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United States Environmental Protection Agency

A method for identifying challenges to air quality management and developing robust management strategies

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Office of Research and Development
Center for Environmental Measurement and Modeling

Project Background

- Tailoring GCAM-USA to support state policy decision making and address state needs
- “Identify emerging challenges to air quality management and GHG mitigation”

Project Background

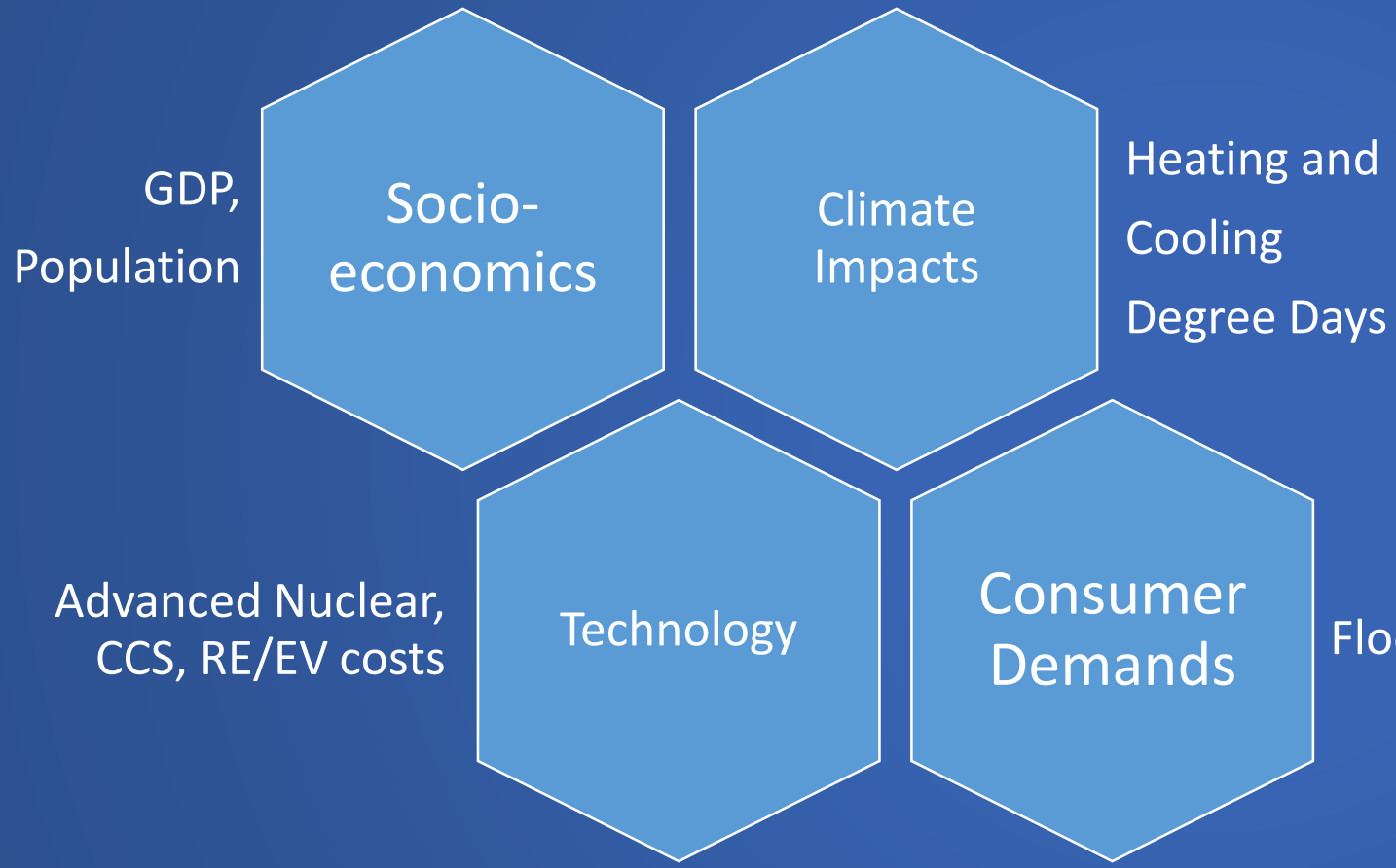
- Tailoring GCAM-USA to support state policy decision making and address state needs
- “Identify emerging challenges to air quality management and GHG mitigation”
  - Time horizon to 2050
  - From predictive to possible
  - Addressing these challenges

Modeling Approach

Large scenario set

- 2-3 levels of each scenario dimension
- Policy combinations

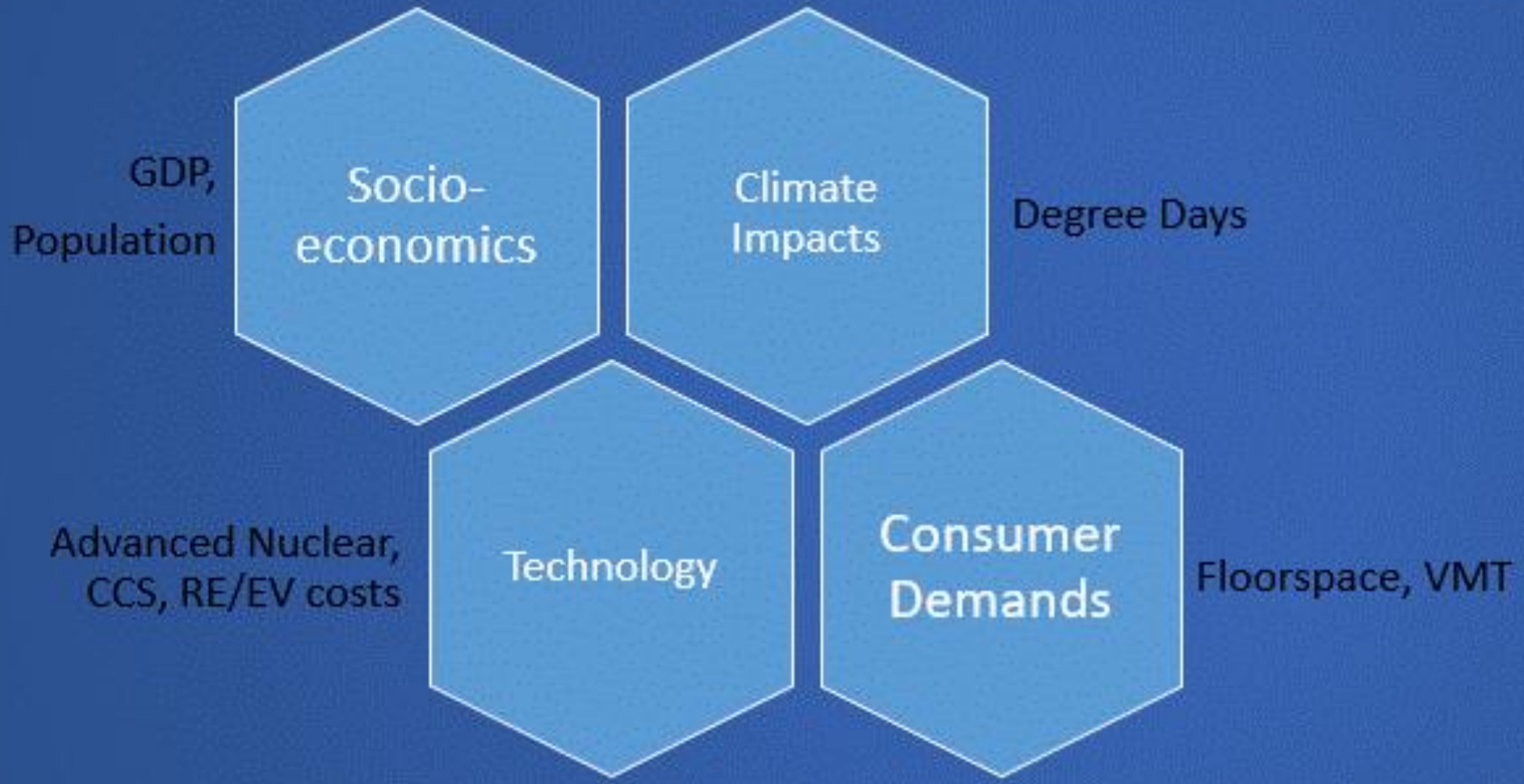
Modeling Approach



Large scenario set

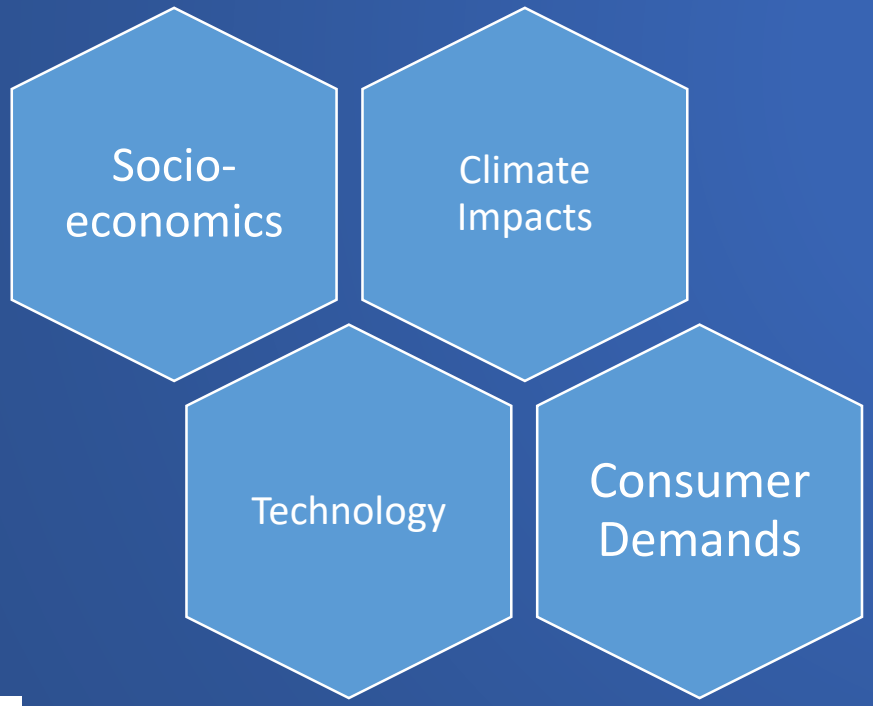
- 2-3 levels of each scenario dimension
- Policy combinations

Scenario Dimensions



Scenario Dimensions

Policies	
Transportation	Building
Electricity	Industry



Outcomes
Emissions
Prices
Demand

Stakeholder Engagement

- Choice of dimensions and policies informed by stakeholders
  - CO, MD, NC, OR, VA and MARAMA
- Primary interest in policy

Experimental Design

- Example based on the transportation sector
- National CO_2 emissions
- Four dimensions, 2-3 levels
  - Socioeconomics
  - ZEV Policy
  - Transportation Demand
  - Load Factor

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SSP3: Low population and GDP growth

SSP2: Reference case

SSP5: High population and GDP growth

Experimental Design

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None: Market-driven ZEV share (8-15% in 2050)

ZEV policy: High ZEV share (50-85% in 2050)

Experimental Design

- Example based on the transportation sector
- National CO_2 emissions
- Four dimensions, 2-3 levels
  - Socioeconomics
  - ZEV Policy
  - Transportation Demand
  - Load Factor

Low:
20% decrease from reference in 2050

Medium:
Reference

High:
20% increase from reference in 2050

Experimental Design

- Example based on the transportation sector
- National CO_2 emissions
- Four dimensions, 2-3 levels
  - Socioeconomics
  - ZEV Policy
  - Transportation Demand
  - Load Factor

(people per vehicle)

Low:
25% decrease from reference in 2050

Medium:
Reference

High:
25% increase from reference in 2050

Experimental Design

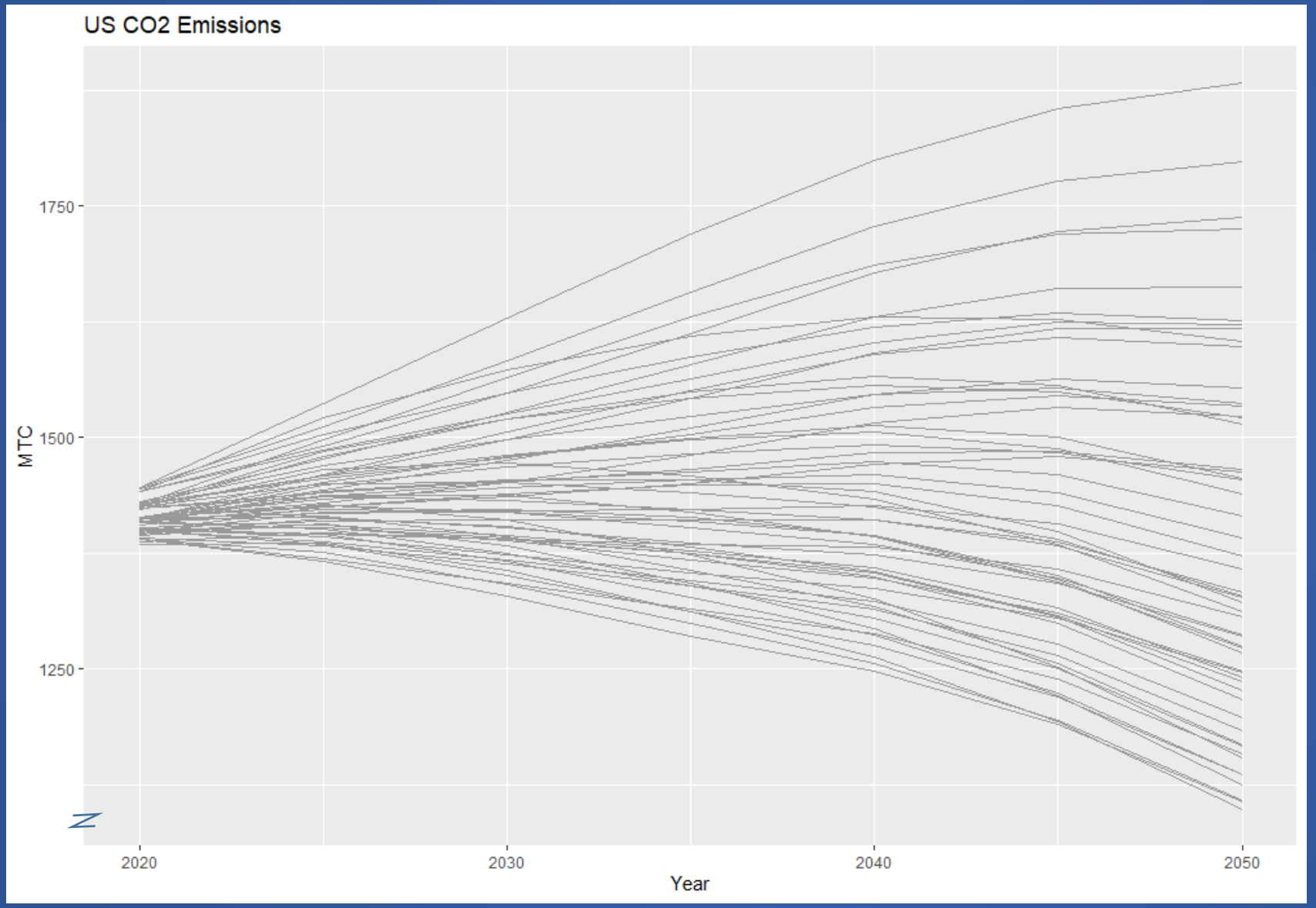
- Example based on the transportation sector
- National CO_2 emissions
- Four dimensions, 2-3 levels
  - Socioeconomics
  - ZEV Policy
  - Transportation Demand
  - Load Factor

54 combinations

Analysis

- Visual factor mapping
  - Tables and parallel axes plots for scenarios with specified outcomes
- Scenario identification through regression trees
  - What dimensions have the greatest impact on outcomes?

Illustrative Results

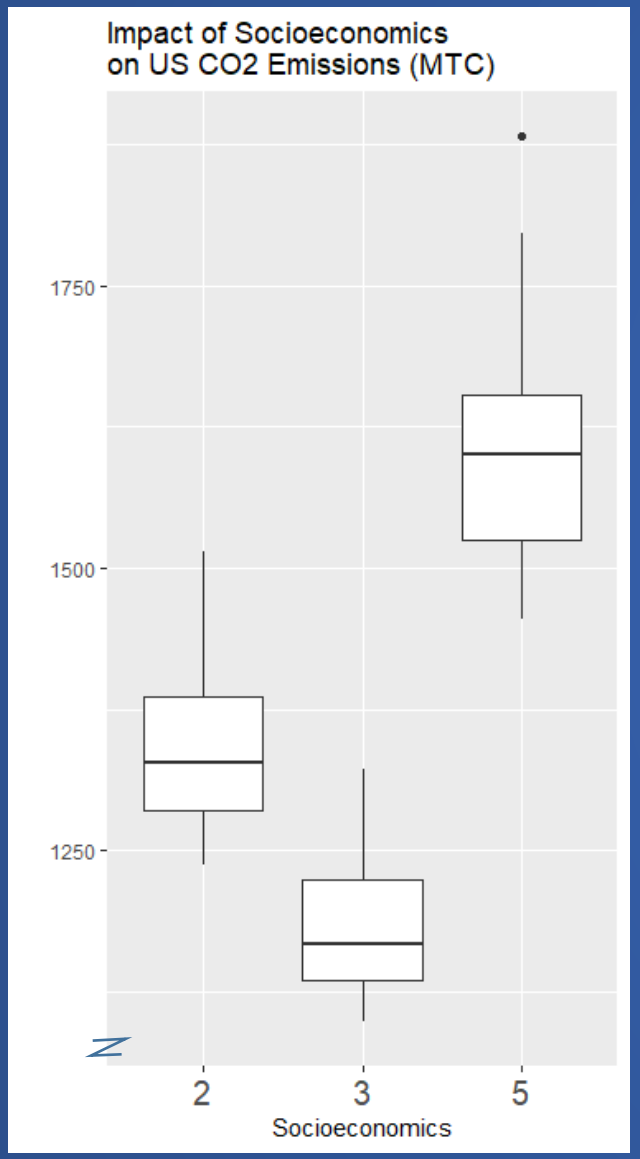


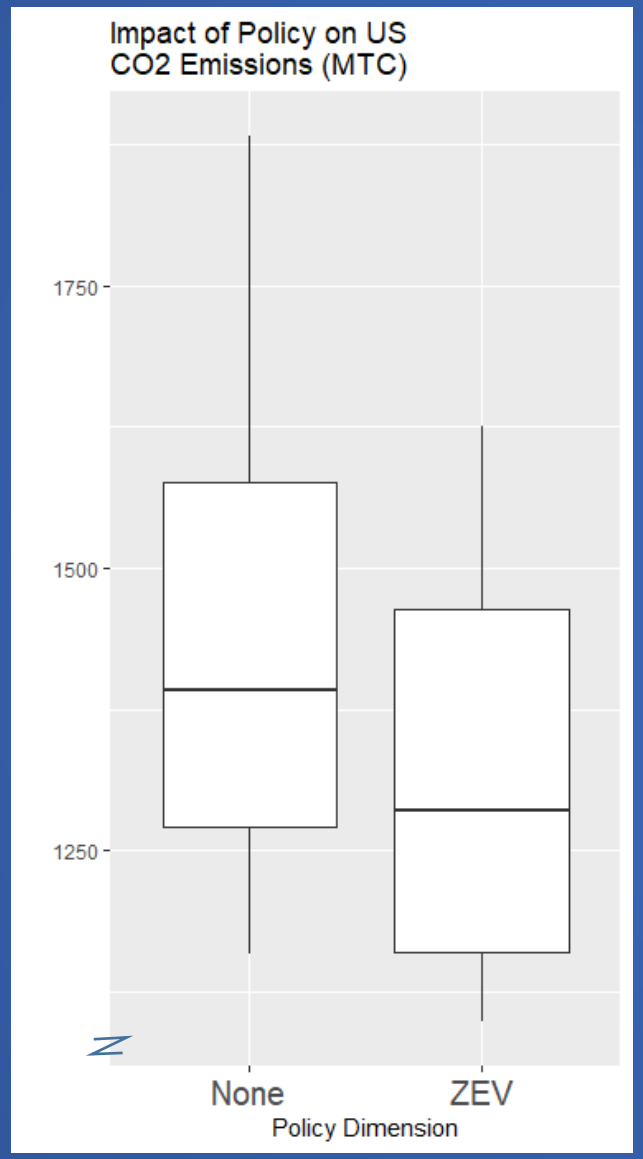
Highest Emissions:
1880 MTC

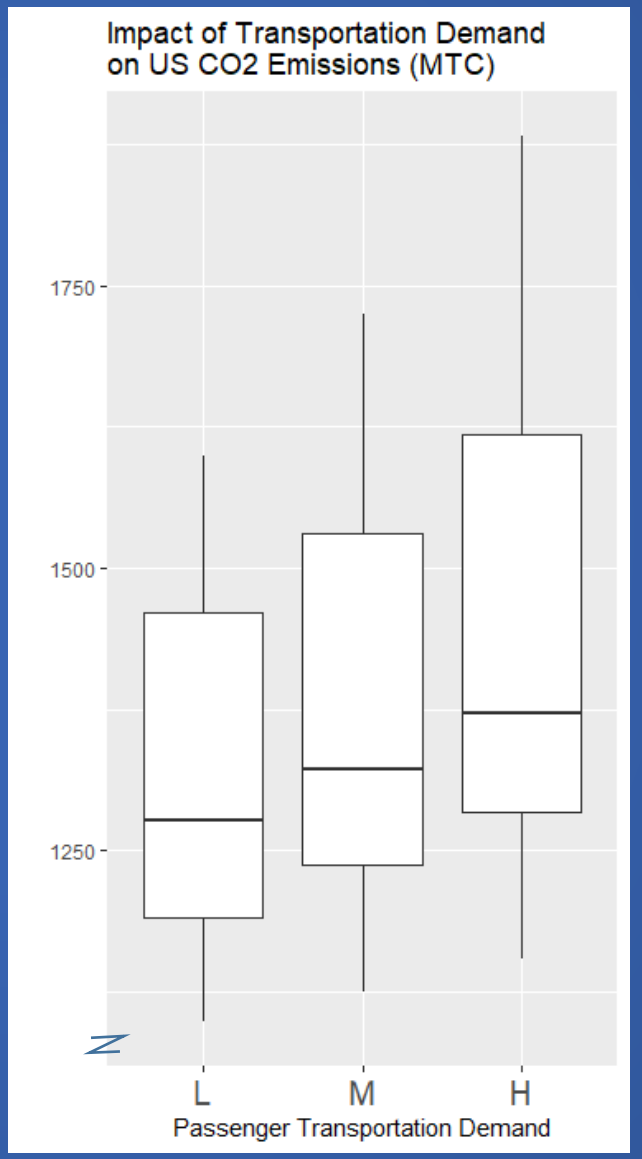
Median Emissions:
1330 MTC

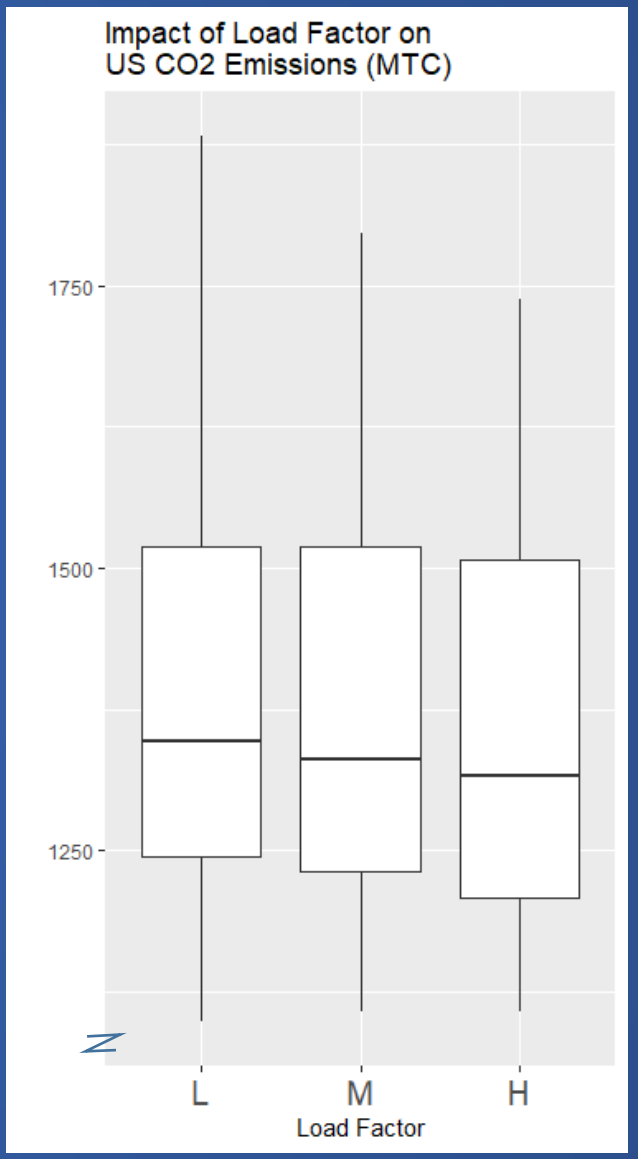
Lowest Emissions:
1100 MTC

Illustrative Results









Illustrative Results

80th Percentile

High Emissions

Total Emissions (MTC)	Emissions % from Median	Socioeconomics	Policy	Transportation Demand	Load Factor
1880	42%	SSP5	None	High	Low
1800	35%	SSP5	None	High	Medium
1740	31%	SSP5	None	High	High
1720	30%	SSP5	None	Medium	Low
1660	25%	SSP5	None	Medium	Medium
1630	22%	SSP5	ZEV	High	Medium
1620	22%	SSP5	ZEV	High	High
1620	22%	SSP5	None	Medium	High
1600	21%	SSP5	ZEV	High	Low
1600	20%	SSP5	None	Low	Low
1550	17%	SSP5	None	Low	Medium

Illustrative Results

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1620	22%	SSP5	None	Medium	High
1600	21%	SSP5	ZEV	High	Low
1600	20%	SSP5	None	Low	Low
1550	17%	SSP5	None	Low	Medium

Illustrative Results

20th Percentile

Low Emissions

Total Emissions (MTC)	Emissions % from Median	Socioeconomics	Policy	Transportation Demand	Load Factor
1100	-17%	SSP3	ZEV	Low	Low
1110	-17%	SSP3	ZEV	Low	High
1110	-17%	SSP3	ZEV	Low	Medium
1130	-15%	SSP3	ZEV	Medium	Low
1140	-14%	SSP3	ZEV	Medium	High
1140	-14%	SSP3	ZEV	Medium	Medium
1150	-13%	SSP3	ZEV	High	Low
1160	-13%	SSP3	None	Low	High
1170	-12%	SSP3	ZEV	High	High
1170	-12%	SSP3	ZEV	High	Medium
1180	-11%	SSP3	None	Low	Medium

Illustrative Results

20th Percentile

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1160	-13%	SSP3	None	Low	High
1170	-12%	SSP3	ZEV	High	High
1170	-12%	SSP3	ZEV	High	Medium
1180	-11%	SSP3	None	Low	Medium

Illustrative Results

Key = Mean CO_2 Emissions (MTC)

Full set

Illustrative Results

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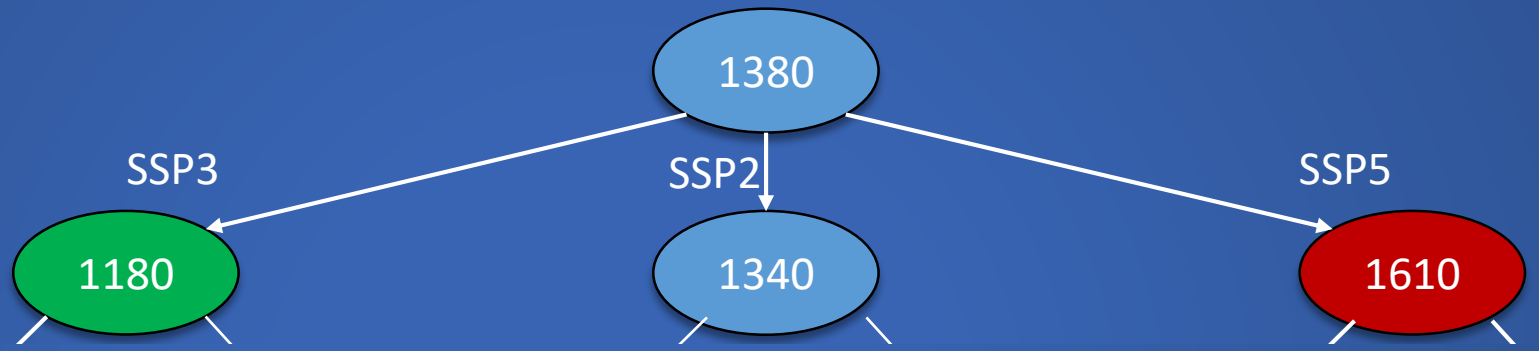
Full set

Socioeconomics



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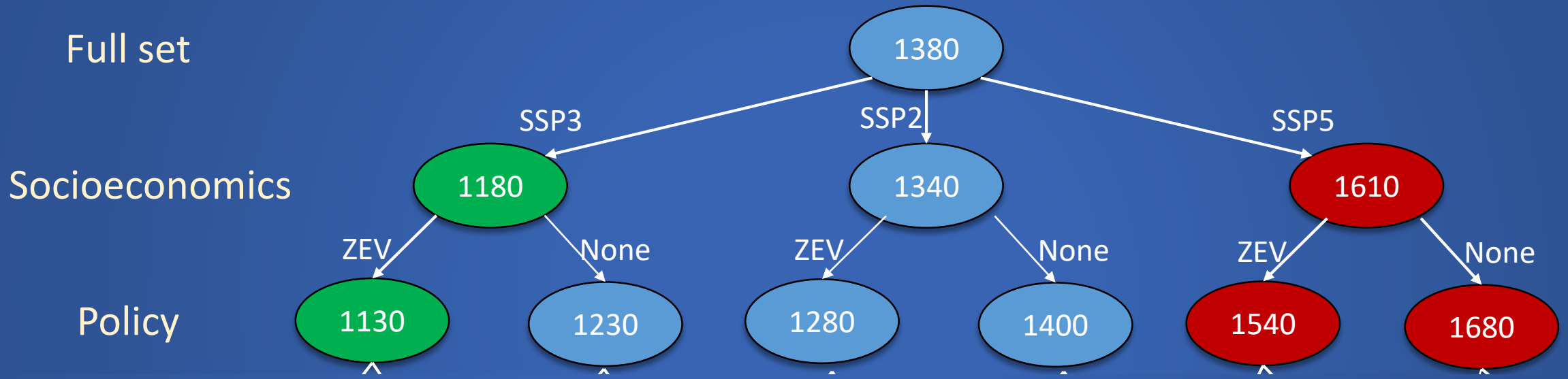

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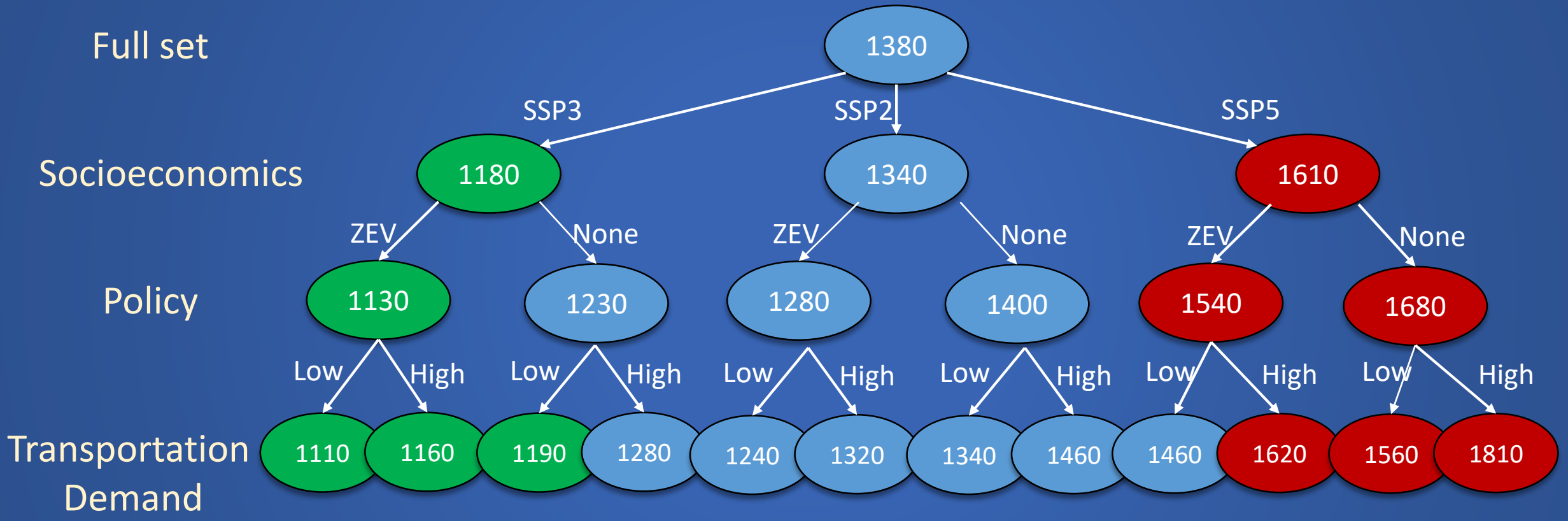

Observations

- Policy insights
  - Population growth may challenge GHG reduction goals
  - ZEV policy and transportation demand management can temper challenge

Summary and Next Steps

- Develop representations of dimensions and policies
- Expand analysis to air pollutant emissions
- Iterate with stakeholders
- Execute model runs
- Analyze and distribute data

EPA United States Environmental Protection Agency

Questions?

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