



# Global Change Analysis Model: Decarbonization and Climate Resilient Energy, Water, Food, and Infrastructure Futures

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PNNL is operated by Battelle for the U.S. Department of Energy

WATER

ENERGY

SOCIO-ECONOMICS

CLIMATE

FOOD

SECURITY

# Questions Answered by Multi-Sectoral Models

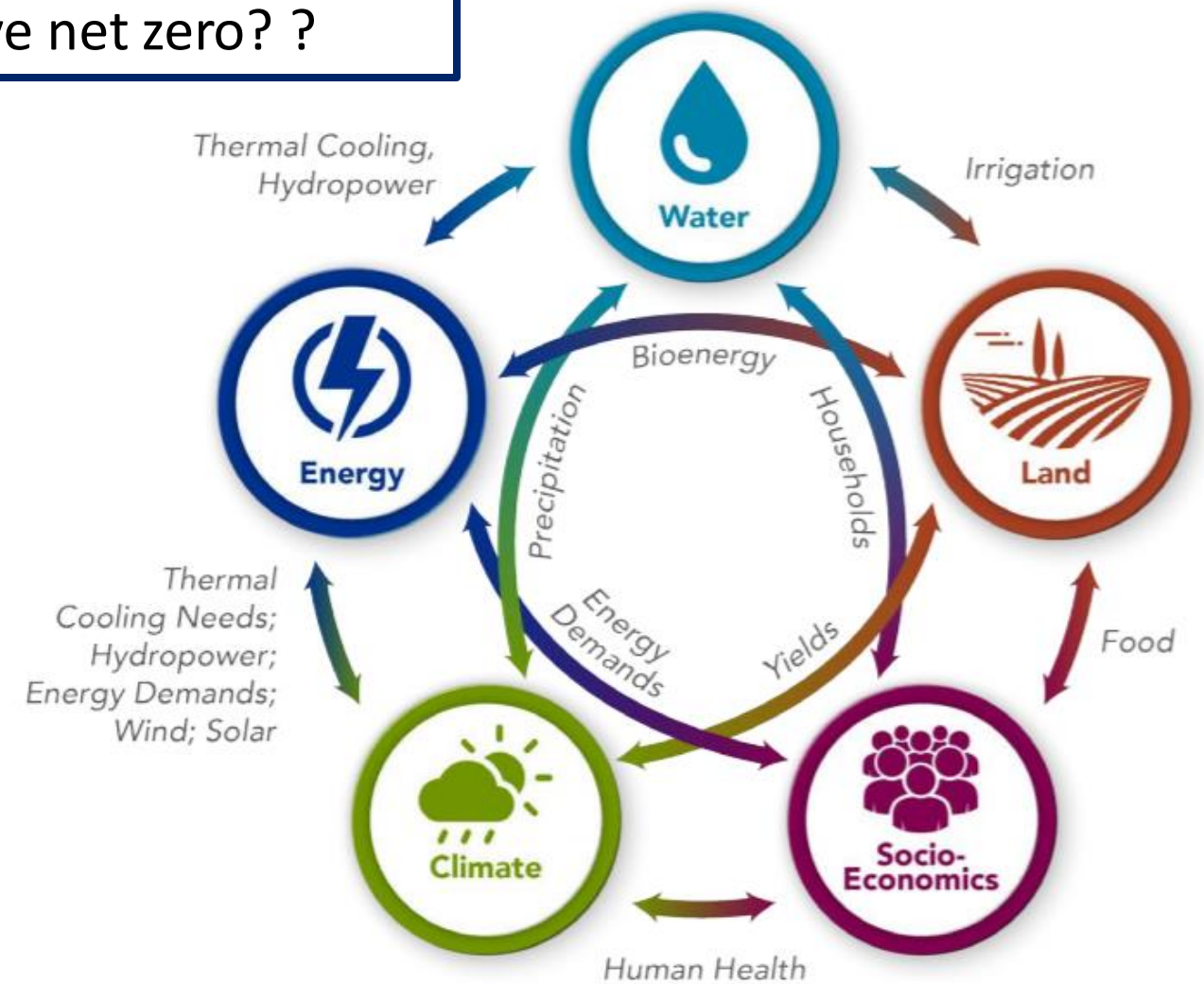
What mix of energy transformation, carbon sequestration, and reduction of overall GHG will achieve net zero? ?

Can we supply the entire energy system, with renewable power? What are the roles for CCS, nuclear, hydrogen?

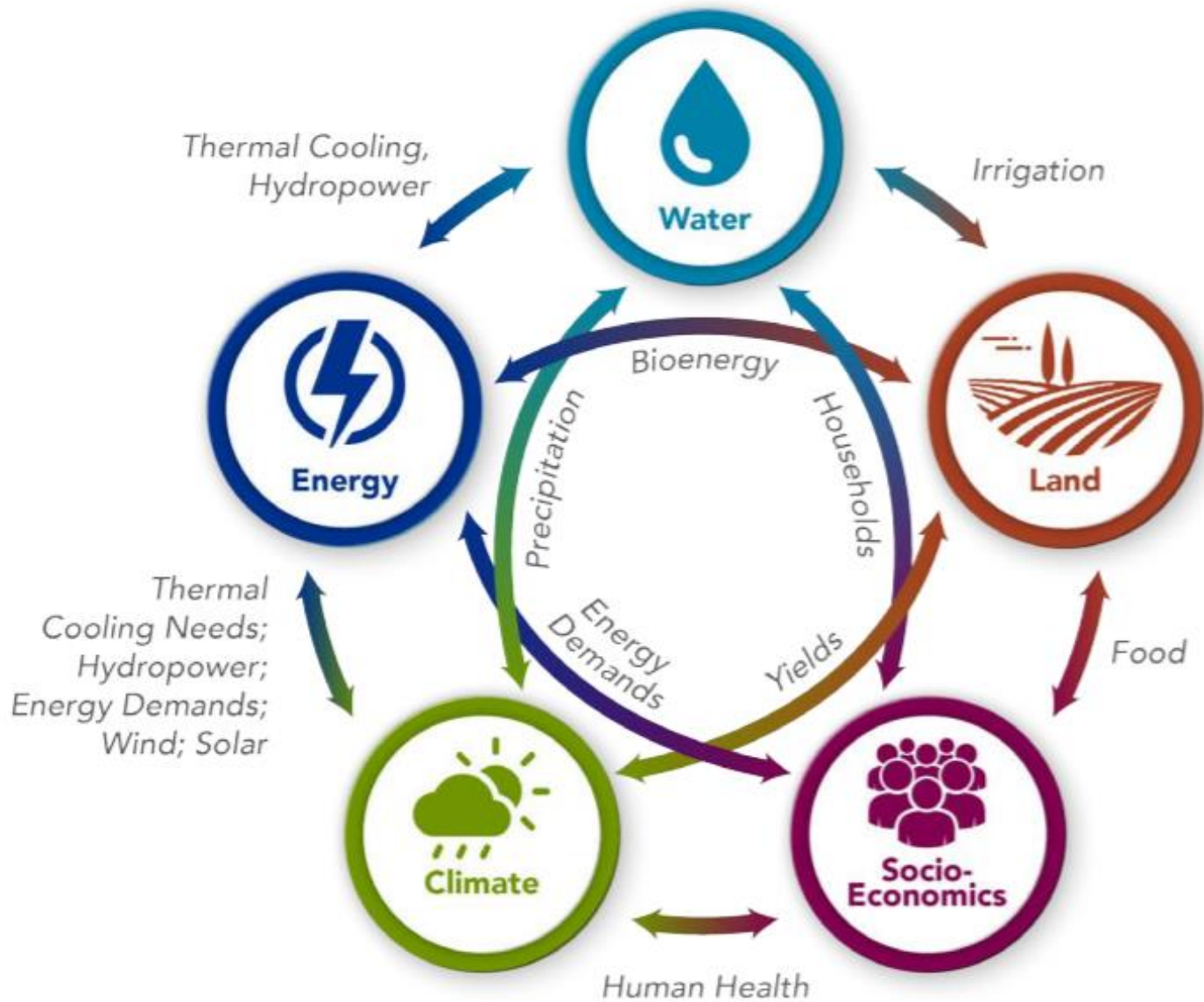
How long can we continue to use coal, gas, and oil? [Need to drop global coal by around  $\frac{3}{4}$  by 2030 if we are to limit warming to 1.5°C]

How will increased bioenergy use and climate changes affect food security and water scarcity?

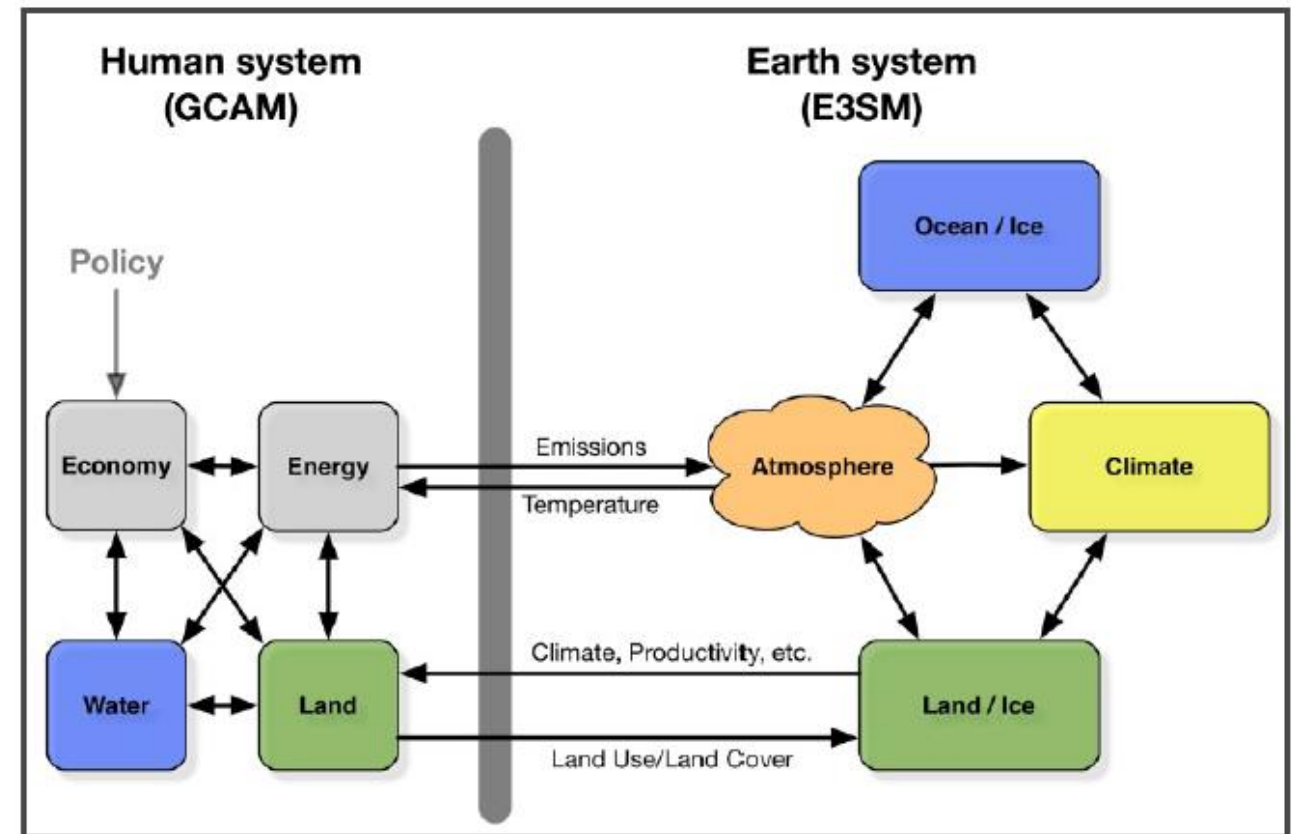
Studies show we need to phase out coal quickly. How do we manage the effects on communities dependent on fossil industries?



# Global Change Analysis Model (GCAM)



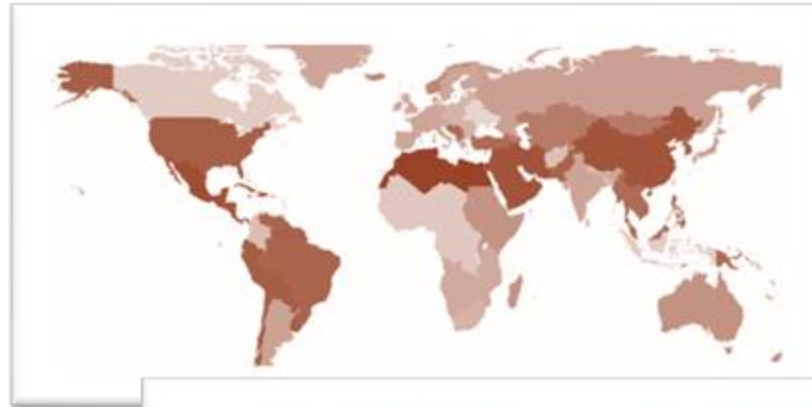
Coupling with the Global Change Analysis Model (GCAM) to simulate the interactions between the **energy system, water, agriculture and land use, the economy, and the climate**



# Global Change Analysis Model (GCAM)

## Model Coverage

32 Energy &  
Economy  
Regions



384 Land  
Regions



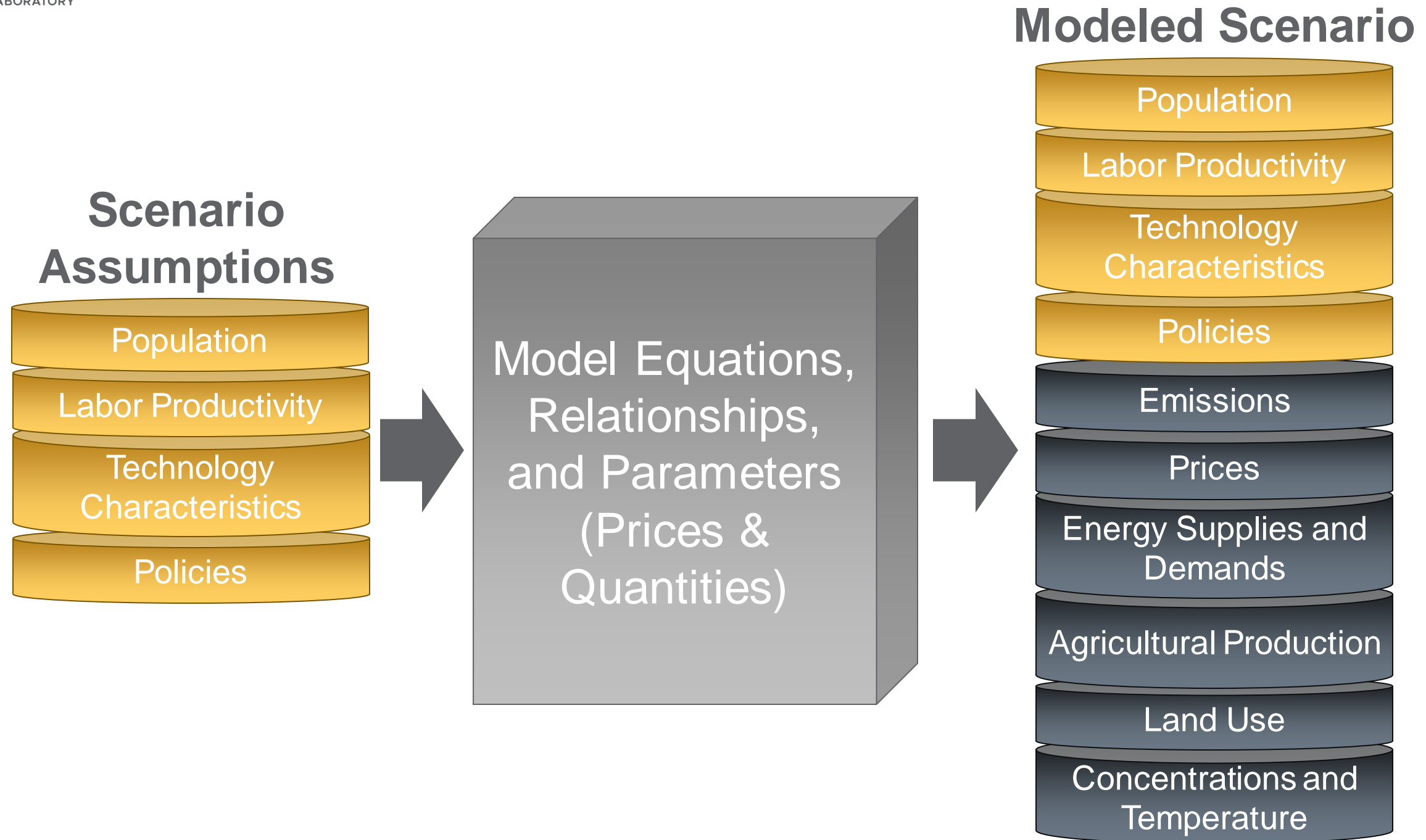
235 Water  
Basins



GCAM is a **global hierarchical equilibrium model**

- ▶ Links **Economic**, **Energy**, **Land-use**, **Water**, and **Climate** systems in a technology-rich model
- ▶ Runs to **2100** in **5-year time-steps**
- ▶ Emissions of 16 greenhouse gases (GHG) and air pollutants are tracked
- ▶ GCAM is a community model: <http://jgcri.github.io/gcam-doc/toc.html>

# Data Flow in GCAM

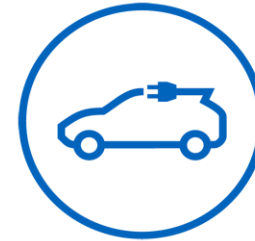




# Executive Order 14057: Federal Sustainability Goals



100% Carbon Pollution-Free Electricity by 2030, including 50% on a 24/7 basis



100% Zero-Emission Vehicle Acquisitions by 2035, including 100% Light Duty Acquisitions by 2027



Net Zero Emissions Buildings by 2045, including a 50% Reduction by 2032



Net Zero Emissions Procurement by 2050



Net-Zero Emissions Operations by 2050, including a 65% Reduction by 2030



Climate Resilient Infrastructure and Operations



Develop a Climate- and Sustainability-Focused Workforce



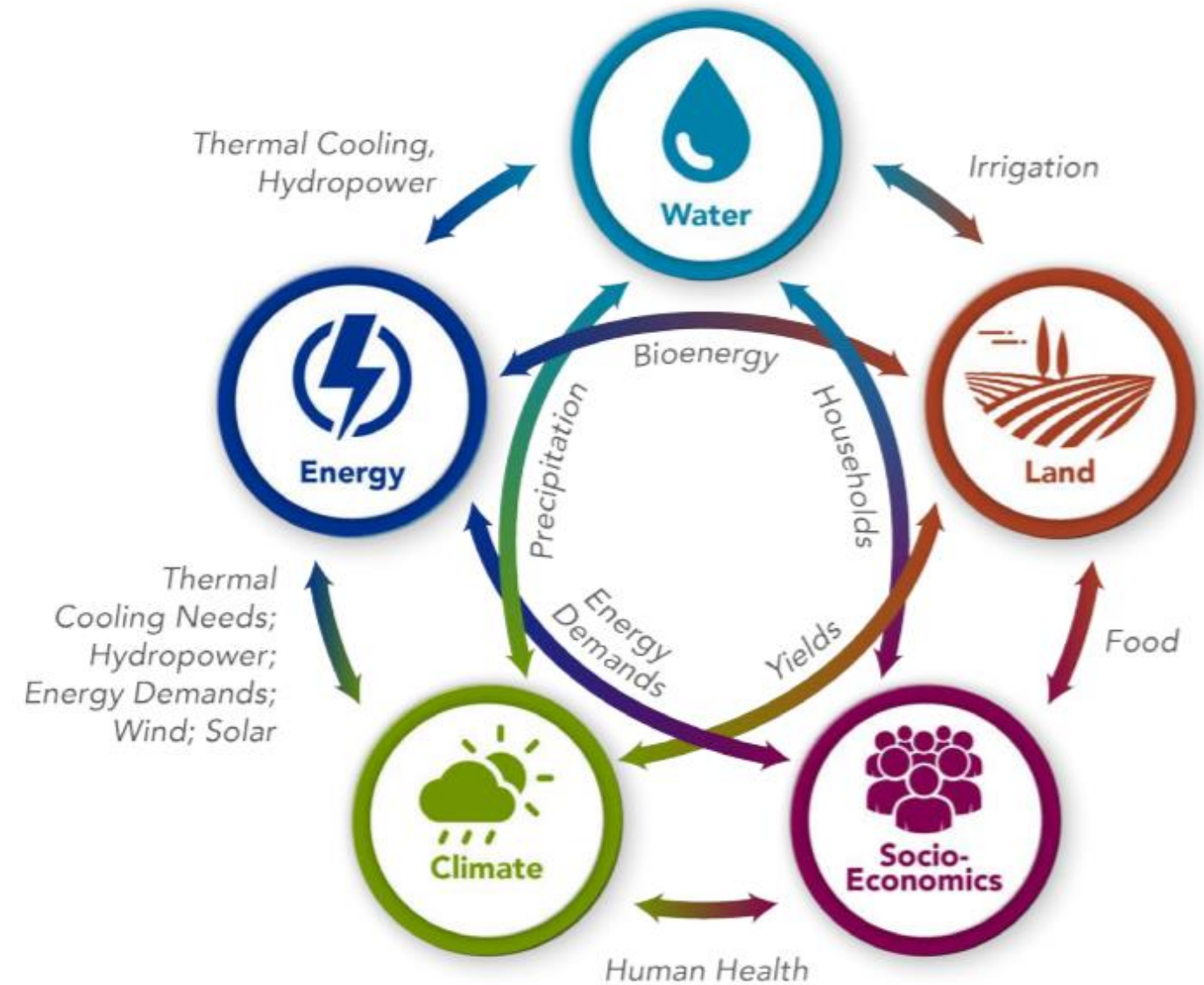
Advance Environmental Justice and Equity-Focused Operations



Accelerate Progress through Domestic and International Partnerships

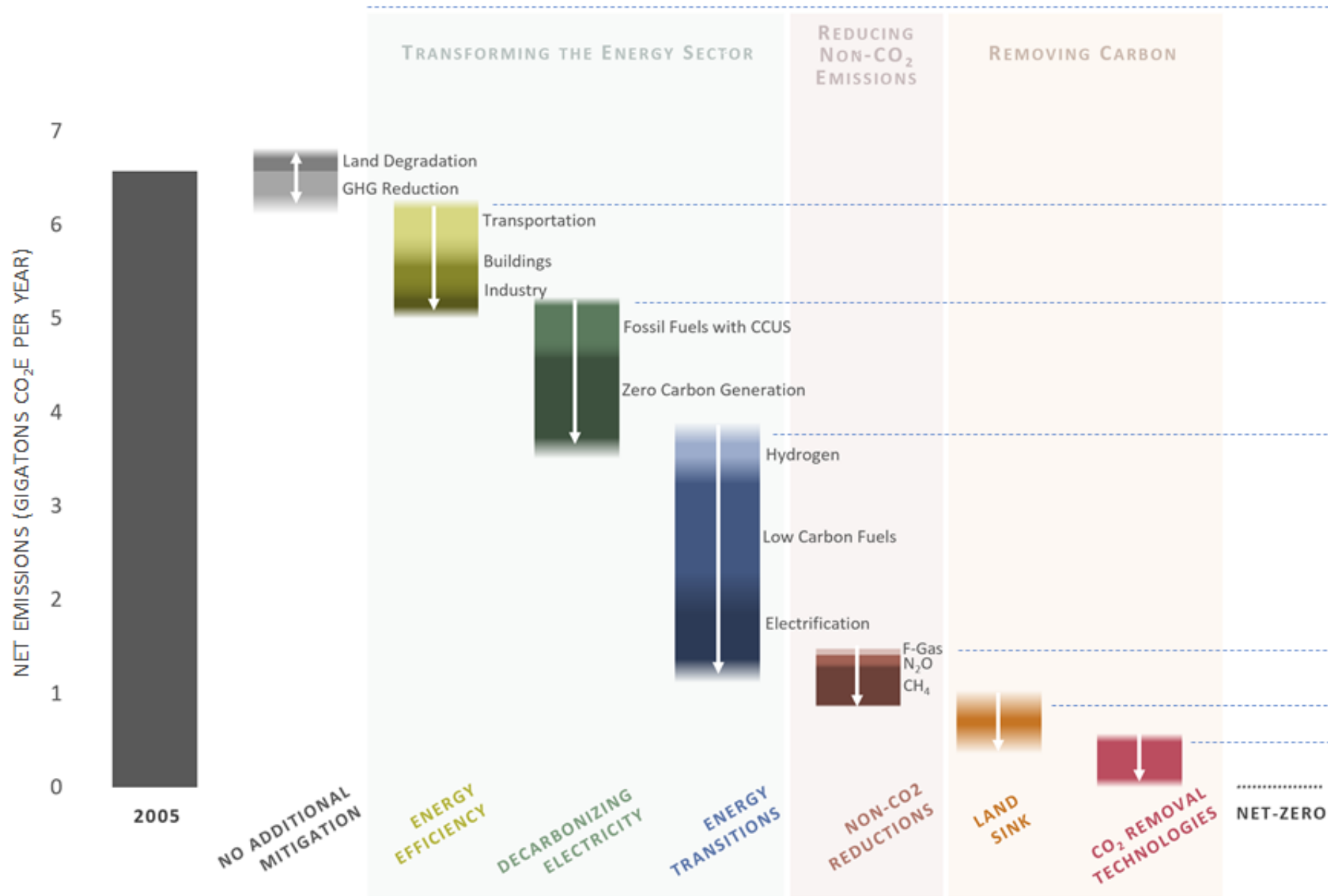
## Example Question to Address for EO 14057

What mix of energy transformation, carbon sequestration, and reduction of overall GHG will achieve net zero?



# The U.S. Long-Term Strategy: Net-Zero Pathways

REPRESENTATIVE PATHWAY TO 2050 NET ZERO







WATER

ENERGY

SOCIO-ECONOMICS

CLIMATE

FOOD

SECURITY

Thank you



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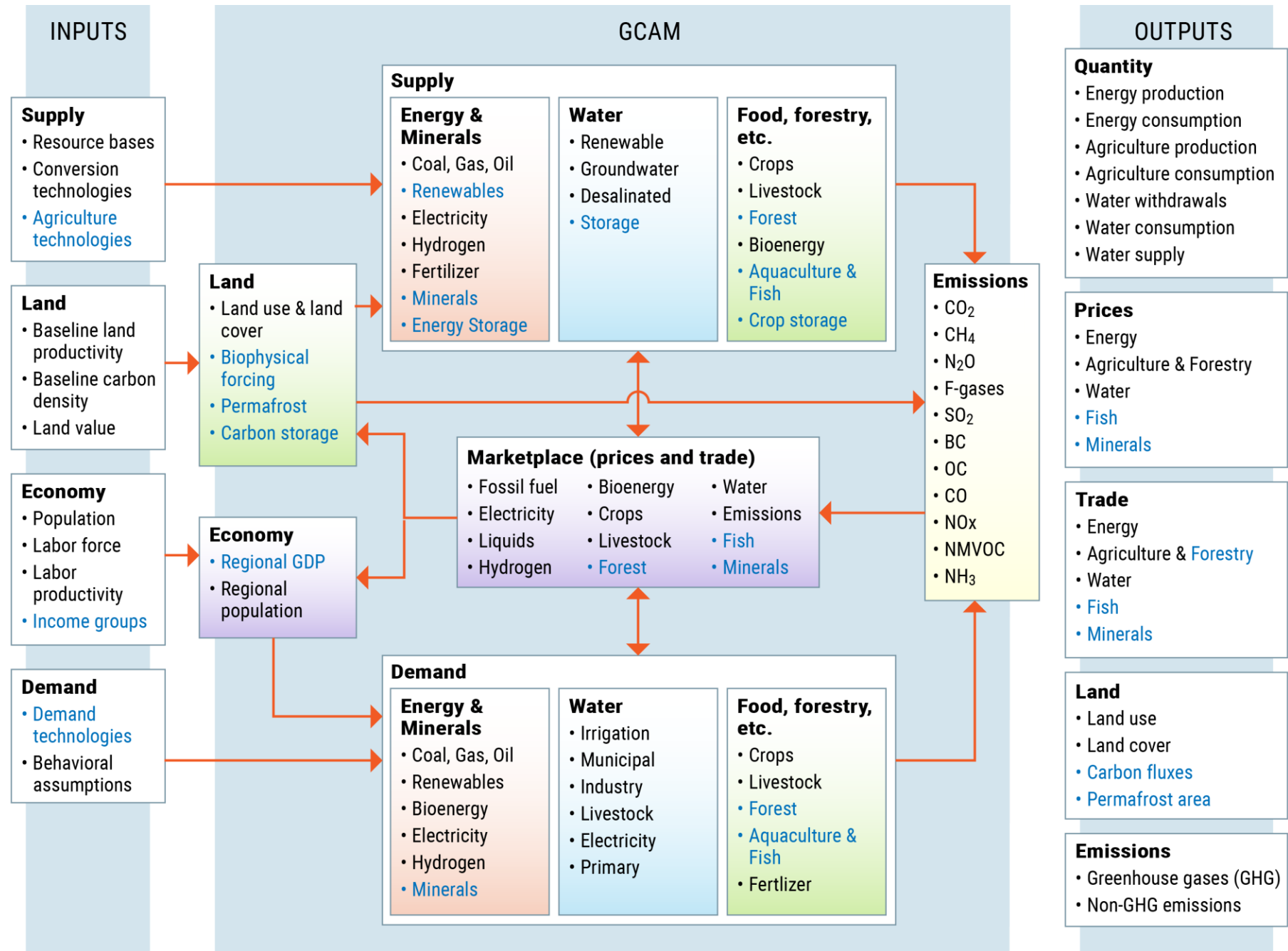
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# Global Change Analysis Model (GCAM)

- ❑ GCAM is widely used by the international research community to explore questions about energy transition, water scarcity, food subsidies, etc.
- ❑ A community model (<https://github.com/JGCRI/gcam-core/releases>)



\* Items in blue text are currently being developed