Regionalized integrated assessment modeling of carbon dioxide removal pathways in USA and China

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Introduction

- Climate change is the most pressing sustainability challenge today because of the rapidly intensifying effect it is having on human wellbeing.
- Net-zero commitments are being made by governments and institutions at many scales ranging from cities, states/provinces, to countries. These plans require extensive mitigation of emissions from power generation, manufacturing, transportation, buildings, and agriculture and increasingly carbon dioxide removal in order to meet their targets.

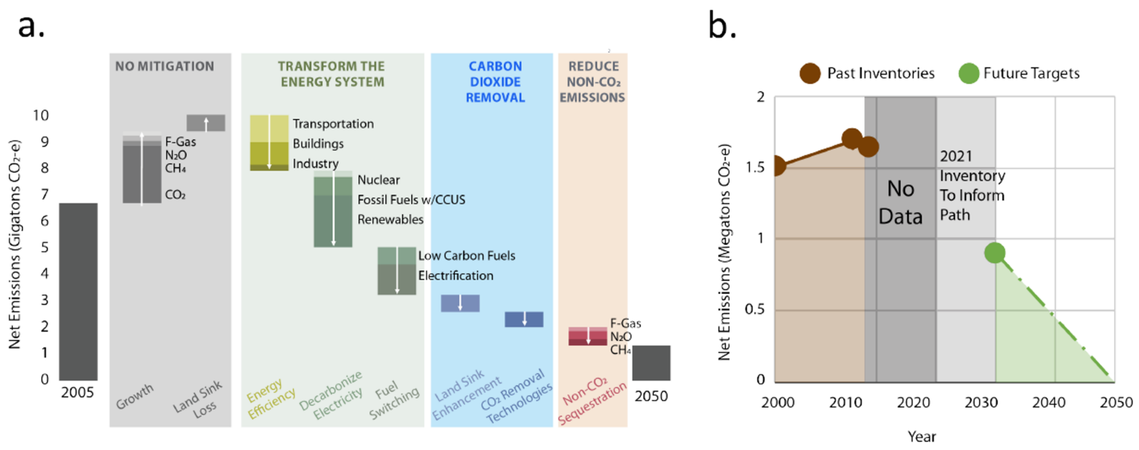
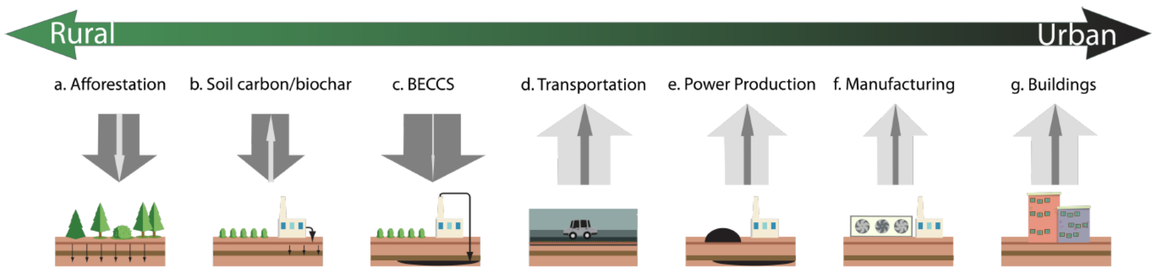


Figure 1: Decarbonization plans at the a. national scale for the United States are much more detailed than b. regional scale plans for Albemarle County, VA

- Bridging this divide between national/regional and urban/rural contributions is critical for countries to collectively meet their goals.
- The goal of this project is to address the institutional capacity gap between regions and nations pursuing net-zero carbon emissions targets. We will create theory and tools to understand how decarbonization will affect people and how regional specialization and preferences will affect global-scale understanding of climate futures.

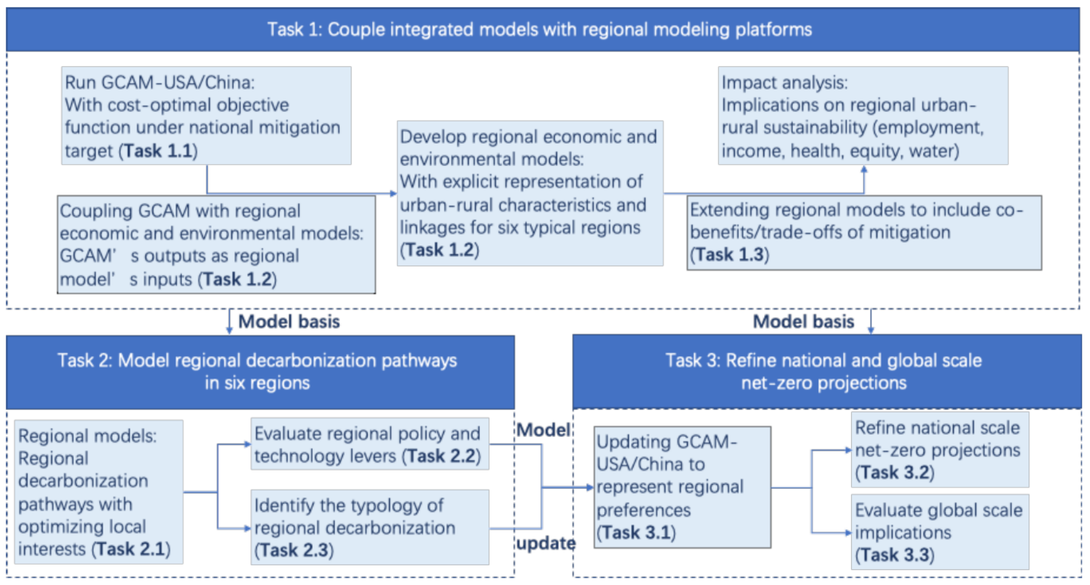
Research Objectives

- Identify topologies of decarbonization ambition at the regional scales
- Understand the implementation gap between global models and regional action
- Evaluating social welfare dimensions of decarbonization using energy-economic computable general equilibrium model
- Characterize policy levers for achieving multiple outcomes alongside decarbonization
- Measure the relative gains and losses to different group specifically urban-rural households



Research Tasks

Task 1. Couple integrated models with regional modeling platforms for multi-dimensional analysis of decarbonization pathways at regional scales



Task 2. Model regional decarbonization pathways in six regions

Country	Region, Cities	Economy
US	Virginia, Washington C	Service dominated coastal city, vulnerable to climate impacts; sustained population growth and high regional energy demand; strong influence of the federal government.
China	Guangdong, Shenzhen	Urbanized service region with strong scientific/technological innovation capability and robust financial and industrial bases. Shenzhen is a leader in Chinese efforts to decarbonize a city and explore the impacts on surrounding regions.
US	Indiana, Indianapolis	Manufacturing dominant region, with major production of steel, automobiles, chemical products and others outside Chicago and Indianapolis, with well-studied net-zero plans.
China	Hebei, Tangshan	Hebei is an important industrial region in China, and a hub for the country's iron and steel industry.
US	Nebraska, Omaha	Nebraska has a large agriculture sector, producing a range of commodities including beef, pork, wheat, corn, soybeans, and sorghum.
China	Qinghai, Xining	Grassland region with significant potential to export carbon reductions and renewable energy. Key sectors including energy and industry.

Task 2.2. Evaluate regional policy and technology levers

Task 2.3. Identify the typology of regional decarbonization

Task 3. Refine national and global scale net-zero projections

Task 3.1. Update GCAM-USA/GCAM-China to represent regional preferences

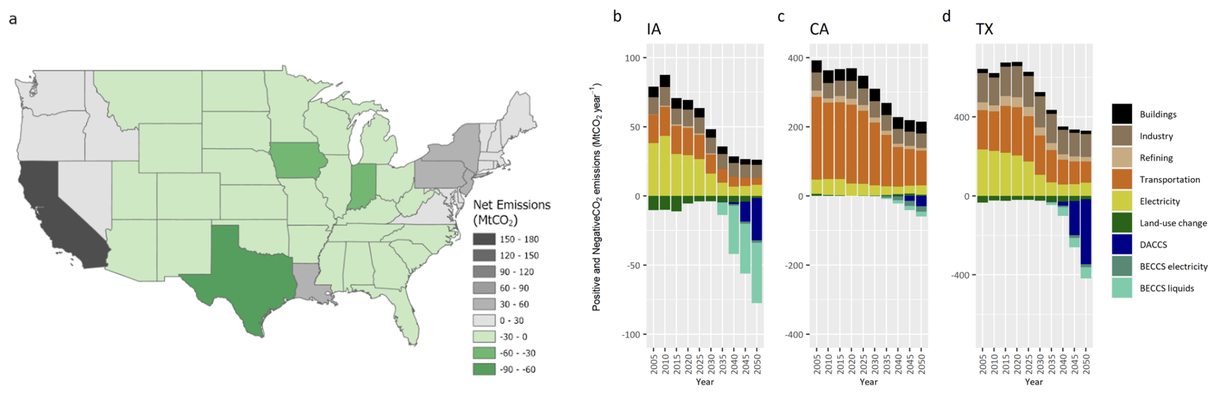


Figure 2: Sector emissions breakdown for the United States under a national 2050 net-zero carbon dioxide emissions scenario: United States (a), Iowa (b), California (c), and Texas (d)

Task 3.2. Refine national scale net-zero simulations

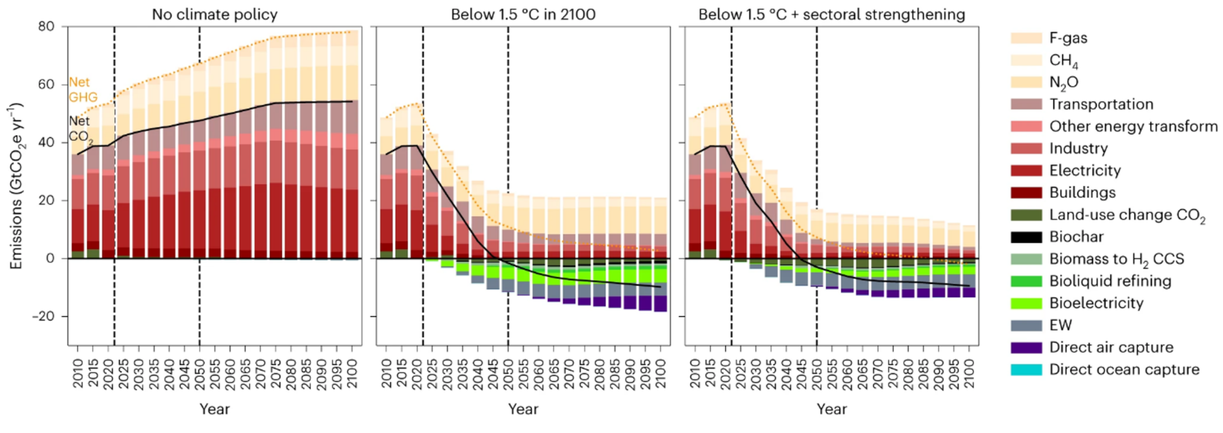


Figure 3: Global positive and negative annual CO2 emissions

Task 3.3. Evaluate global-scale implications of regional conditions in GCAM