

REMI Modeling of Emissions Peaking in the United States and China

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Model



REMI E3+ is the premier software solution for analyzing the macroeconomic and demographic impacts of any initiatives related to the energy and environmental sectors.

Decision-makers depend on E3+ to provide comprehensive evaluations of:

- ✓ The total economic impact of altering electric rates
- ✓ Introducing new power sources
- ✓ Investing in the production of energy
- ✓ And other policy changes

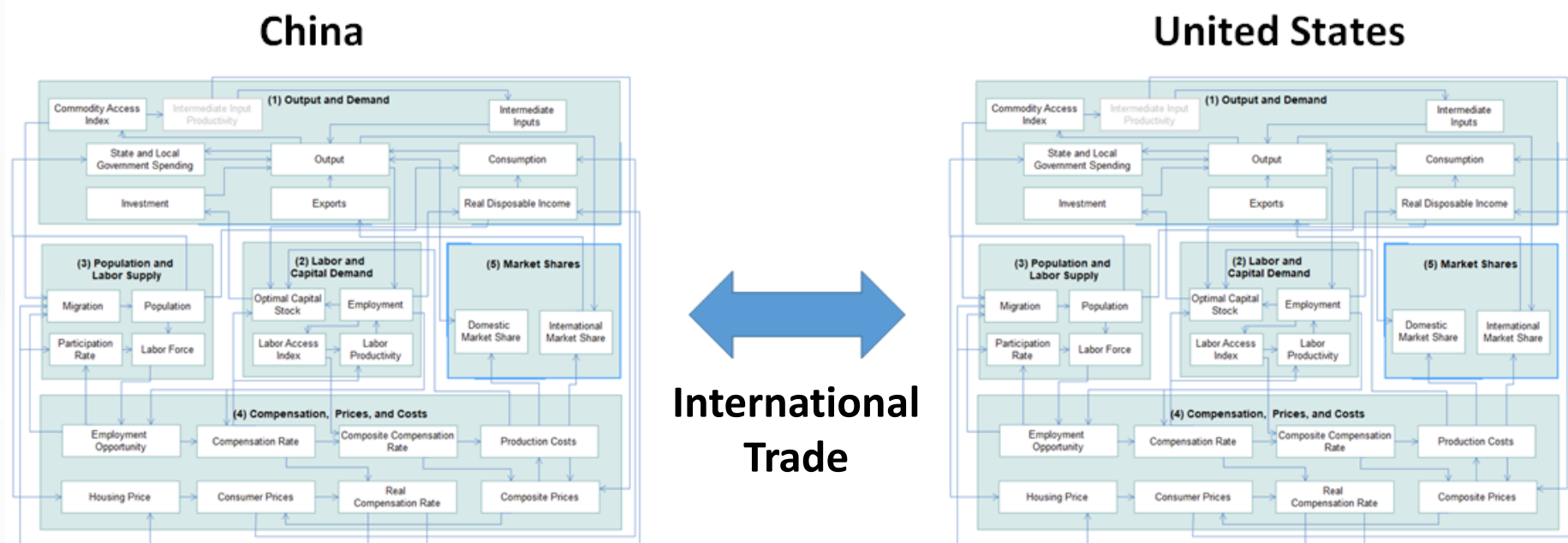


REMI PI+ is the premier software solution for examining public policies and producing dynamic macroeconomic impact analysis of public policy.

As our flagship model, PI+ specializes in generating realistic year-by-year estimates of the total local, state, and national effects of any specific policy initiative. PI+ is uniquely customizable to your region's economy:

- ü Detailed industrial sector data
- ü Accommodates region's economic and demographic projections

Interaction between the US and China



- Domestic policy: reduction in fuel use and innovation
- International policy: trade between US and China and has impact on domestic policy

REMI Model Simulations

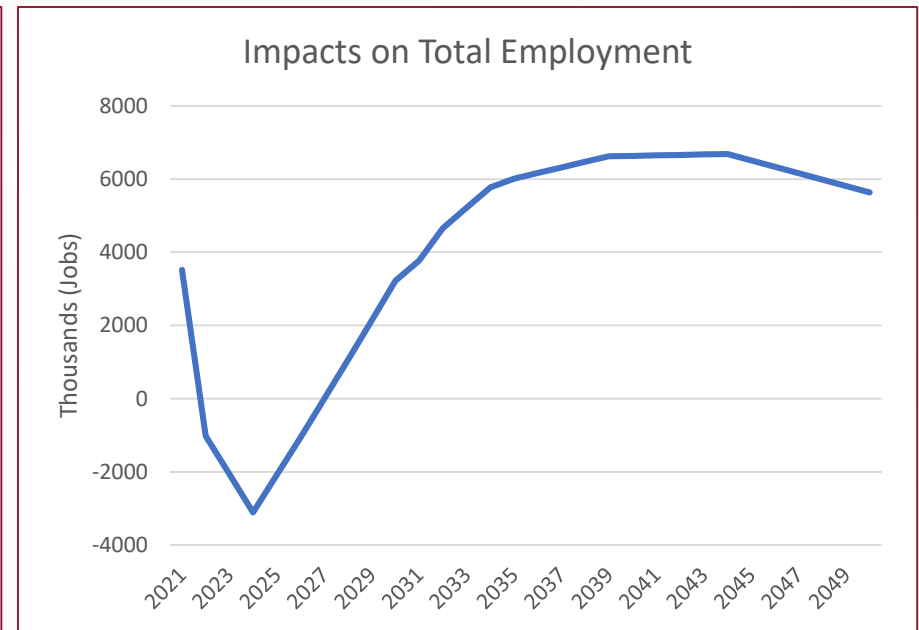
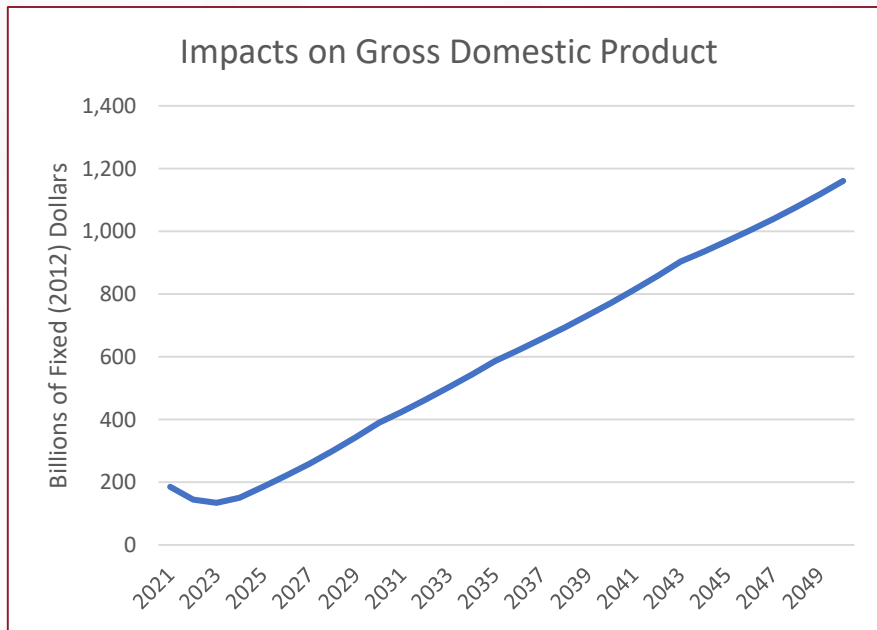
Simulations

- Scenarios
 - 1. National Energy Policy
 - 2. International Trade from National Energy Policy
 - Policy Variables Inputs
 - The United States E3+ Model, China PI+ Model
 - Results
 - Economic Impacts
 - Environmental (CO2 Emissions) Impacts
- Summary
 - National Energy Policy and International Trade from National Energy Policy

1. National Energy Policy

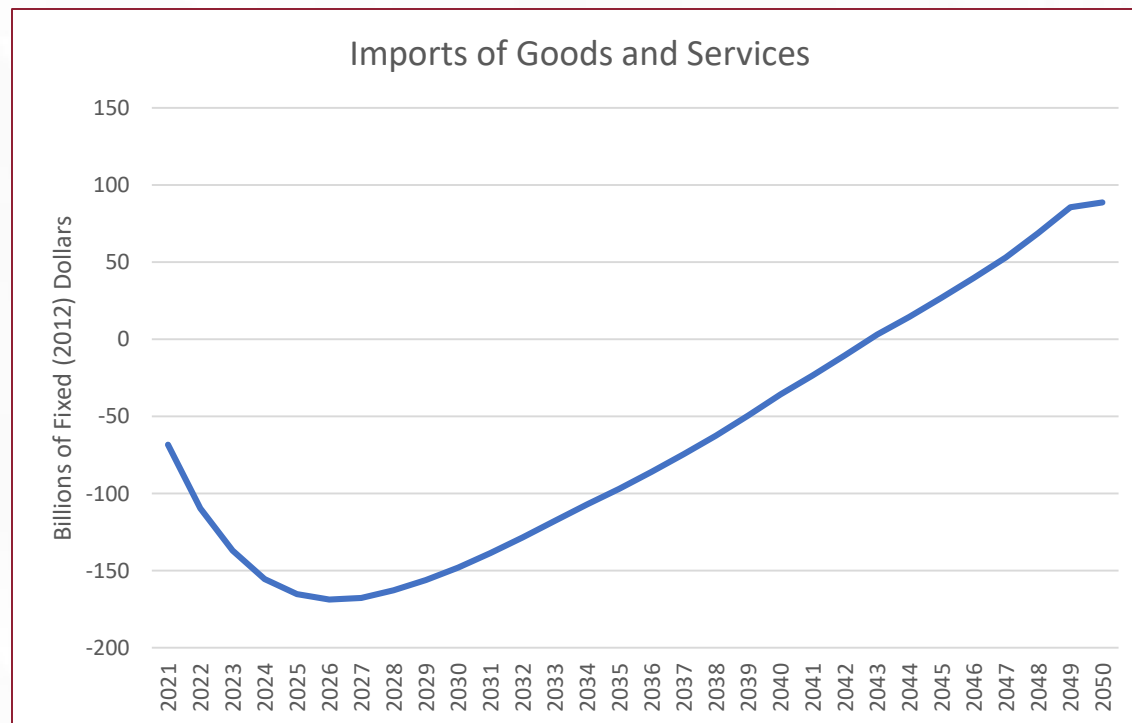
1. China Energy Policy

- Economic Impacts (Difference)



1. China Energy Policy

- Economic Impacts: Imports of Goods and Services

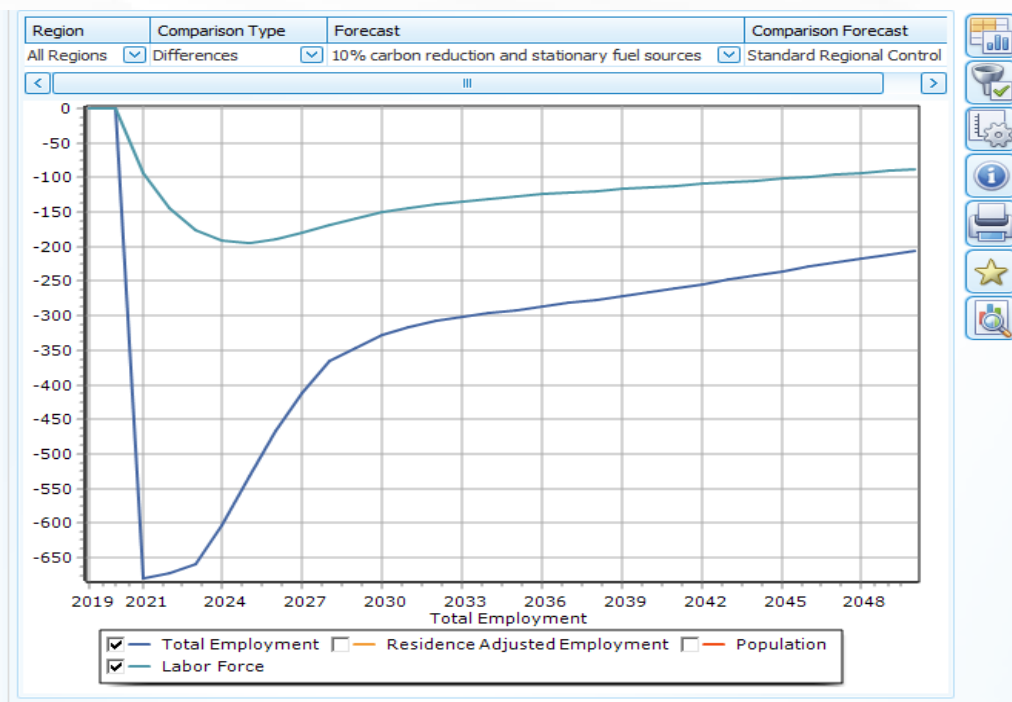


1. US Energy Policy

- Inputs
 - Years 2021 to 2050
 - 1. Increase in Fuel Cost: +10%
 - 2. Decrease in Production Cost: starting at 0 in 2021 and scaling down to -0.2% by 2050
 - 3. Both 10% increase in Fuel Cost and 0.2% decrease in Production Cost

1. US Energy Policy

- 1. Results from 10% increase in Fuel Cost
 - Total Employment & Labor Force



what does REMI say? sm

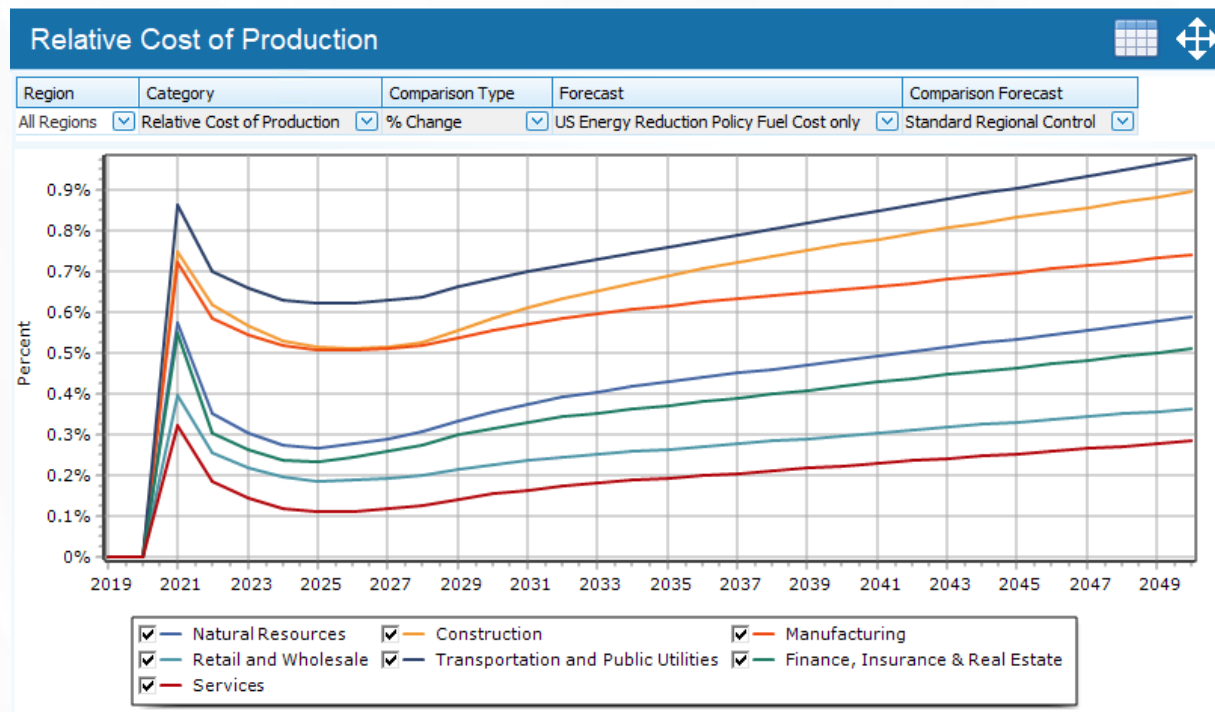
1. US Energy Policy

- 1. Results from 10% increase in Fuel Cost
- Relative Fuel Cost

Region	Category	Comparison Type	Forecast										Comparison Forecast
All Regions	Relative Fuel Costs	% Change	10% carbon reduction and stationary fuel sources										Standard Regional Control
Industries	Units	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	
Home health care services	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+
Hospitals; private	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+
Nursing and residential care facilities	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+
Individual and family services; Communit	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+
Child day care services	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+
Performing arts companies; Promoters of	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+
Spectator sports	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+
Independent artists, writers, and perform	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+
Museums, historical sites, and similar inst	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+
Amusement, gambling, and recreation in	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+
Accommodation	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+
Food services and drinking places	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+
Automotive repair and maintenance	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+
Electronic and precision equipment repair	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+
Commercial and industrial machinery and	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+
Personal and household goods repair and	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+
Personal care services	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+
Death care services	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+
Drycleaning and laundry services	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+
Other personal services	Percent	0.000%	0.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+10.000%	+

1. Energy Policy: The US

- 1. Results from 10% increase in Fuel Cost
 - Relative Cost of Production



1. US Energy Policy

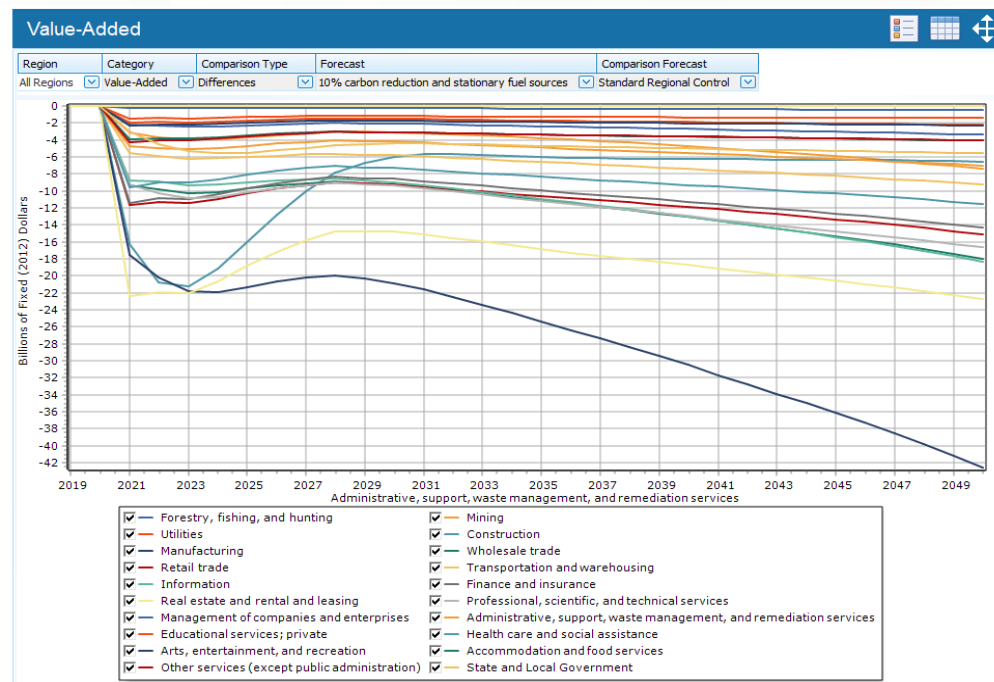
- 1. Results from 10% increase in Fuel Cost
 - Output by Industry

Output										
Region	Category	Comparison Type	Forecast				Comparison Forecast			
All Regions	Output	Differences	US Energy Reduction Policy				Standard Regional Control			
Industries	Units	2021	2022	2023	2024	2025	2026	2027	2028	2029
Forestry, fishing, and hunting	Billions of Fixed (2012) Dollars	-0.318	-0.389	-0.429	-0.435	-0.425	-0.411	-0.400	-0.389	-0.378
Mining	Billions of Fixed (2012) Dollars	-5.828	-6.999	-7.532	-7.416	-6.993	-6.505	-6.060	-5.644	-5.257
Utilities	Billions of Fixed (2012) Dollars	-3.164	-3.074	-3.131	-3.004	-2.810	-2.639	-2.509	-2.378	-2.247
Construction	Billions of Fixed (2012) Dollars	-30.722	-39.151	-39.901	-35.918	-29.890	-23.819	-18.594	-13.369	-8.144
Manufacturing	Billions of Fixed (2012) Dollars	-47.732	-55.230	-59.903	-60.614	-59.467	-58.043	-57.062	-56.081	-55.099
Wholesale trade	Billions of Fixed (2012) Dollars	-15.346	-16.158	-16.827	-16.537	-15.824	-15.149	-14.658	-14.167	-13.676
Retail trade	Billions of Fixed (2012) Dollars	-19.339	-18.743	-18.786	-17.974	-16.841	-15.865	-15.136	-14.407	-13.678
Transportation and warehousing	Billions of Fixed (2012) Dollars	-10.353	-11.032	-11.584	-11.534	-11.201	-10.858	-10.592	-10.326	-10.060
Information	Billions of Fixed (2012) Dollars	-15.324	-15.219	-15.898	-15.709	-15.151	-14.642	-14.270	-13.898	-13.526
Finance and insurance	Billions of Fixed (2012) Dollars	-21.038	-19.955	-20.044	-19.038	-17.658	-16.484	-15.617	-14.750	-13.883
Real estate and rental and leasing	Billions of Fixed (2012) Dollars	-32.159	-31.505	-31.688	-29.697	-26.994	-24.549	-22.631	-20.713	-18.795
Professional, scientific, and technical services	Billions of Fixed (2012) Dollars	-14.025	-15.540	-16.469	-16.237	-15.477	-14.703	-14.091	-13.479	-12.867
Management of companies and enterprises	Billions of Fixed (2012) Dollars	-3.406	-3.573	-3.712	-3.629	-3.451	-3.282	-3.153	-3.024	-2.895
Administrative, support, waste management and remediation services	Billions of Fixed (2012) Dollars	-7.945	-8.182	-8.460	-8.219	-7.757	-7.319	-6.977	-6.635	-6.293
Educational services; private	Billions of Fixed (2012) Dollars	-2.215	-2.109	-2.133	-2.058	-1.942	-1.840	-1.764	-1.688	-1.612
Health care and social assistance	Billions of Fixed (2012) Dollars	-15.414	-14.556	-14.573	-13.907	-12.956	-12.169	-11.607	-11.045	-10.483
Arts, entertainment, and recreation	Billions of Fixed (2012) Dollars	-3.700	-3.447	-3.462	-3.316	-3.111	-2.936	-2.803	-2.670	-2.537
Accommodation and food services	Billions of Fixed (2012) Dollars	-7.079	-6.702	-6.733	-6.471	-6.100	-5.782	-5.540	-5.298	-5.056
Other services (except public administration)	Billions of Fixed (2012) Dollars	-7.043	-6.535	-6.492	-6.158	-5.726	-5.363	-5.091	-4.819	-4.547

what does REMI say? sm

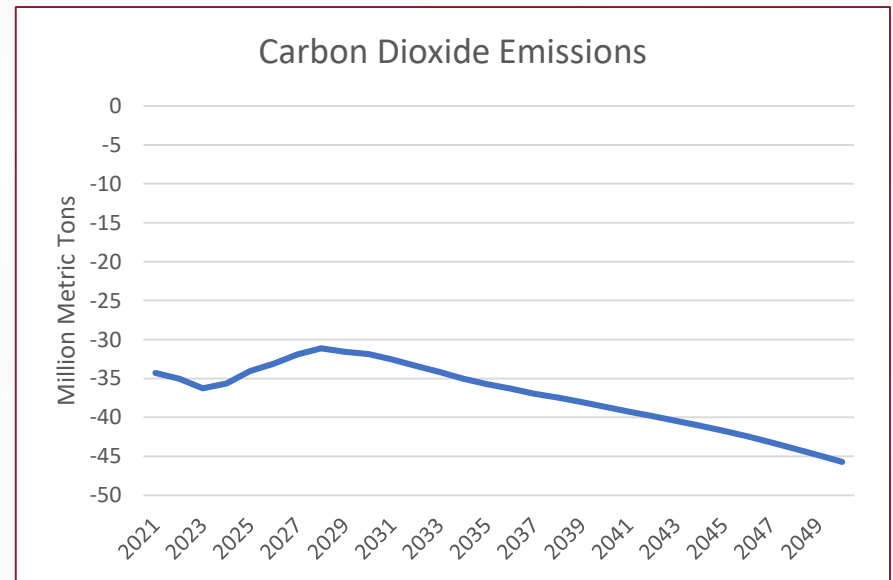
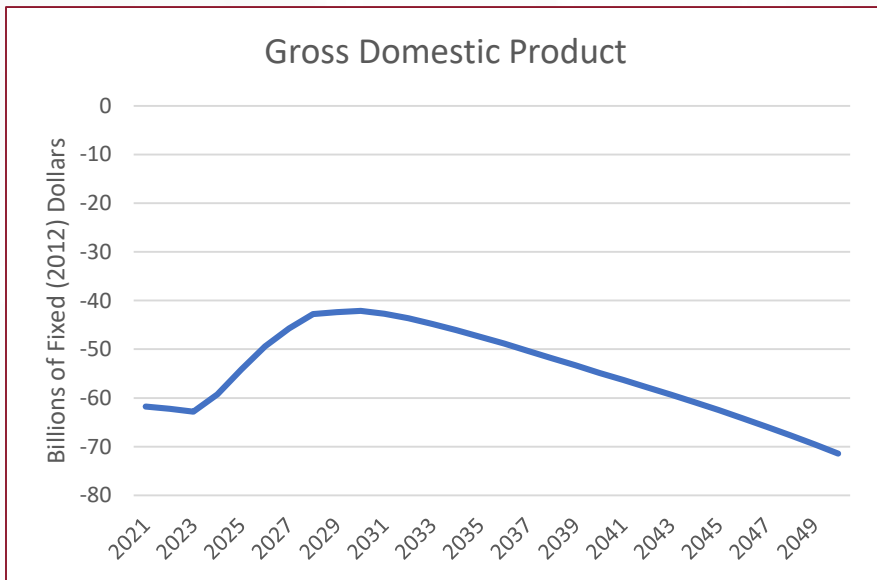
1. US Energy Policy

- 1. Results from 10% increase in Fuel Cost
 - Value Added by Industry



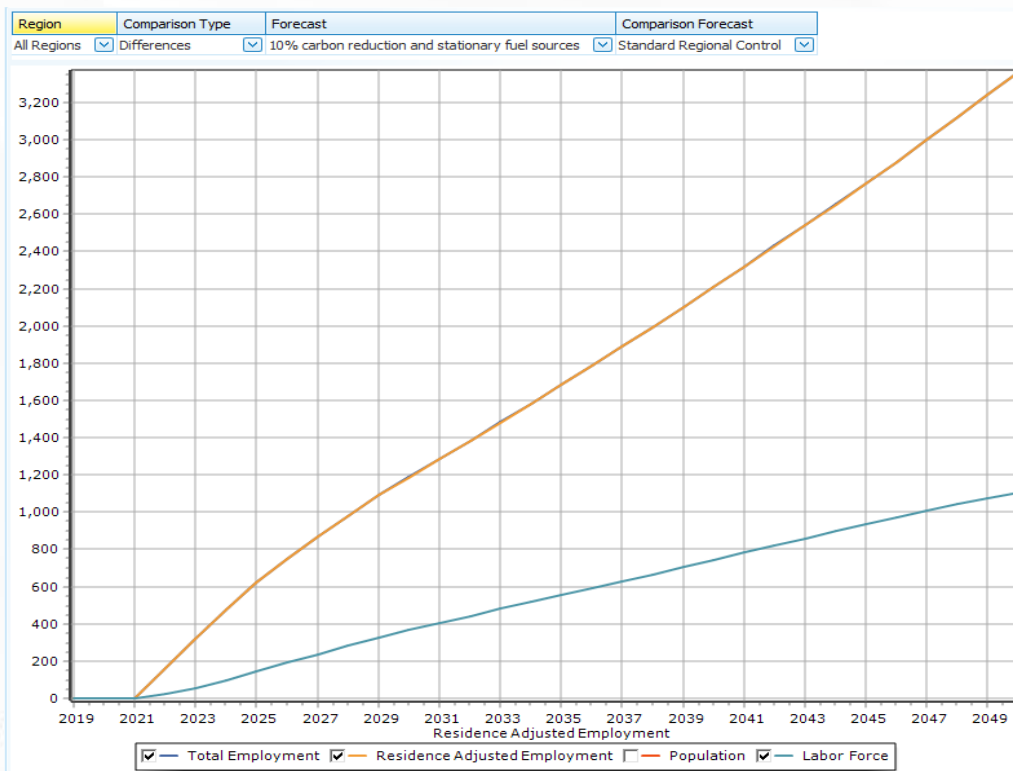
1. US Energy Policy

- 1. Results from 10% increase in Fuel Cost
 - Impacts on GDP & Carbon Dioxide Emissions



1. US Energy Policy

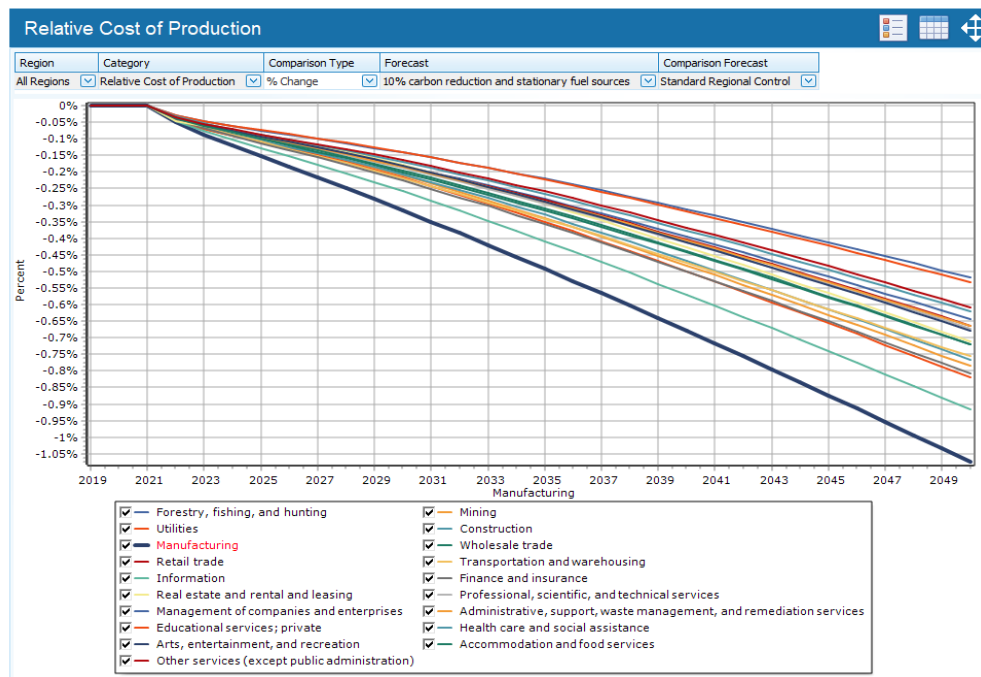
- 2. Results from 0.2% decrease in Production Cost
 - Employment and Labor Force



what does REMI say? sm

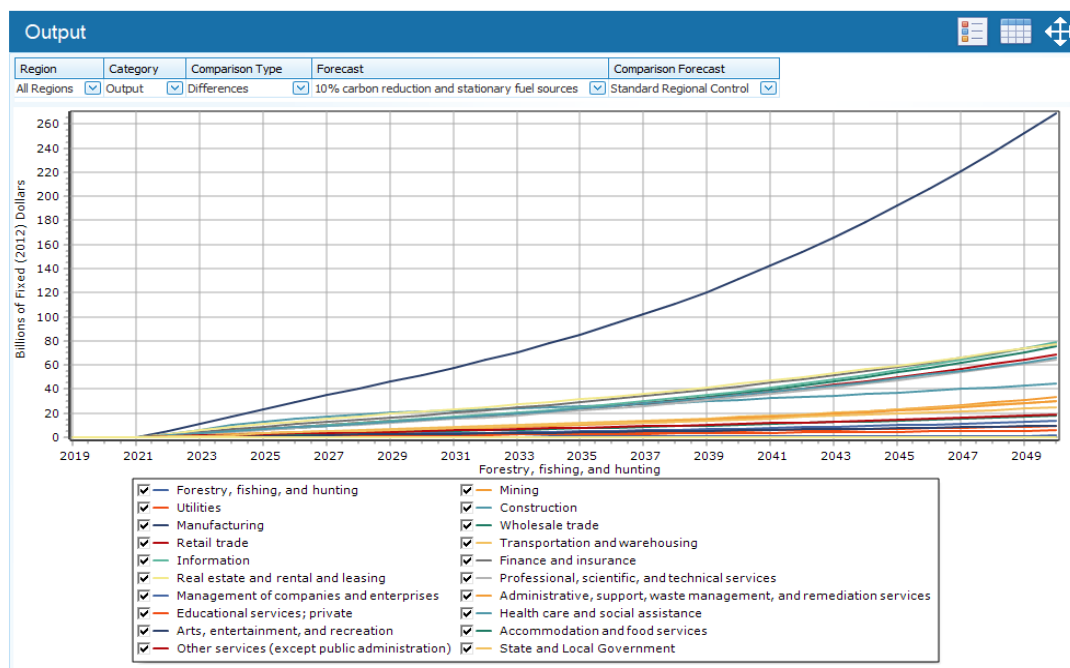
1. US Energy Policy

- 2. Results from 0.2% decrease in Production Cost
 - Relative Cost of Production



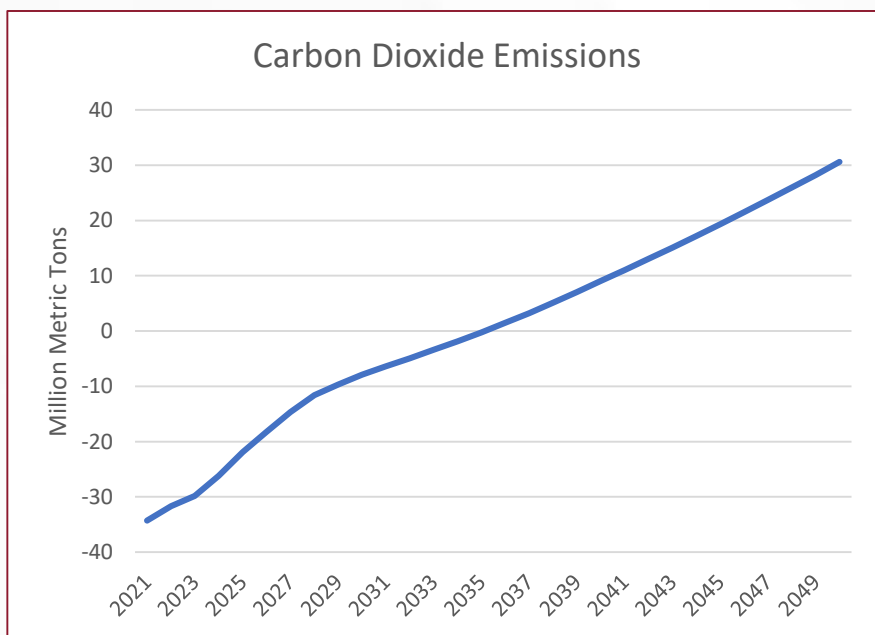
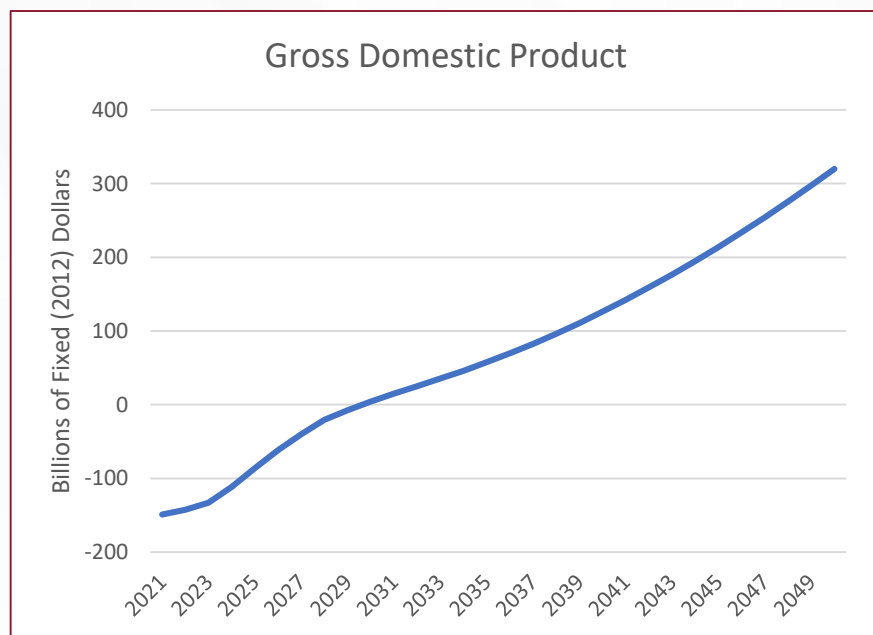
1. US Energy Policy

- 2. Results from 0.2% decrease in Production Cost
 - Output by Industry



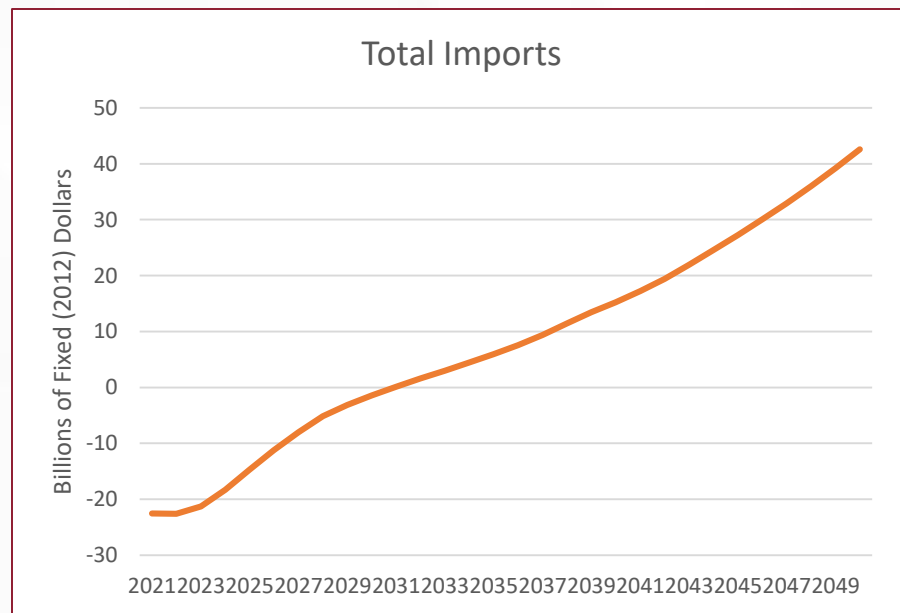
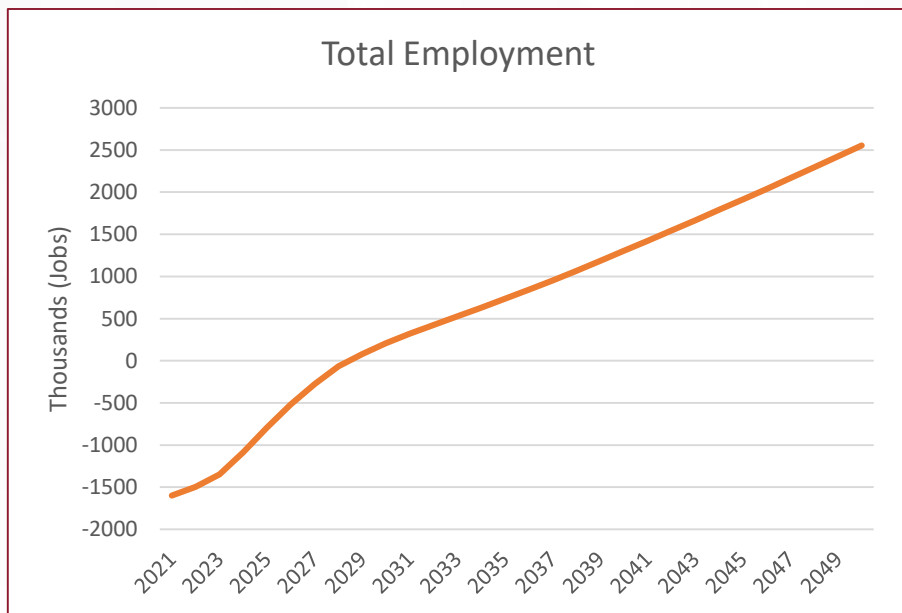
1. US Energy Policy

- 3. Results from 10% increase in Fuel Cost and 0.2% decrease in Production Cost (Differences)



1. US Energy Policy

- 3. Results from 10% increase in Fuel Cost and 0.2% decrease in Production Cost (Differences)



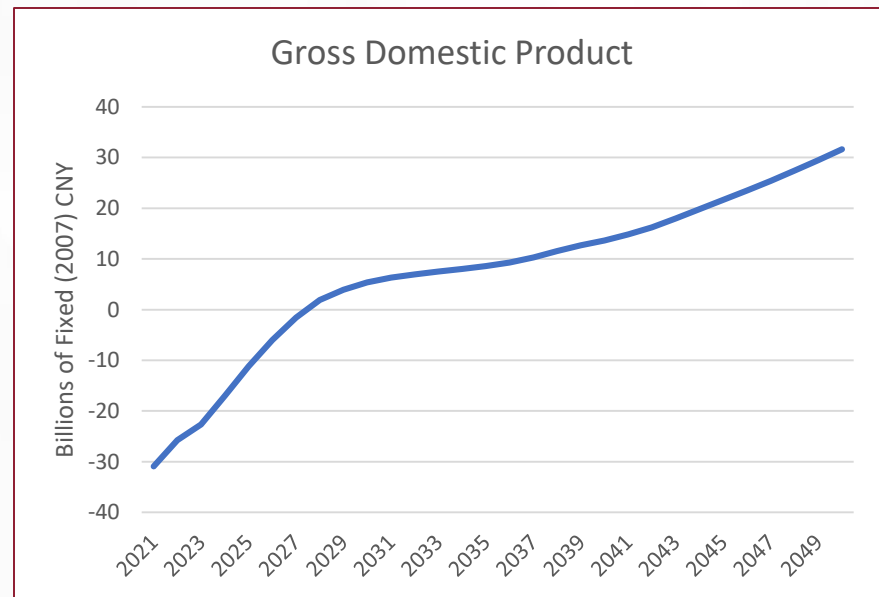
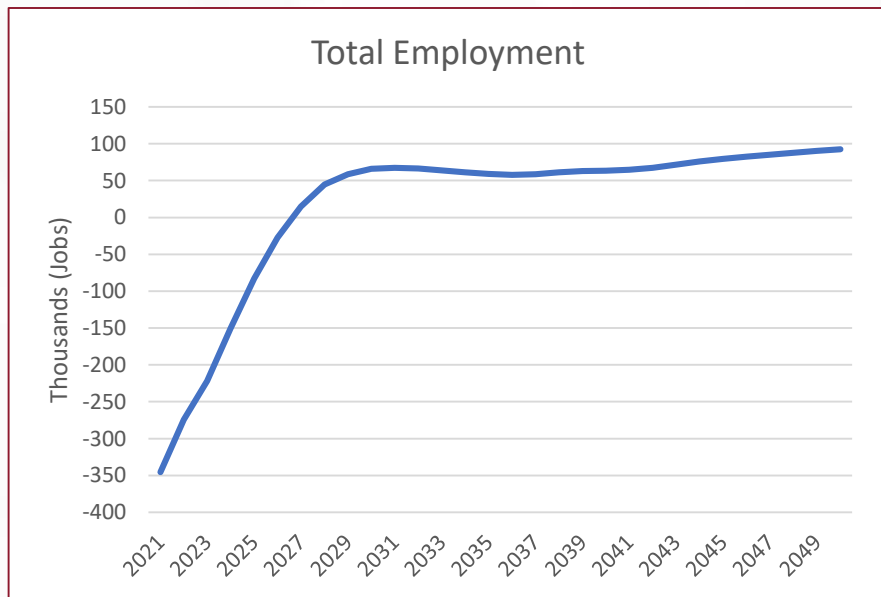
2. International Trade

2. China Trade

- Inputs
 - Effect of exports from China being reduced and that corresponding change in US imports from that simulation
 - Policy Variable: Industry Sales (International Exports from China to US)
 - $\% \text{ US imports from China} = \frac{\text{US imports from China}}{\text{Total US imports}} = 17.91\%$
 - $\text{Exports from China to US} = \text{Change in Total US Imports} * \% \text{ US imports from China (17.91\%)}$

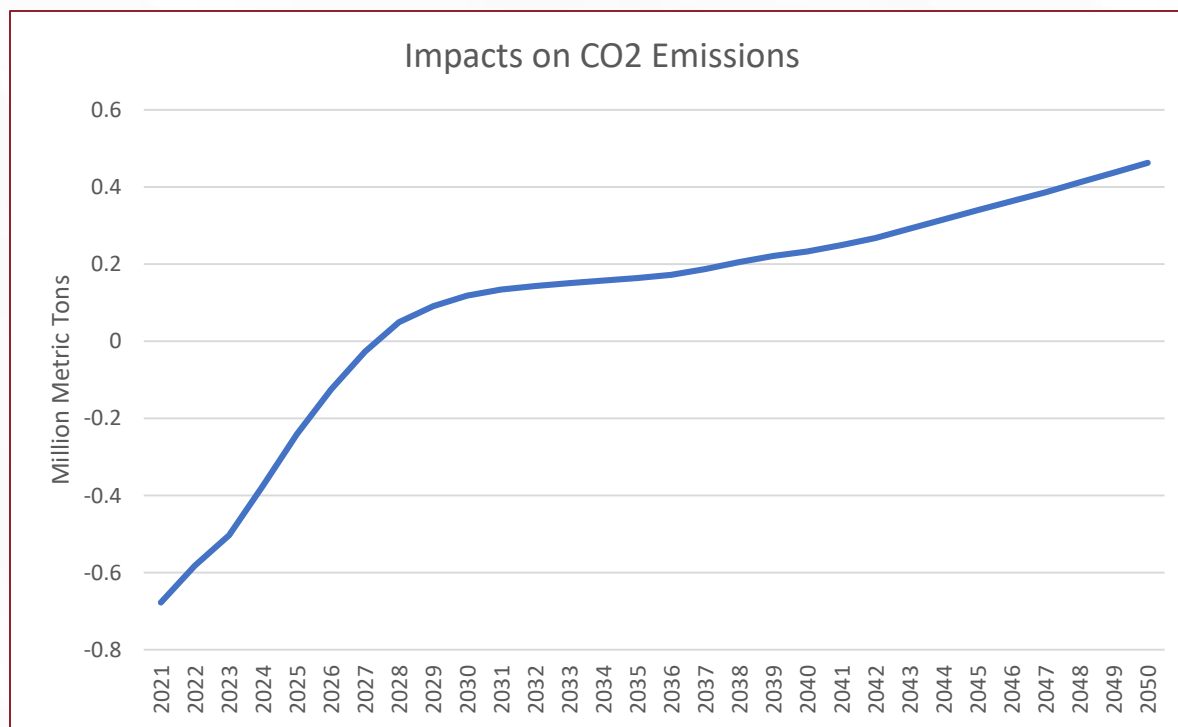
2. China Trade

- Economic Impacts: Differences from baseline



2. China Trade

- Environmental Impacts: Carbon Emissions



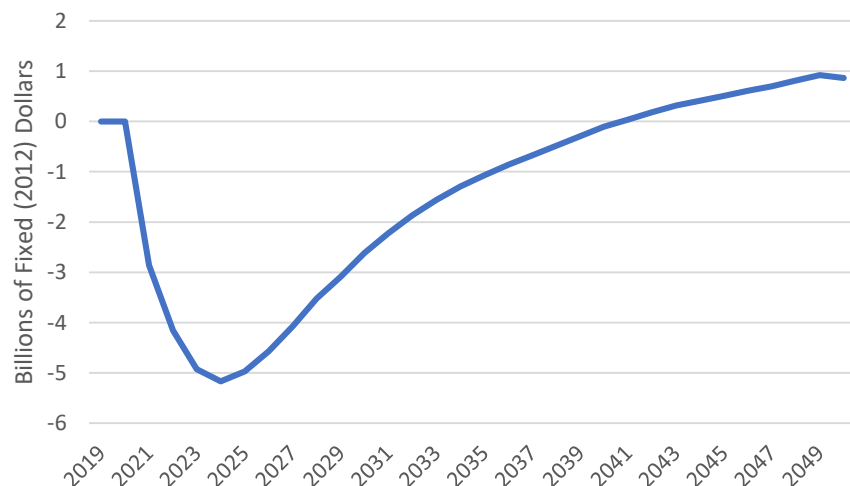
2. US Trade

- Inputs
 - Effect of exports to China being reduced and that corresponding change in US exports from that simulation
 - Policy Variable: Industry Sales (International Exports from US to China)
 - $\% \text{ China imports from US} = \text{China imports from US} / \text{Total China imports} = 2.88\%$
 - $\text{Exports from US to China} = \text{Change in Total China Imports} * \% \text{ China imports from US} (2.88\%)$

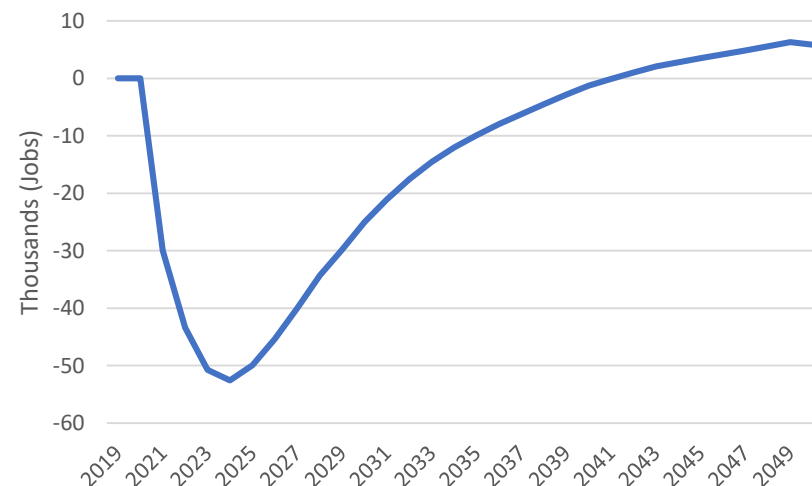
2. US Trade

- Economic Impacts: Differences from baseline

Gross Domestic Product

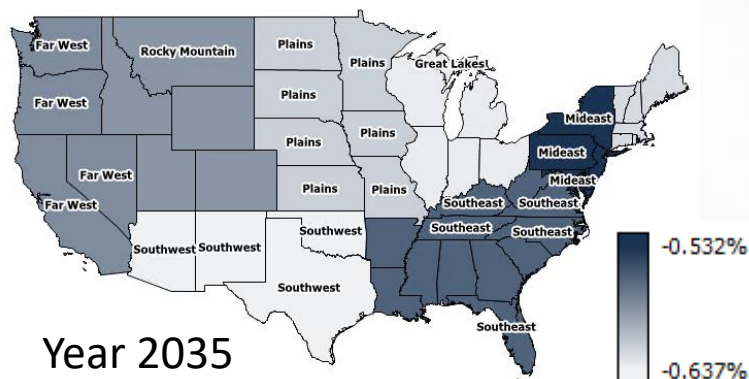
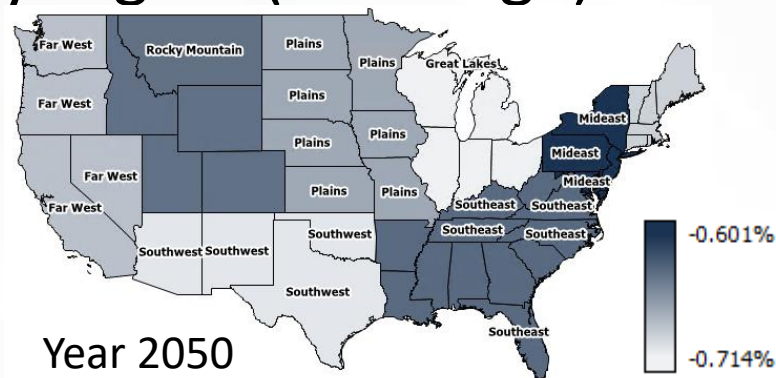
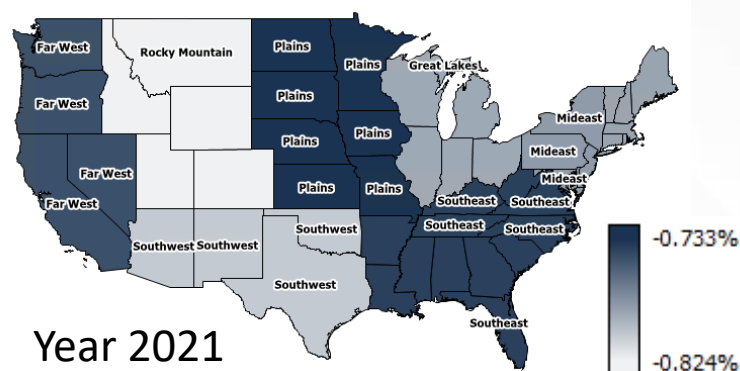


Total Employment



2. US Trade

- Economic Impacts: GDP by region (% change)

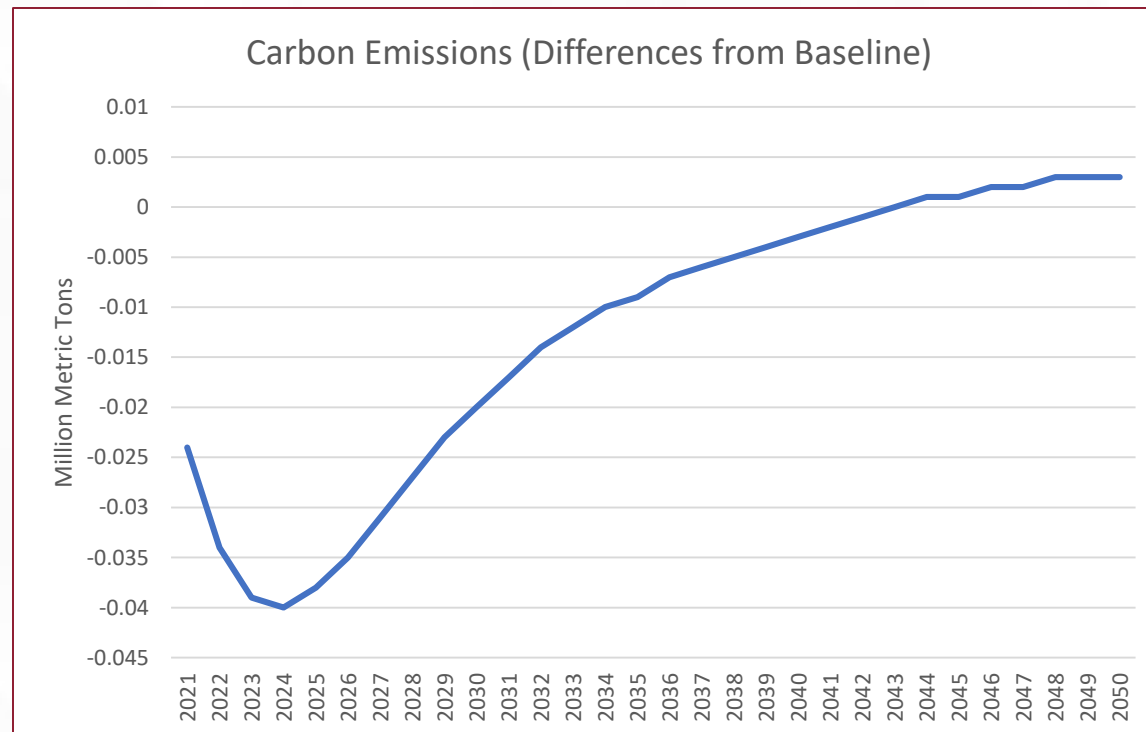


Region	Units	2021	2035	2050
All Regions	Percent	-0.77%	-0.59%	-0.67%
New England	Percent	-0.79%	-0.63%	-0.70%
Mideast	Percent	-0.78%	-0.53%	-0.60%
Great Lakes	Percent	-0.79%	-0.63%	-0.71%
Plains	Percent	-0.73%	-0.62%	-0.67%
Southeast	Percent	-0.74%	-0.56%	-0.63%
Southwest	Percent	-0.81%	-0.64%	-0.71%
Rocky Mountain	Percent	-0.82%	-0.59%	-0.64%
Far West	Percent	-0.75%	-0.58%	-0.69%

what does REMI say? sm

2. US Trade

- Environmental Impacts: Carbon Emissions



Summary Policy & Trading

Summary

- Impacts on Carbon Emissions (Million Metric Tons)
 - Years 2021-2050

	Policy	Trading	Total
China	-33.20	3.03	-30.17
United States	-10.57	-0.39	-10.96
Total	-43.77	2.64	-41.13

Q & A

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