

Pathways to Economy-Wide Net-Zero by 2050

U.S. Economy-Wide Deep
Decarbonization Scenario Analysis



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Economy-Wide vs. Electric Sector Only Framing

What is the value of a broader perspective?

→ Endogenous consideration of cross-sector interactions



Direct Electrification

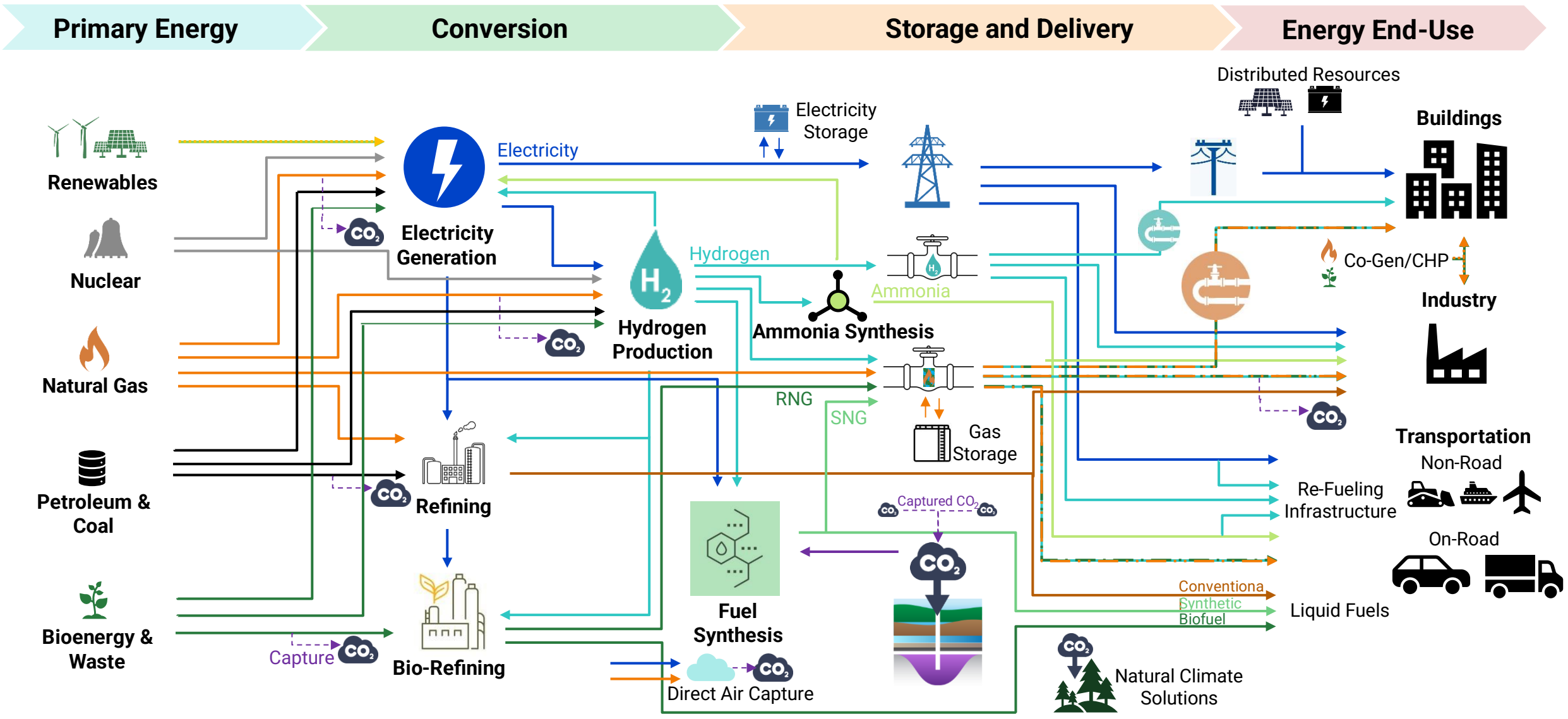


Indirect Electrification (e-fuels)

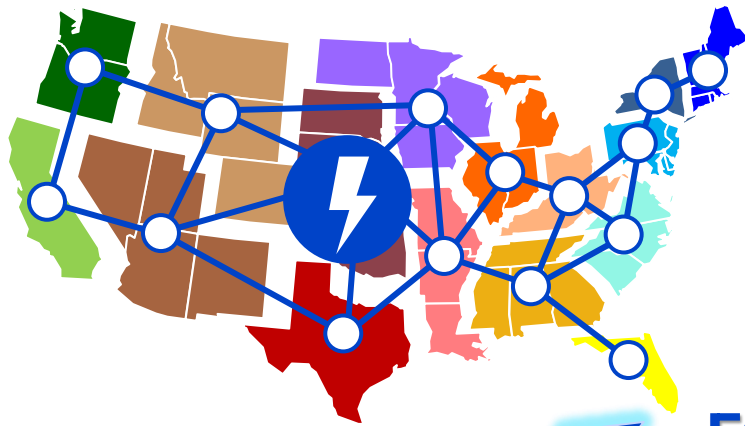


CO₂ Removal (CDR)

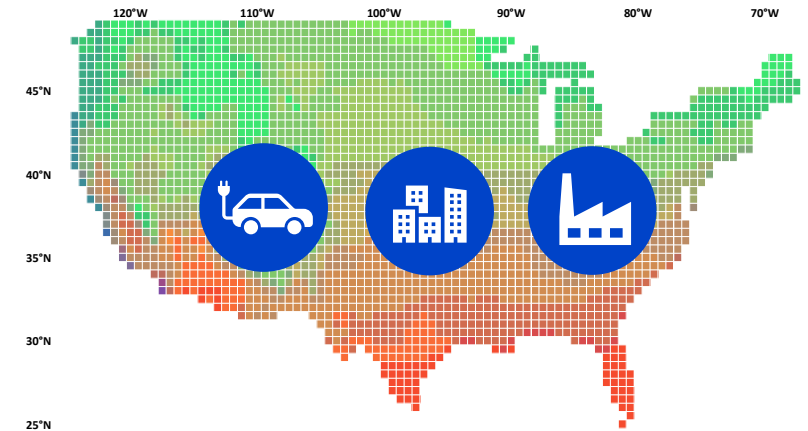
Economy-Wide Low-Carbon Energy Pathways



Electric Generation

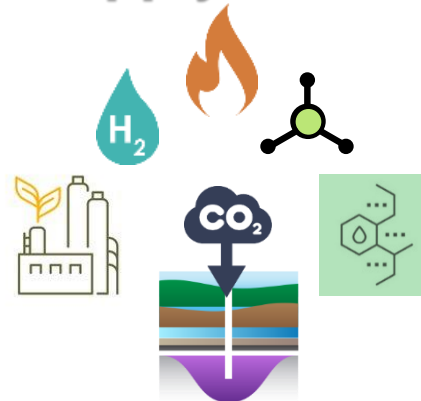


Energy Use



Synchronized
prices/supply/demand

Fuel Supply/Conversion



Model Inputs:

Service demands, technology costs, resource availability, policy constraints, climate

Model Outputs:

Economic equilibrium across energy production and use
Emissions, air quality, and water

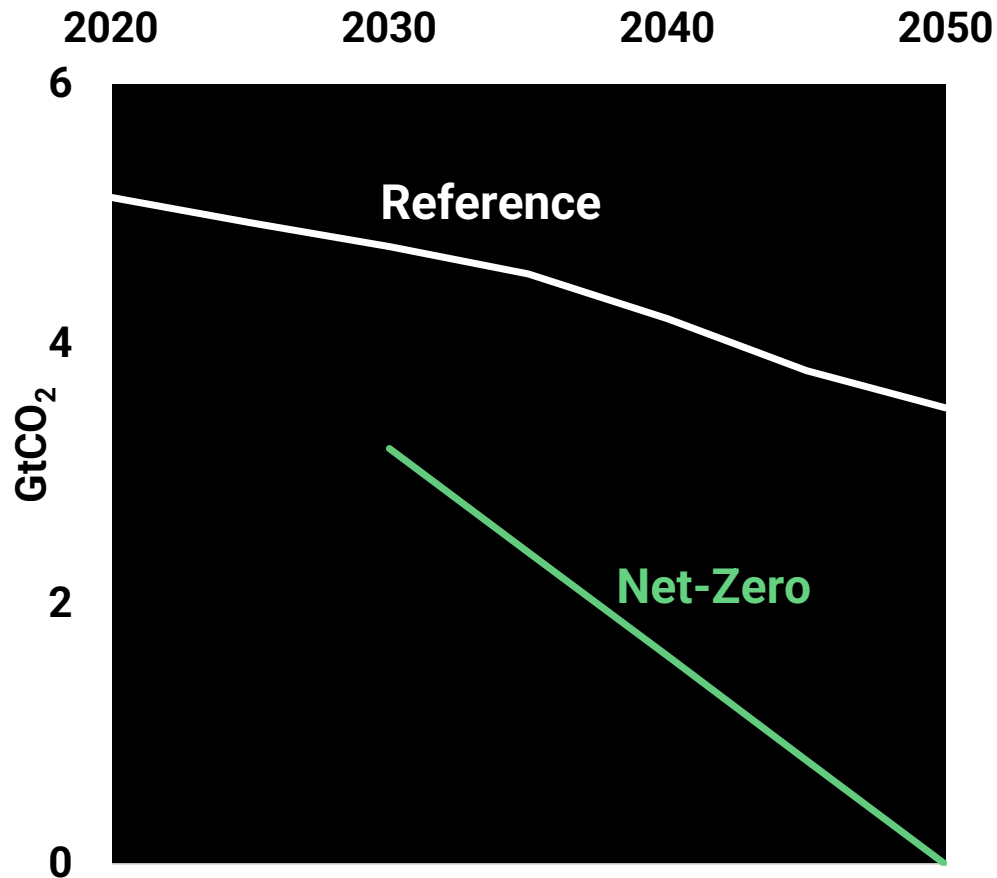
- Framework for understanding drivers of change in the electric sector and energy system
- Supported by EPRI engineering expertise and technology projections

LCRI NET-ZERO 2050

Full report available at lowcarbonlcri.com/netzero



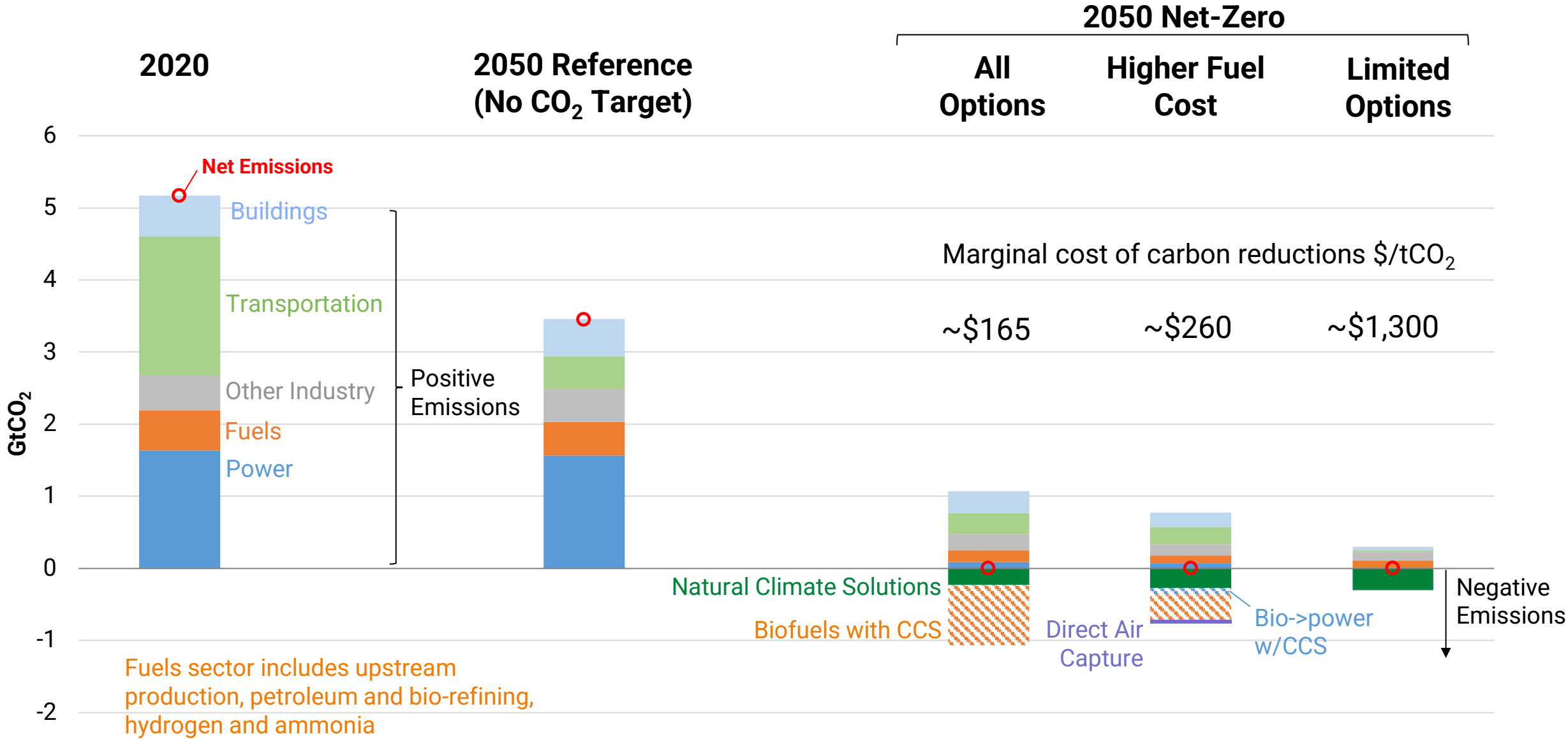
Reference with no new carbon policy, continued technology improvements



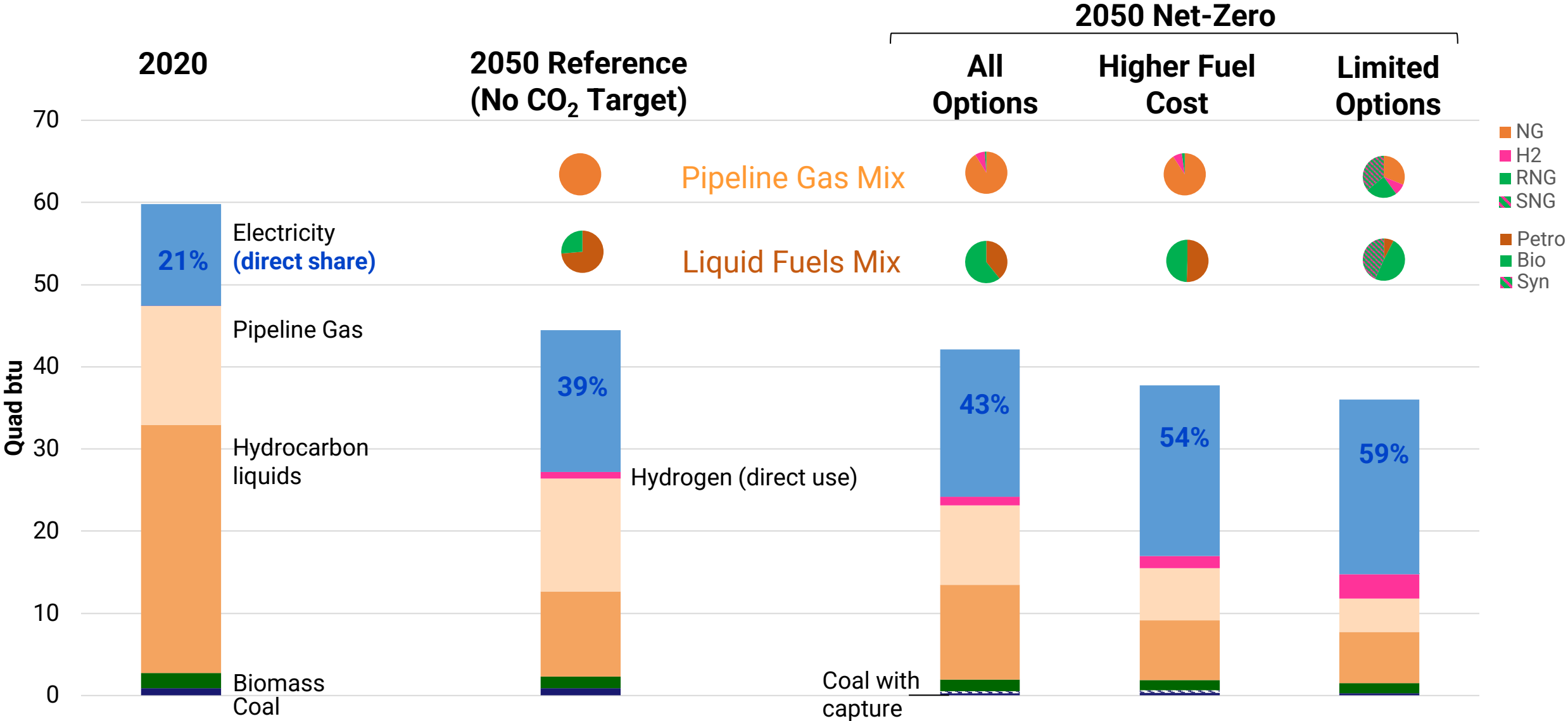
Net-Zero by 2050 with three core sensitivities around CCS, gas, bioenergy

	All Options	Higher Fuel Cost	Limited Options
Geologic Storage of CO ₂	Lower Costs	Higher Costs	Not Available
Natural Gas Supply Costs	Lower Costs	Higher Costs	Lower Costs
Bioenergy Feedstock Supply	Full	Supply Limited	Supply Limited

Direct CO₂ Emissions by Sector

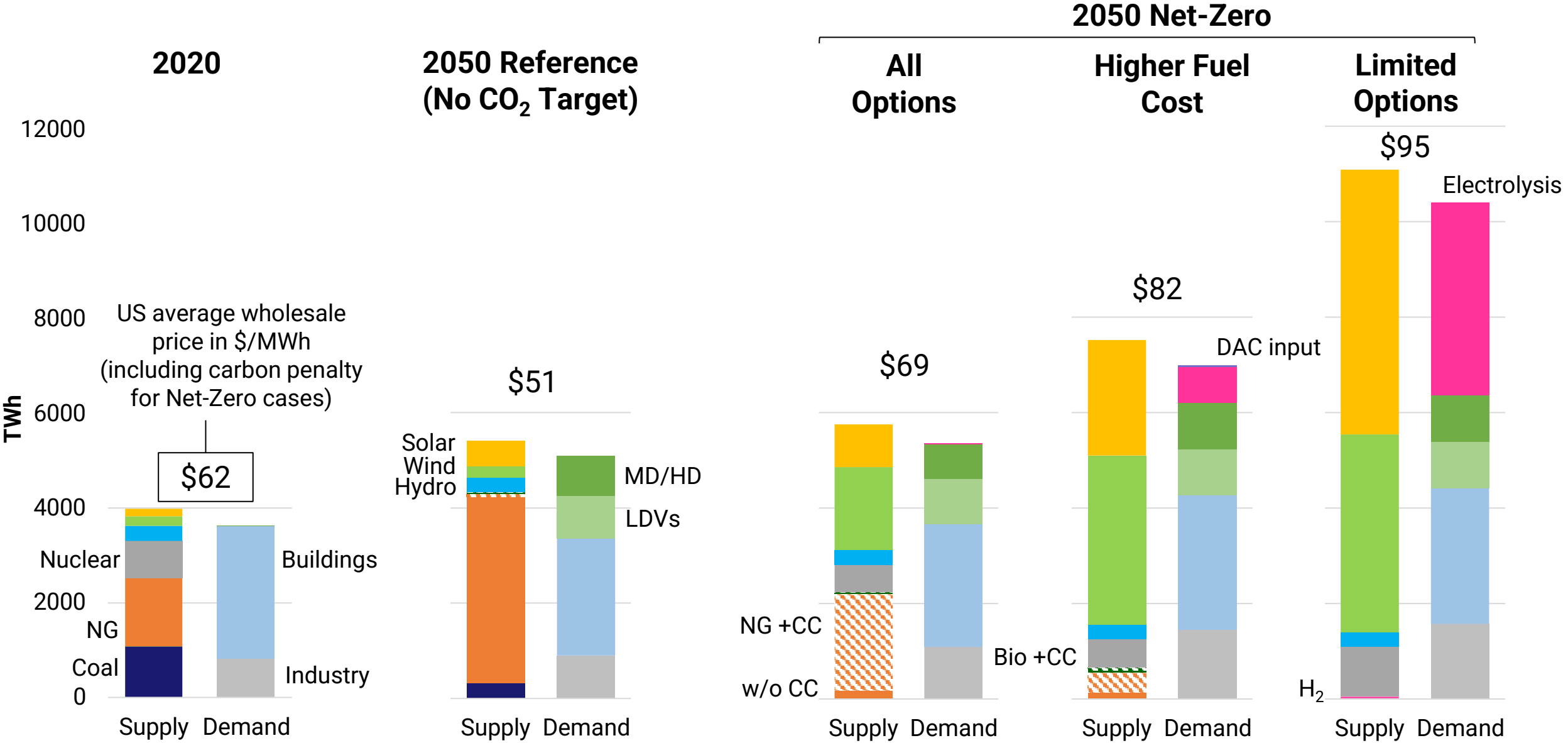


U.S. Total Final Energy (by delivered fuel)

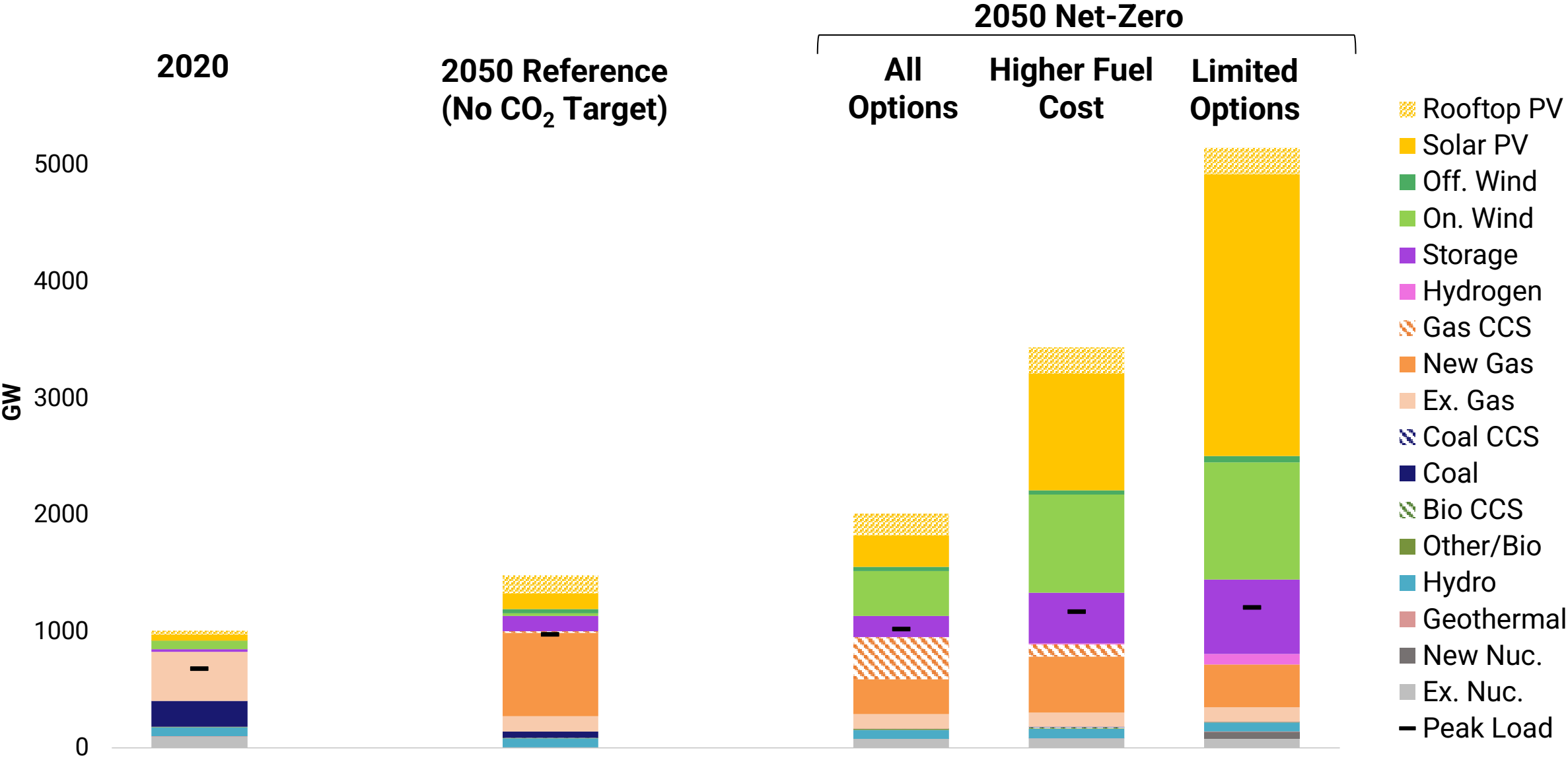


This chart excludes non-energy use of fuels

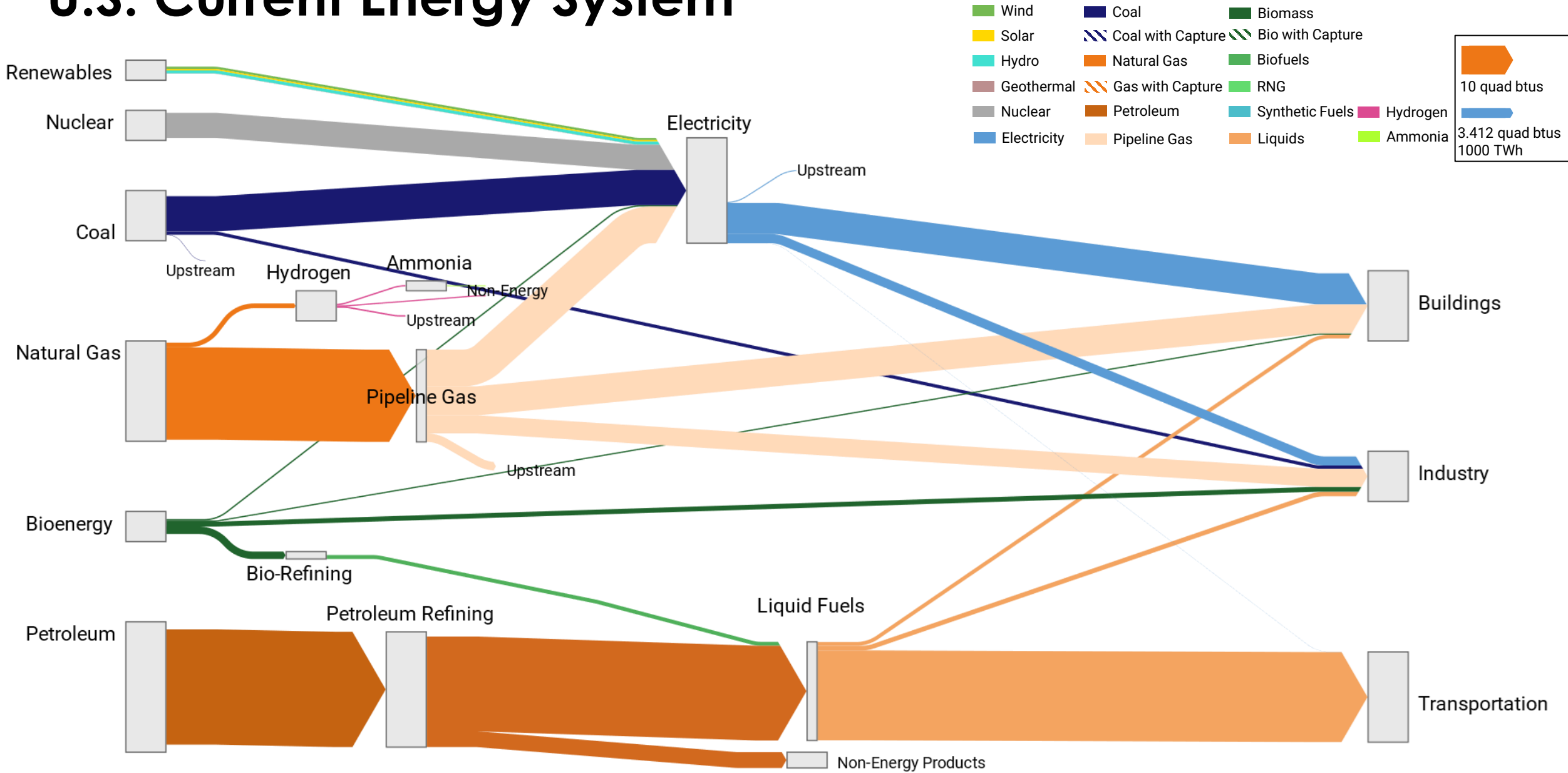
Electricity Supply and Demand



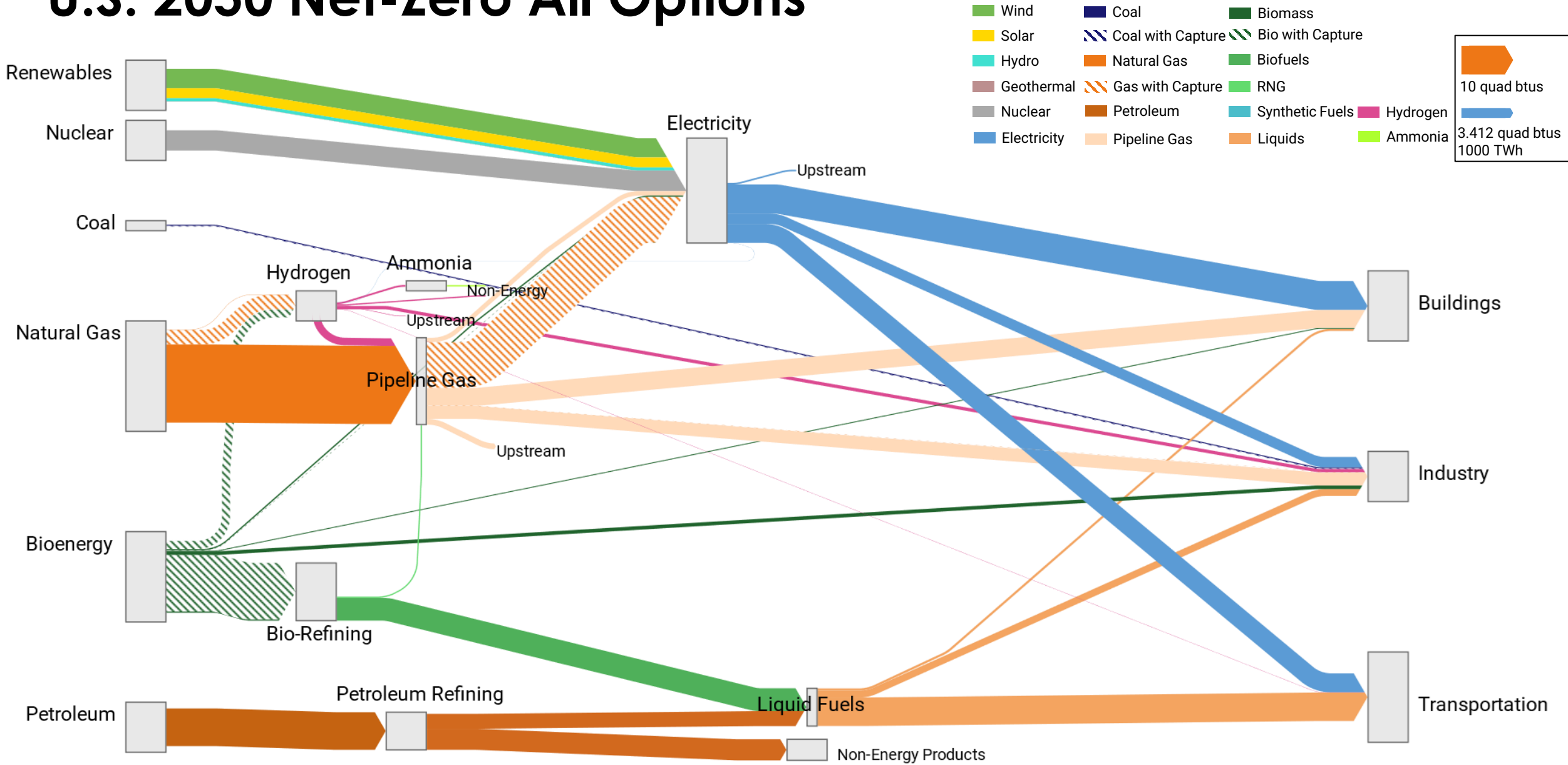
U.S. Total Installed Capacity Mix



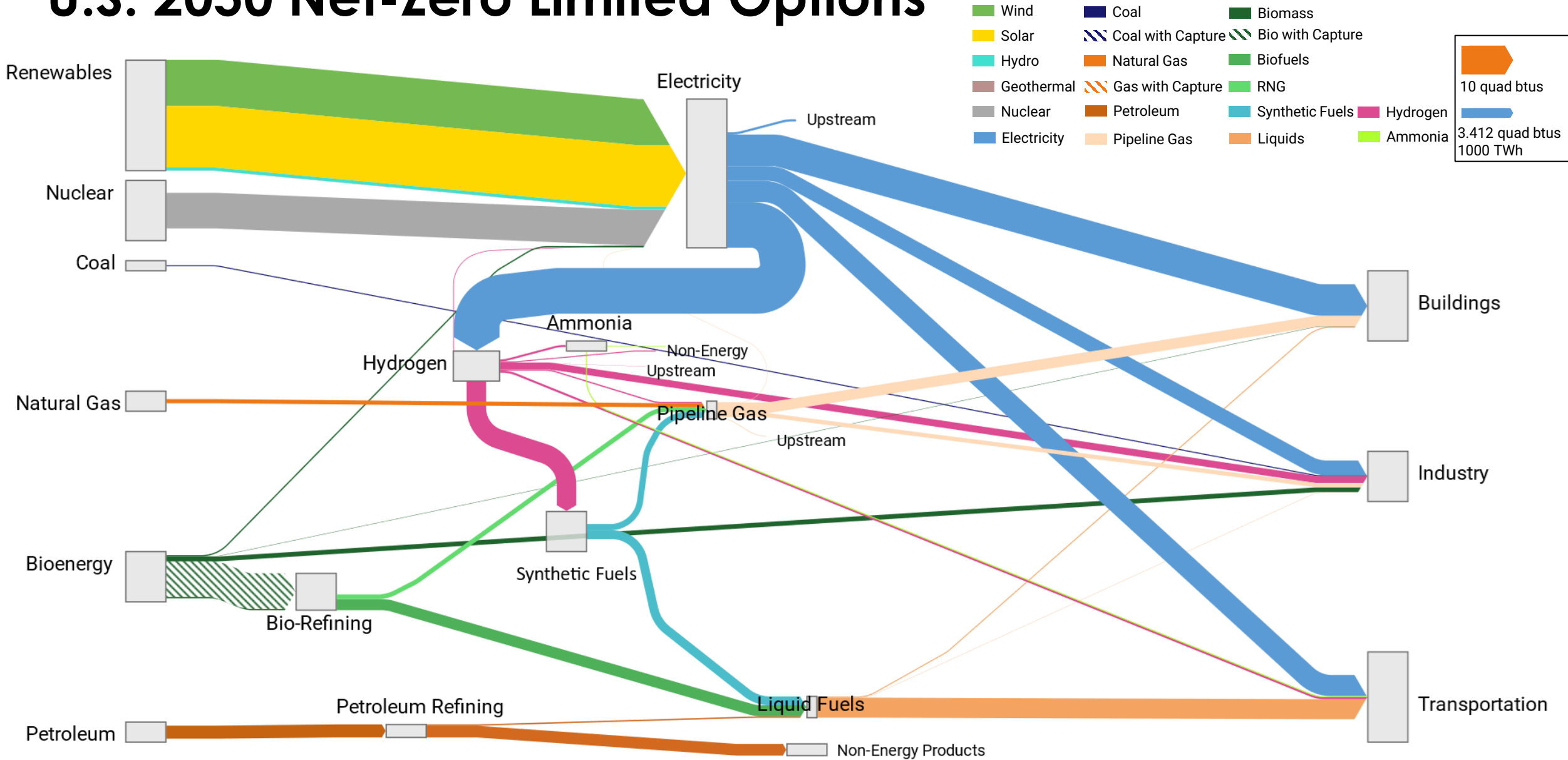
U.S. Current Energy System



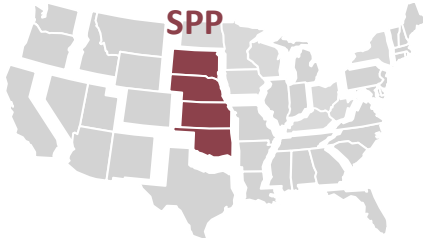
U.S. 2050 Net-Zero All Options



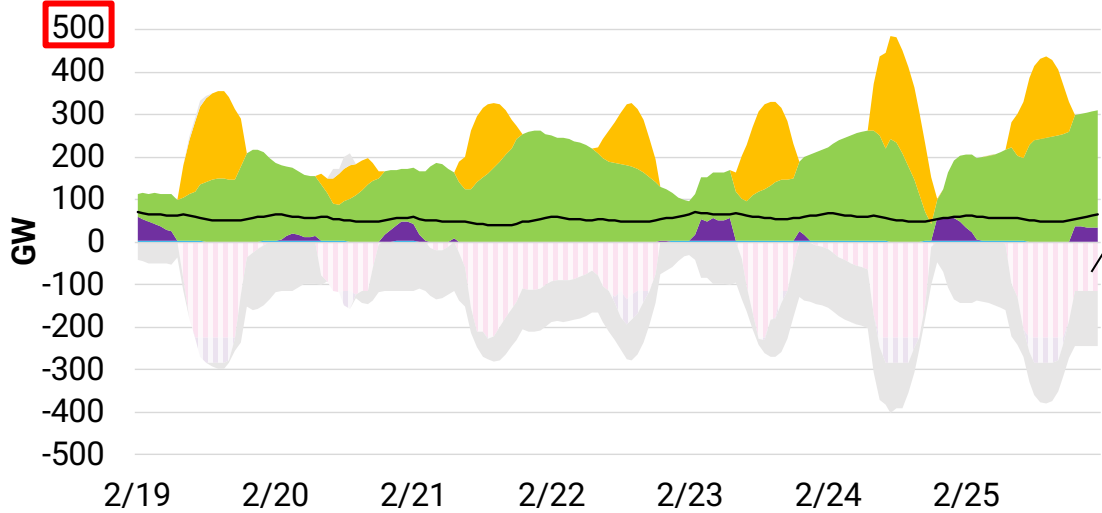
U.S. 2050 Net-Zero Limited Options



Electrolysis Load Profile System Impacts

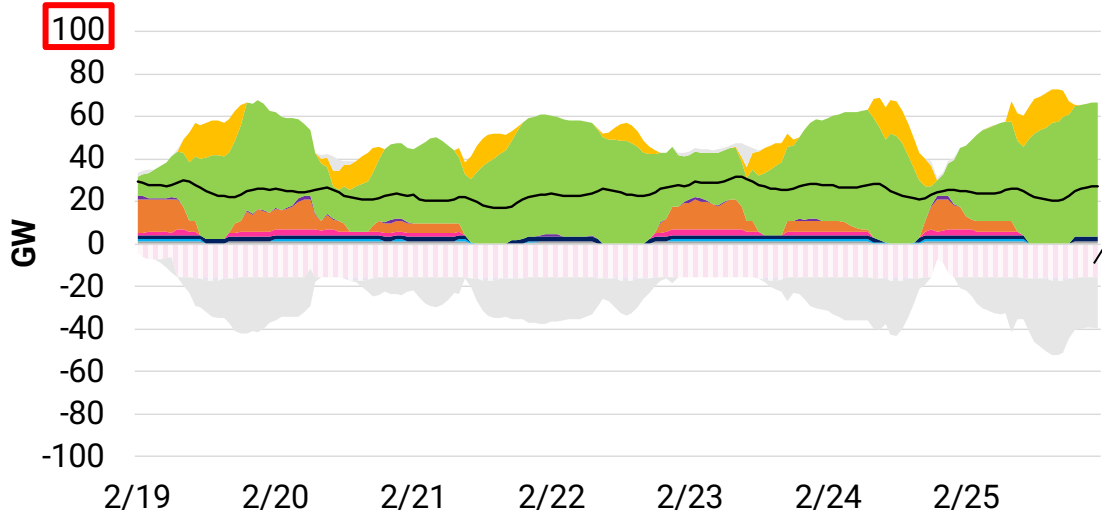


2050 Net-Zero Limited Options Scenario



Economy-wide CO₂ target leads to **variable electrolysis production**, generally aligned with renewable output

2035 IRA + 45V Scenario

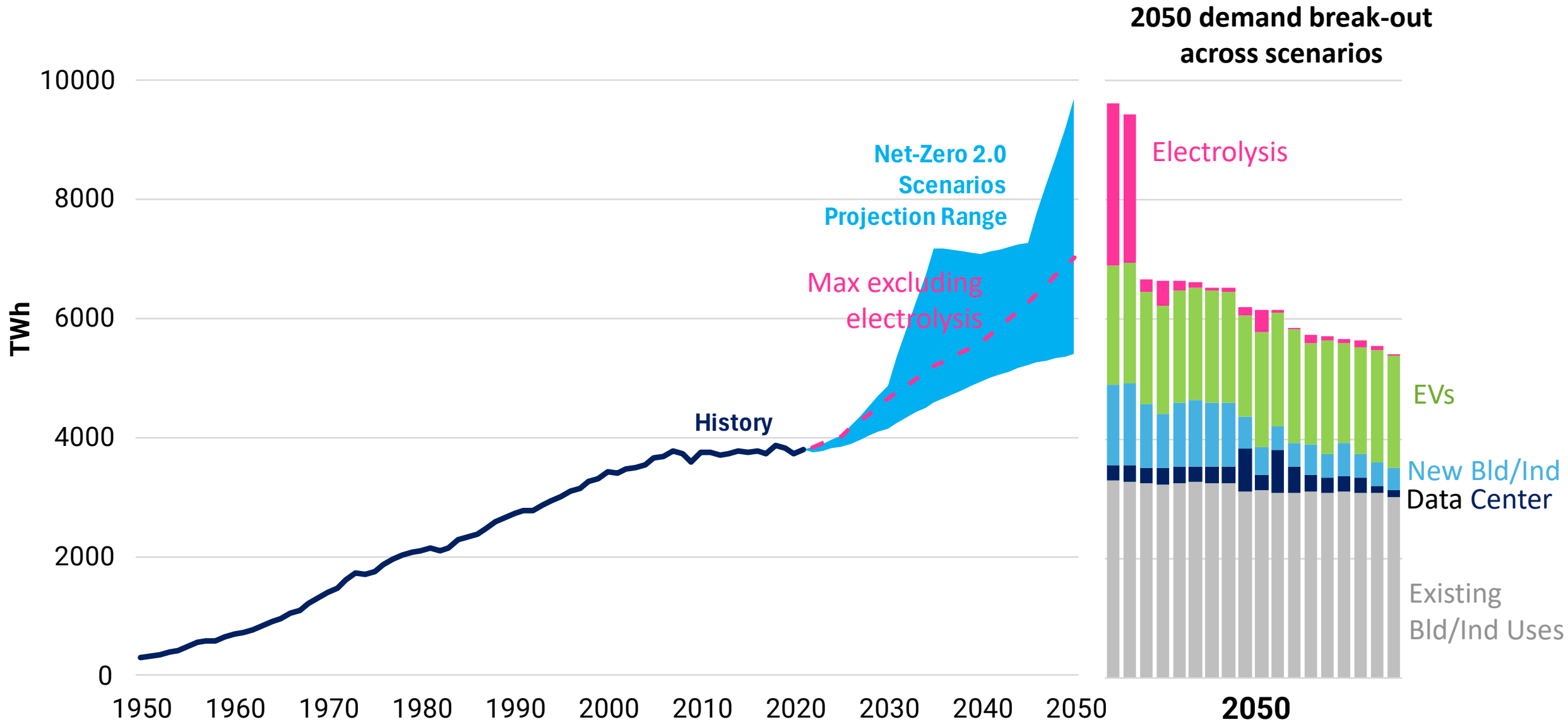


45V tax credit leads to **near-constant electrolysis production**, even with hourly matching requirement

- Net Imports
- Solar
- Wind
- Storage Discharge
- Gas
- Hydrogen
- Gas-CCS
- Coal
- Bio/Other
- Bio-CCS
- Hydro
- Nuclear
- Electrolysis (high-temp)
- Electrolysis (PEM)**
- Storage Charge
- Net Exports
- End-use Load

45V scenario report: [Impacts of IRA's 45V Clean Hydrogen Tax Credit](#)

Electricity Demand Grows in All Scenarios



Key Insights from Economy-Wide Net-Zero Analysis

- Increased electricity demand
 - Decarbonization goals in end-use sectors drive incremental **direct electrification**, especially in buildings and industry
 - **Indirect electrification**, i.e. e-fuels for “hard-to-electrify” end-uses, can be a major driver of increased load, especially with limited CDR options
- Opportunities for CDR
 - With **net-zero flexibility** to allocate positive and negative emissions economy-wide, electric sector can leverage CDR from other sectors, particularly biofuels with CCS
- Availability of low-carbon fuels
 - Firm capacity with low utilization is fundamental piece of net-zero electric systems; an **economy-wide perspective expands options** for this piece, e.g. hydrogen, renewable fuels, synthetic fuels, or conventional fuels with CDR offsets



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