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Implications of Climate Change Mitigation and Socioeconomic Development on the US Electric Power Sector

Introduction

Unprecedented **climate change** is impacting every sector of society. Picking up the pace of emission reduction at the subnational level (i.e., state) is central to achieving the national target. **End-use electrification** contributes to reducing GHG emissions and is thus an effective way to mitigate climate change. Economy-wide electrification will spike demand for electricity, which largely depends on factors such as population dynamics, economic development, policy, and regulations. In addition, CO_2 emissions from power generation contribute significantly to climate change!

Our goal: To advance our understanding of the interplay between top-down climate change mitigation and socioeconomic development in affecting the US electric power sector at the state level.

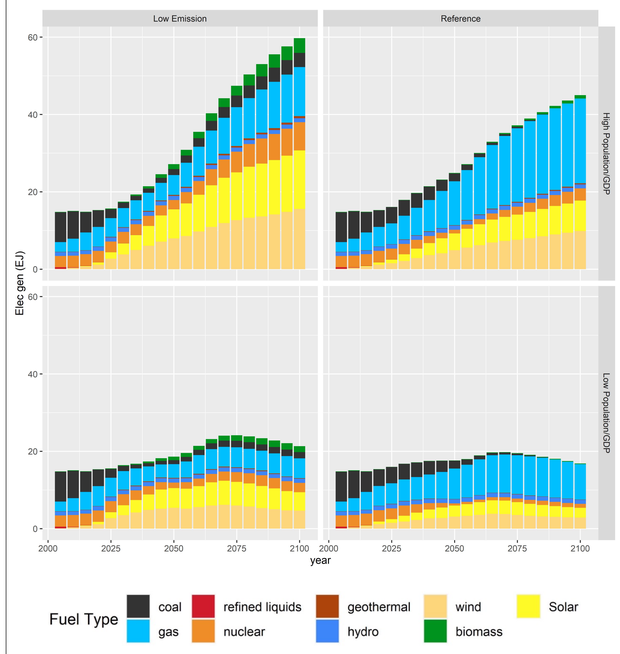
Methodology

The Global Change Analysis Model, USA version (**GCAM-USA**), is an integrated assessment model developed to assess the dynamics of the coupled human-Earth system and its response to global changes, with the US resolved at 50 states plus the District of Columbia.

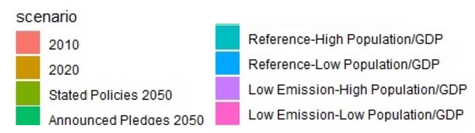
- State-level future electric power demand was projected under four scenarios:

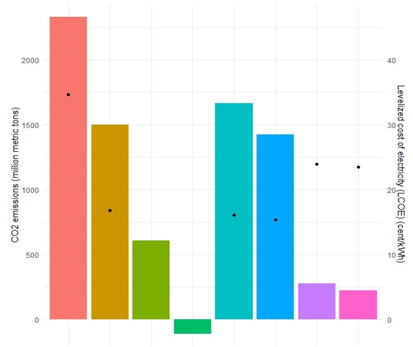
Scenarios		Socioeconomic Development	
		Low Population/GDP	High Population/GDP
Climate Change Mitigation	Reference	RCP6.0/SSP3 equivalent	RCP6.0/SSP5 equivalent
	Low emission	RCP2.6/SSP3 equivalent	RCP2.6/SSP5 equivalent

Results

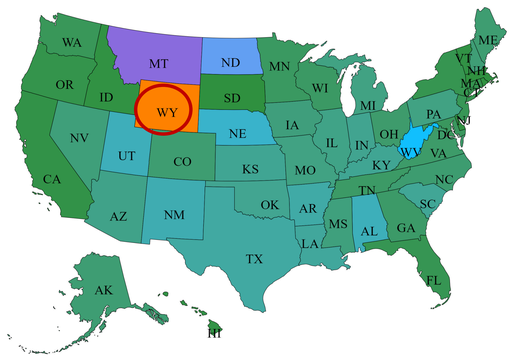


- **Higher** impact of **socioeconomic** development than **mitigation** on electric generation growth.
- A general **increase** in **renewable energy** shares.

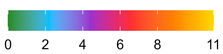




Low Emission

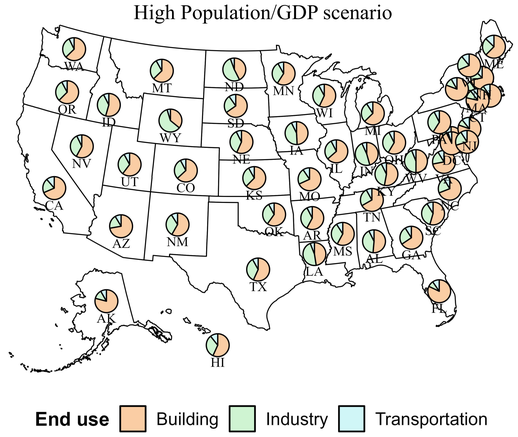


Higher values suggest other factors besides population growth dictate the increases in electricity generation.



$$\frac{normalized\ \Delta E}{normalized\ \Delta Pop}$$

End-use Electric Generation for each state in 2050s under Low emission and High Population/GDP scenario



- **Decrease** in electric generation in the second haft of the period for both **reference** scenarios, which is in line with the Population growth.
- Population growth dictates increases in electric generation **in most states, but not all**.

Conclusions

- The electric power sector will respond differently to top-down climate change mitigation at the state level.
- How each state responds will depend on mitigation, demographic dynamics, and economic structure and development.
- To minimize CO_2 emissions from power generation, more strict emission reduction policies and regulations are required to be employed.

Implication: Insights for future electric power system planning that meets demand, mitigation, and economic objectives, given the top-down climate change mitigation and socioeconomic development.

Future Work

Dive-in analysis for other electric grids or states, considering different state-level decarbonization in the electric sector.

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