MARCH 2022

TEXAS
The University of Texas at Austin

SECTORAL FEASIBILITY OF GREENHOUSE GAS MITIGATION AND CLEAN ENERGY TRANSITIONS

Fueling a Sustainable Energy Transition (FSET) Research Showcase

UT Energy Week 2022

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Focus of Our Presentation

- Enhancing policy realism in energy system optimization models: Politically feasible decarbonization pathways for the United States

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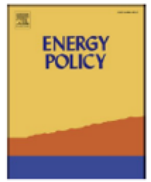

Enhancing policy realism in energy system optimization models: Politically feasible decarbonization pathways for the United States

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Research Questions

- How can granular, sector-specific decarbonization policies be incorporated into an energy system optimization model?
- Using climate policy instruments that are politically feasible under various U.S. federal political contexts, how much decarbonization can be achieved by 2050?
- How expensive is it to decarbonize the U.S. economy using portfolios of sectoral policies relative to following the ideal, least-cost decarbonization pathway?
- What sources of greenhouse gas (GHG) emissions are very difficult to decarbonize using currently feasible policies and technologies?

Sectoral Policy Portfolios

- ***Recorded video presentation by Joshua Busby***

Joshua
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Associate Professor
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TIMES Model

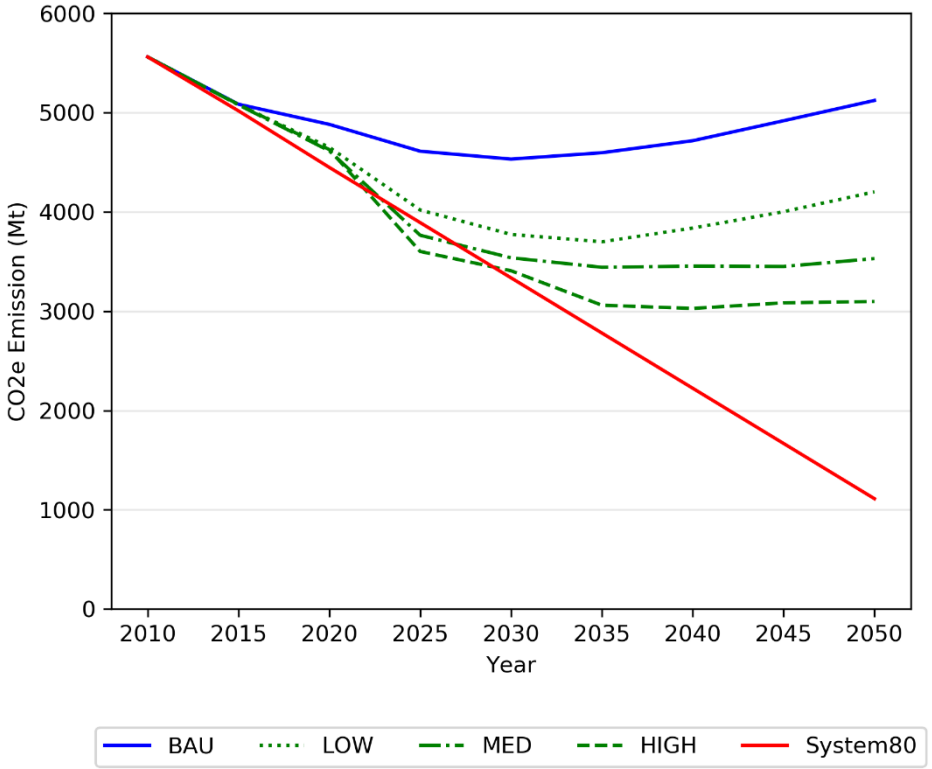
- An energy system optimization framework develop by the IEA's Energy Technology System Analysis Programme (ETSAP)
- A bottom-up, technology-rich, least-cost linear program
- End-use demands for energy services are exogenously specified and market clearing conditions lead to partial equilibrium in energy markets
- Model makes decisions on technology capacity investments and operational levels, leading to outcomes for energy mixes and GHG emissions

US-TIMES Model

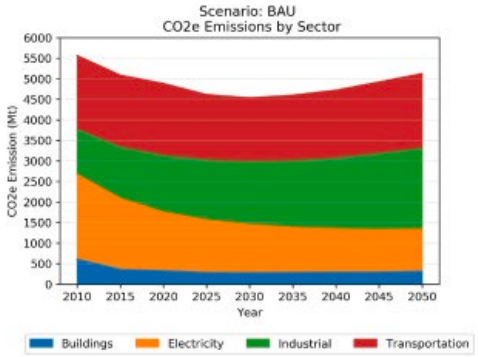
EPAUS9r Regions	
R1	New England
R2	Middle Atlantic
R3	East North Central
R4	West North Central
R5	South Atlantic
R6	East South Central
R7	West South Central
R8	Mountain
R9	Pacific

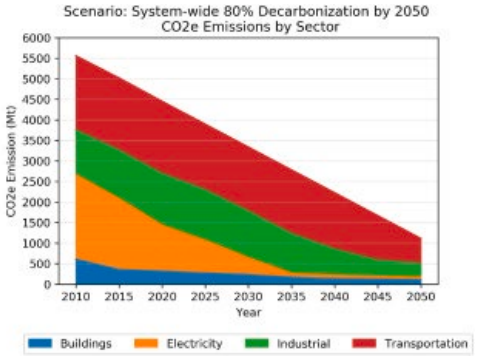
- The TIMES model of the U.S. employs the EPAUS9rT database developed by the EPA
- Divides the U.S. into 9 regions
- Sectors included: electricity, buildings, transportation, industry
- Timeframe: 2010 – 2050 with investment time steps of 5 years
- Default assumptions are mostly aligned with the EIA Annual Energy Outlook

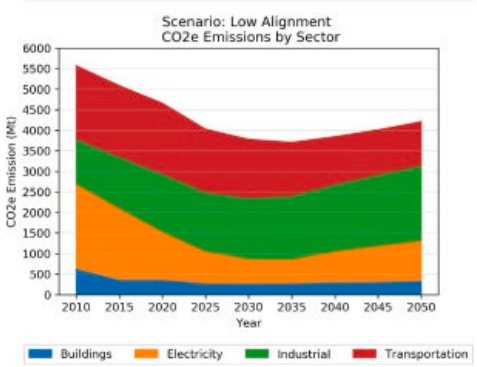
Results: Total GHG Emissions

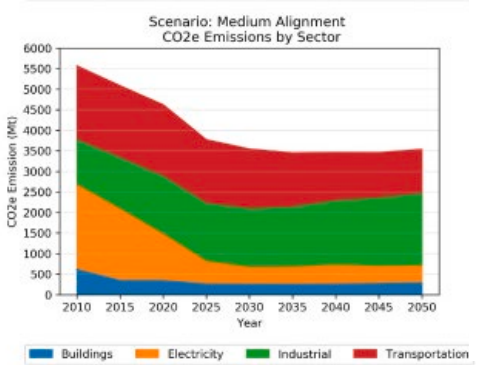


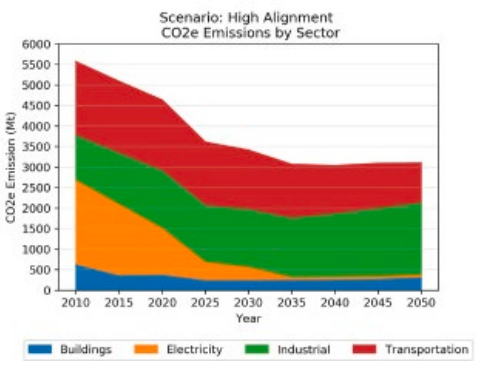
Results: GHG Emissions by Sector



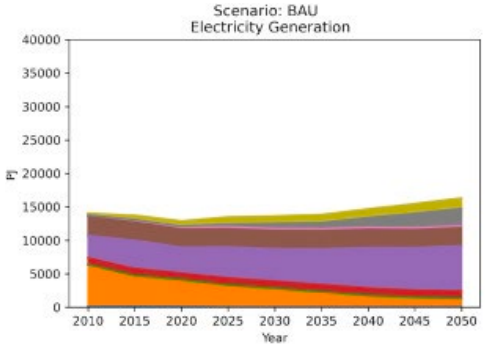


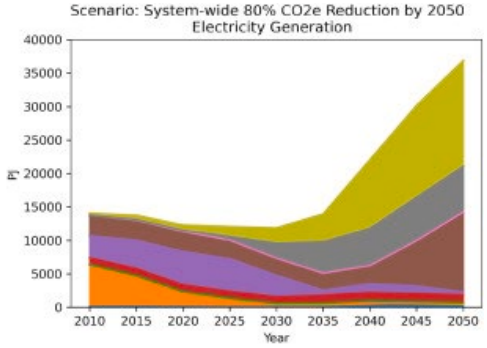


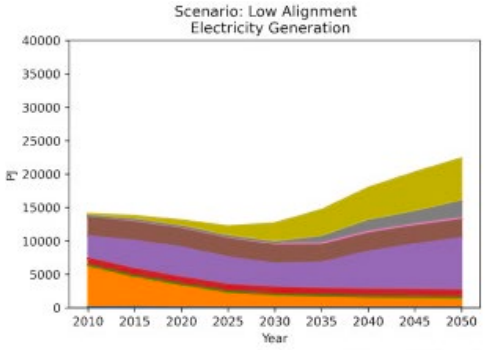


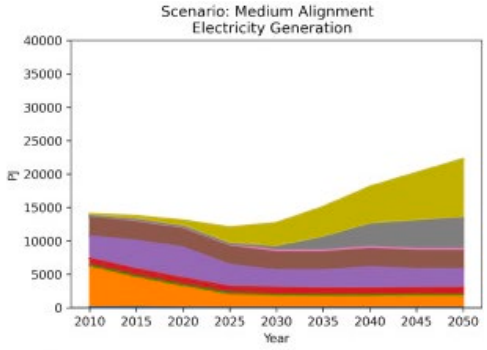


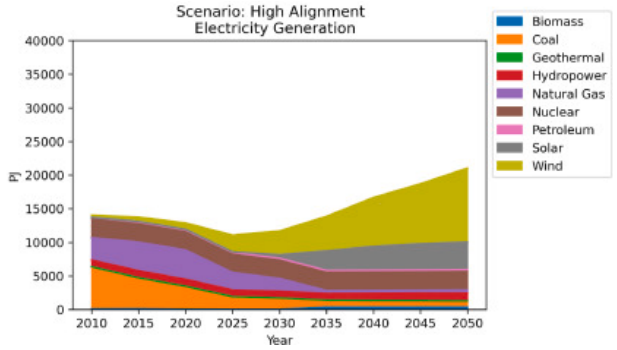
Results: Electricity Generation



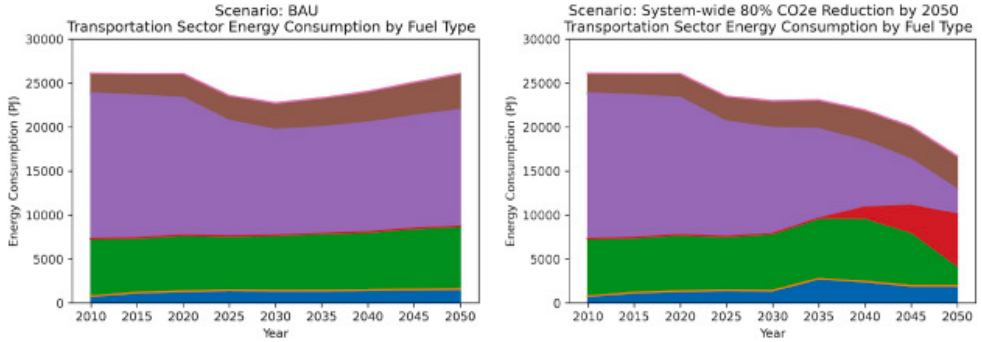


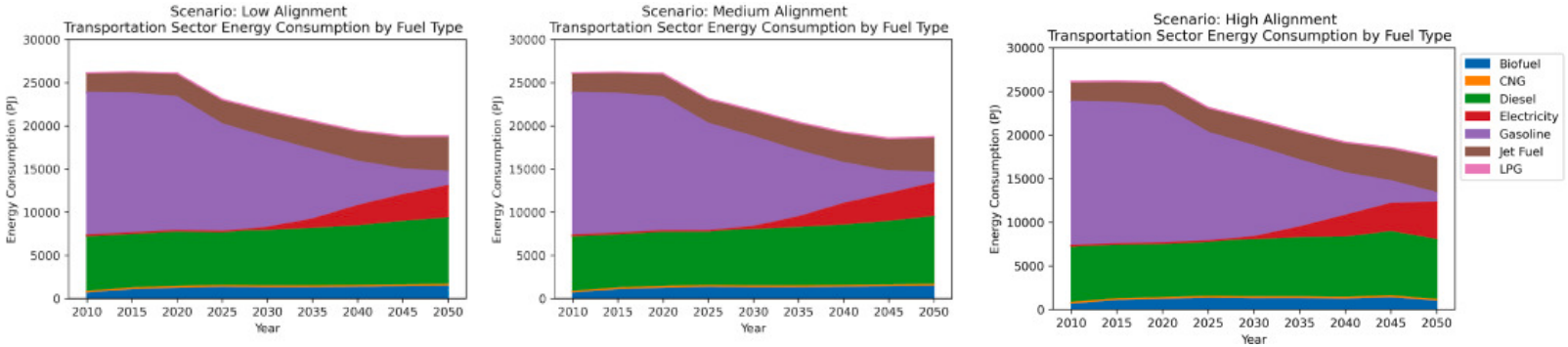




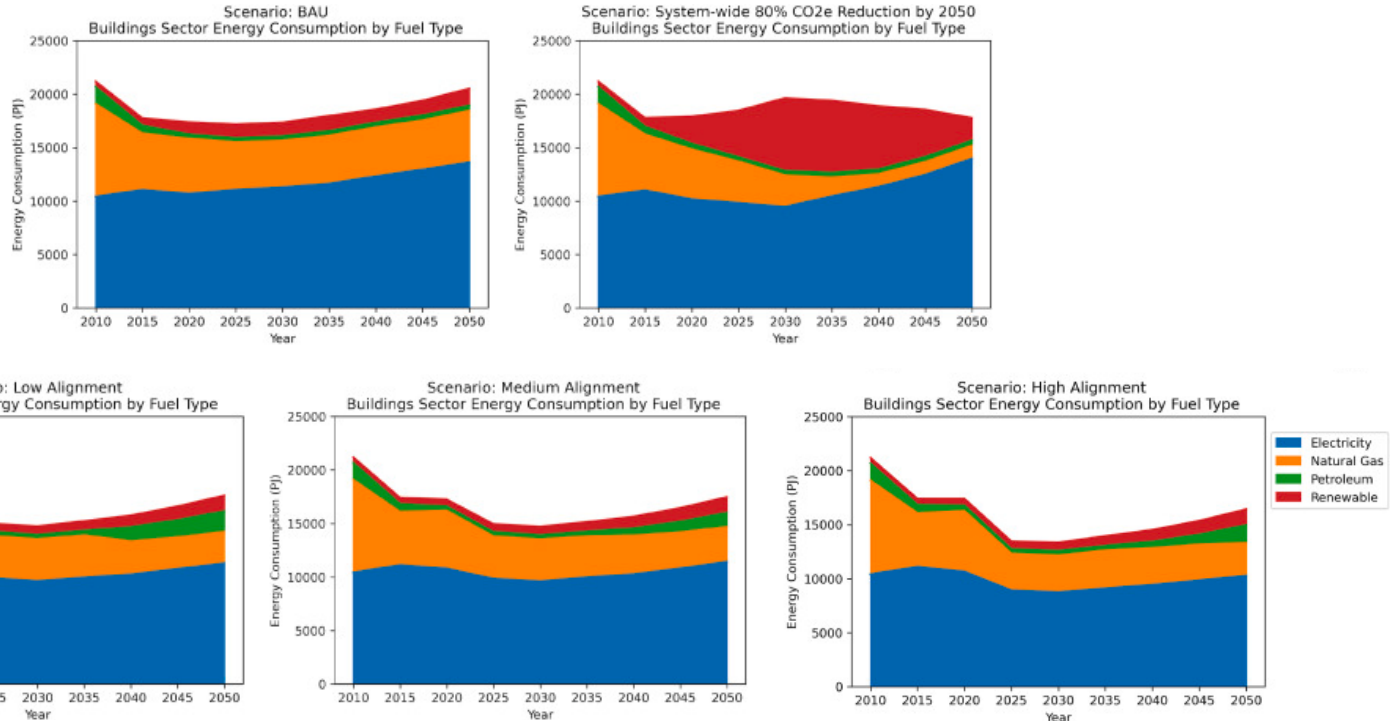


Results: Transportation Fuel Mix

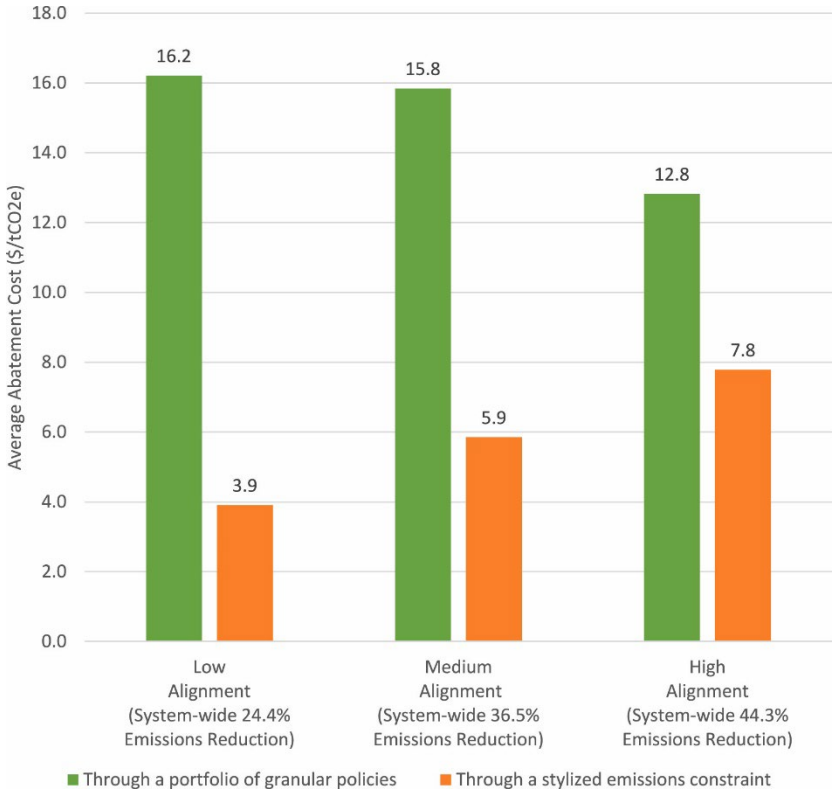




Results: Building Energy Mix



Results: Average Abatement Costs



Key Findings

- The most cost-effective near-term decarbonization opportunities exist in the electricity sector
- The electrification of end-use sectors plays a crucial role in reaching deeper system-wide GHG reductions
- Optimal decarbonization of the economy leverages synergies among different sectors

Key Findings

- Decarbonizing the U.S. economy using portfolios of sectoral climate policies is several times more expensive than doing so via the least-cost pathways
- However …
  - The gap between the two AAC values narrows as the political environment allows for policy instruments that are simultaneously more ambitious and more cost-effective
  - The sectoral policy portfolio AAC values are still lower than mainstream social cost of carbon estimates, so the portfolios should still produce net benefits compared to BAU

Policy Implications

- In the near-term, infrastructure transformation is needed to provide adequate clean electricity generation
- It is important to use the complementary policy tools of mandates and standards, investments, and tax credits
- New technologies and policies will be needed to address emissions from industry, medium- and heavy-duty vehicles, natural gas use in buildings, air travel, and so on
- Sectoral policies should not be assessed in isolation
- The U.S. economy can be substantially decarbonized by 2050 at modest cost and many sectoral policies would likely yield net benefits

The End

- We hope that you enjoyed our presentation!
- To learn more about this work, please see our paper:
  - Zhu, Q., Leibowicz, B.D., Busby, J.W., Shidore, S., Adelman, D.E., Olmstead, S.M., 2022. Enhancing policy realism in energy system optimization models: Politically feasible decarbonization pathways for the United States. ***Energy Policy*** 161, 112754.