero Scenario,2020-2030

- **Feed dehydration**
- **CO_2 Capture**
- **CO_2 Compression**



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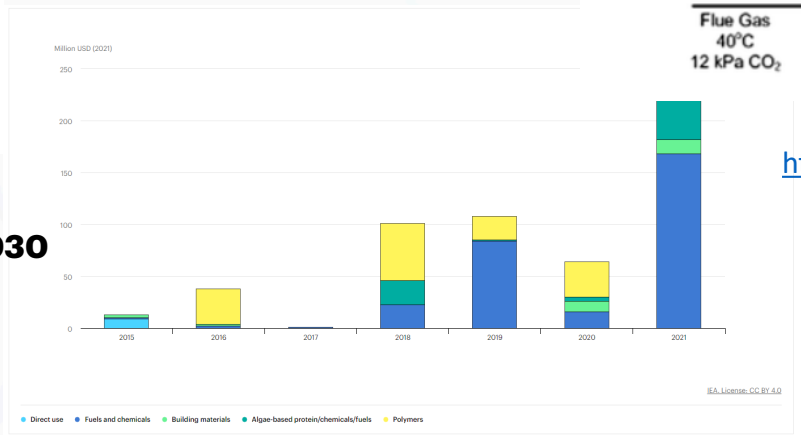

Venture Capital investments in CCU start-ups, 2015-2021

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Low Emissions Fuels : Hydrogen

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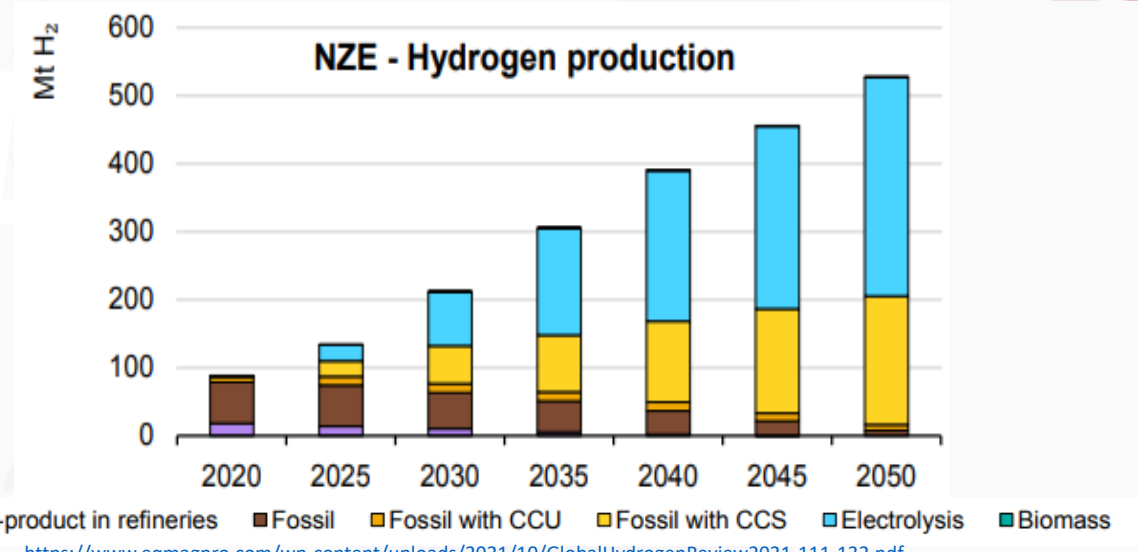
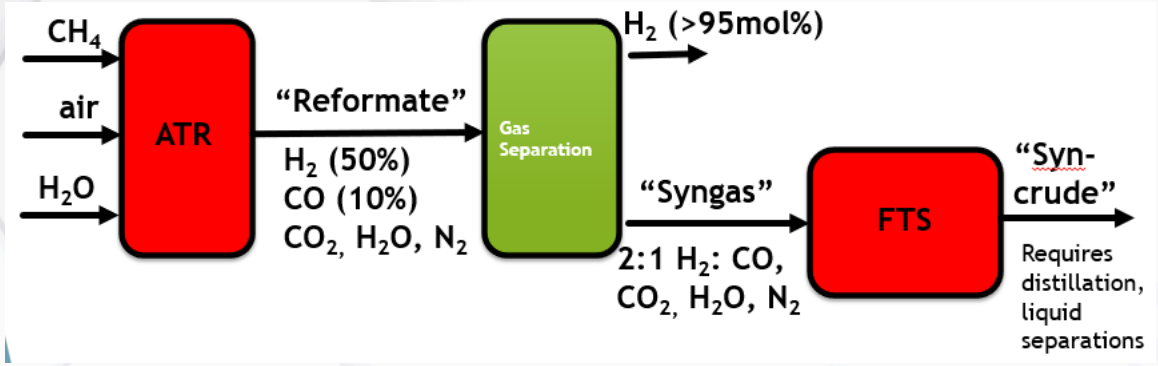
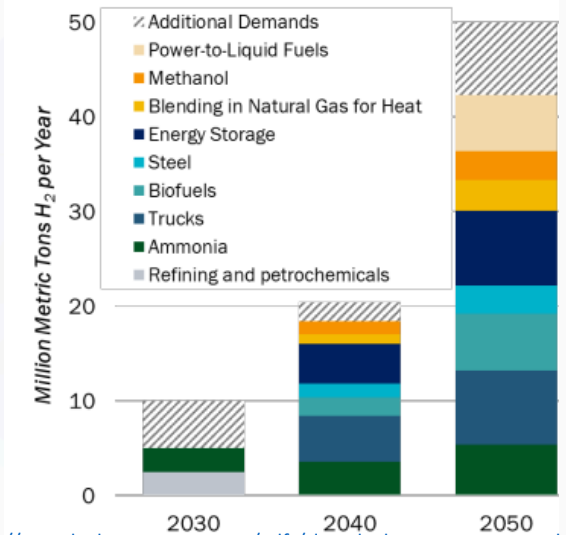
Blue Hydrogen :

- Steam Methane Reformation (SMR) + CCUS
- Autothermal Reformation of Methane (ATR)+CCUS
- Coal Gasification + CCUS
- Biomass Anaerobic Digestion, Fermentation, Gasification or Pyrolysis +CCUS



https://www.eqmagpro.com/wp-content/uploads/2021/10/GlobalHydrogenReview2021-111-132.pdf





https://www.hydrogen.energy.gov/pdfs/clean-hydrogen-strategy-roadmap.pdf

Green Hydrogen:

- Electrolysis using Renewable Electricity or Nuclear Electricity

Biofuel

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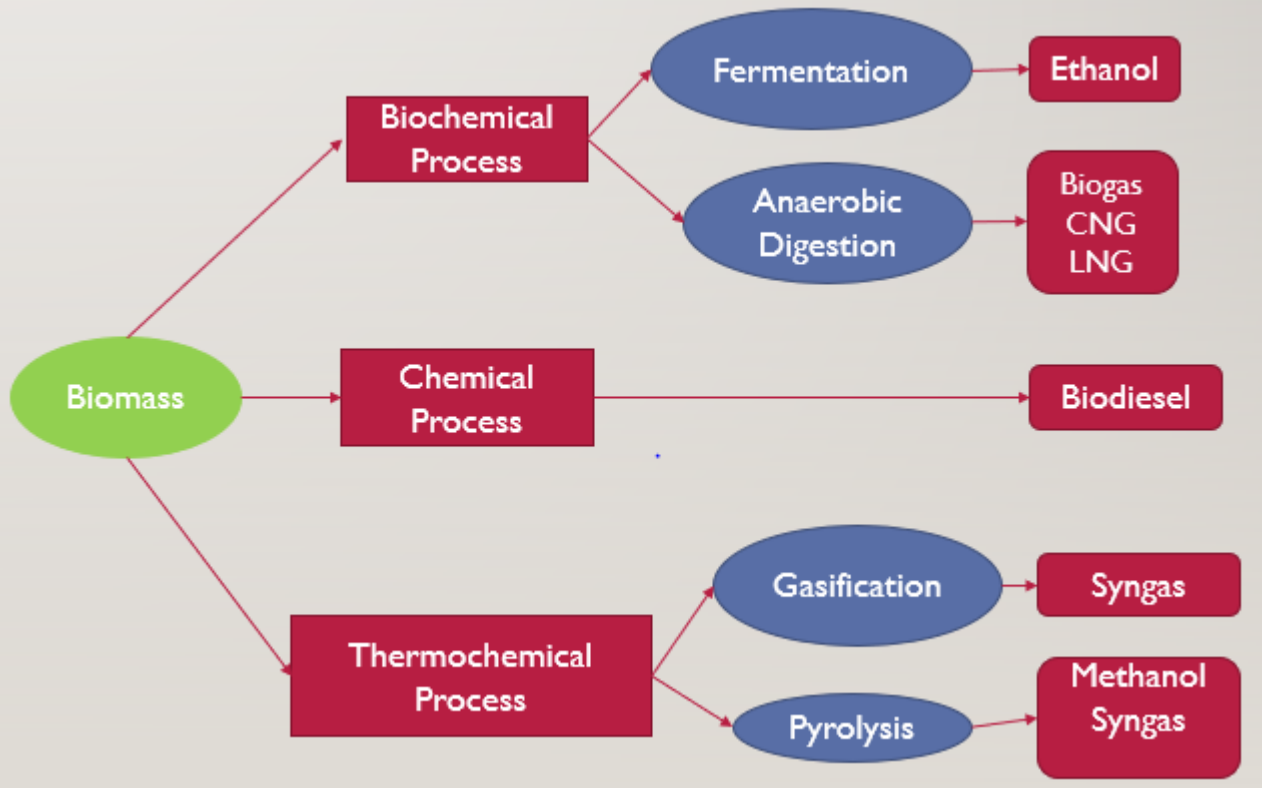

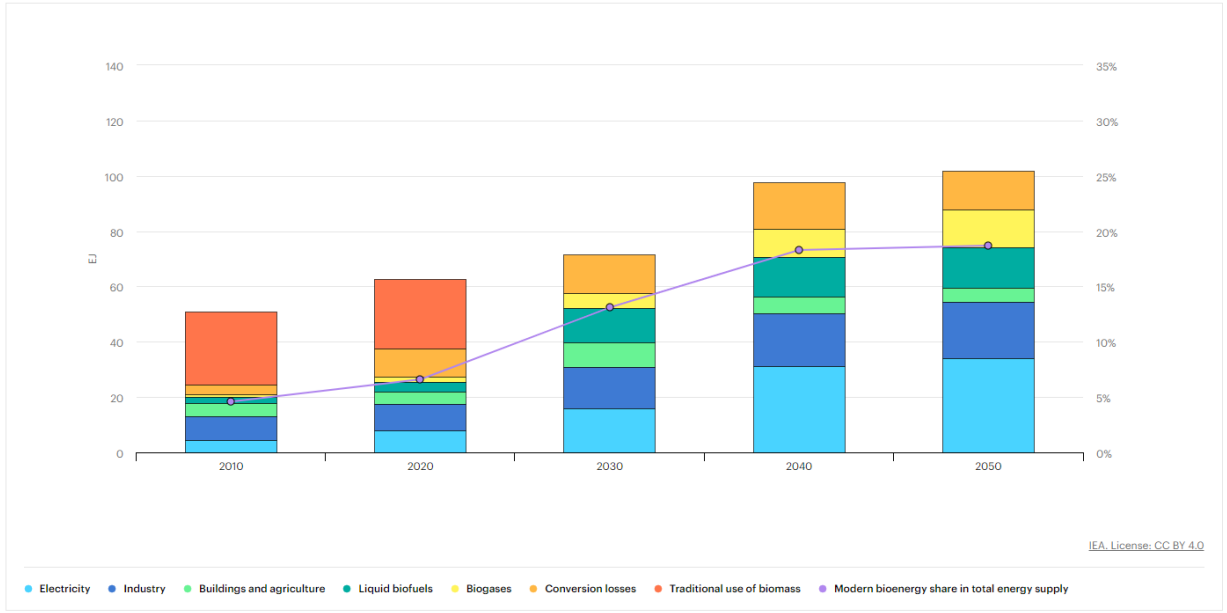

Bioenergy demand in the Net-Zero by 2050 Scenario, 2010-2050

Last updated 26 Oct 2022

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3) Net Zero by 2050 A Roadmap for the Global Energy Sector

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