Future U.S. Gulf Coast Electricity: GCAM Sensitivity Results

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Joint Global Change Research Institute
GTSP / GCAM Community Modeling Meeting
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How important is Gulf Coast today

- You just saw Yuyu tell you about regional climate impacts on buildings. Here we would like to focus on various impacts on electricity to put the climate impacts in context.
- This is part of the RIAM project, which is focused on the Gulf Coast, so we are focusing here on the five states that sit on the Gulf Coast.
- We will have a longer discussion of the 50-state model on Thursday afternoon.

Gulf Coast Share of Total US Generation

Gulf Coast Electricity Fuel Mix

<table>
<thead>
<tr>
<th>technology</th>
<th>AL</th>
<th>FL</th>
<th>LA</th>
<th>MS</th>
<th>TX</th>
<th>Rest of US</th>
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</thead>
<tbody>
<tr>
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<td>1.15</td>
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</tbody>
</table>
The Reference Scenario
Reference case socioeconomics

The other regions have populations that grow slowly.

TX and FL dominate.
Buildings dominate electricity demands

Transportation grows

Industry is flat

Buildings are really the big driver
Electricity Trade in the Reference Scenario

- Use electricity markets based on NEMS
- States can trade electricity within their markets
- Trade between markets is fixed at base year levels
States are mostly self sufficient

Regional Electricity Trade

TX and FL are on their own for electricity

AL is an exporter

LA and MS have potential to import/export
Coal, gas, and nuclear are mainstays

Electricity Generation by Fuel

There is some potential for wind and solar

Coal and gas are the main fuels
Sensitivities Explored in this Study
What are the factors that we’re gonna look at

- Climate impacts on buildings
- Electrification of Transport
- Economic and Population Growth
- Electricity Trade
- Carbon price
Changing HDD/CDD

- Methodology as discussed in the earlier presentation on Climate impacts on building energy use
- The climate results for this are from GFDL A2 scenario from CASCaDE

Note figure are results from the PCM model.
Adding climate effects to buildings increases cooling / reduces heating

Change in Building Fuel Use (% change from total)

<table>
<thead>
<tr>
<th>State</th>
<th>Change in Building Fuel Use</th>
<th>1 liquids</th>
<th>2 gas</th>
<th>5 electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL</td>
<td>2.5</td>
<td>-0.1</td>
<td>0.2</td>
<td>2.6</td>
</tr>
<tr>
<td>FL</td>
<td>2.0</td>
<td>-0.1</td>
<td>0.1</td>
<td>2.0</td>
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<tr>
<td>LA</td>
<td>2.5</td>
<td>-0.1</td>
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<tr>
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<td>2.0</td>
<td>-0.1</td>
<td>0.1</td>
<td>2.0</td>
</tr>
<tr>
<td>TX</td>
<td>3.0</td>
<td>0.2</td>
<td>0.1</td>
<td>2.7</td>
</tr>
</tbody>
</table>

Electricity is impacted for additional cooling requirements

Not a large impact due low heating needs
Cheaper electric cars

- The aim is to have electric cars take 50% of LDV market share by 2050.
- We do this by adjusting the price of electric cars.
Range in socioeconomics

GDP per capita

- Labor productivity +/- 0.5% per year
- Populations scaled for UN high and low scenarios
Alternative Electricity Trade

- Move from restrictive trade to open grid

Single US Market
Carbon Policy

- 50% CO2 emissions reduction from 2010 levels to 2050
- Policy Starts in 2020
- Roughly the prices <= 2050 are in the realm of what it would take to reach 450 PPM
- The rest of the world will face a similar carbon price in that time horizon
Results
Demand effects provide little to moderate changes in electricity demand.

- Climate impacts to buildings are not as large as other factors in 2050.
- Electric cars are on the same order of magnitude as socioeconomics.
- Socioeconomic factors are very important drivers.
- Carbon price is small.
- Allowing more flexible electric grid allows significant increase in demand.

Change in Electricity Demand (% change from Base)

- AL
- FL
- LA
- MS
- TX

2050

Scenario:
- Climate Change
- Carbon Price
- Electric Cars
- High Socio
- Low Socio
- Full Trade
Trade has the largest impact on supply

Demand Effects have similar effects on supply

Most of these states would generate a lot less electricity under full trade
Demand effects do not have much impact on mix.

These sensitivities other than carbon price do not have a large effect on mix.
Climate change impacts on buildings are only one of several factors that will influence energy demand.

The impacts on electricity generation through buildings will largely be associated with the size of demand and not the mix of generation technologies.

- Carbon policy tends to be the only influence studied here to impact mix
- It is important to remember that this study has only explored energy. There could also be substantial impacts on supply-demand matching on shorter time scales (e.g., brown outs).

The most prominent issues for electricity planning from the sensitivities explored here are largely electricity trade and uncertainty about economic growth.
Acknowledgements

Thanks to Regional Integrated Assessment Modeling (RIAM) project at DOE office of science and Platform for Regional Integrated Modeling and Analysis (PRIMA) at PNNL for support
Fuels can mostly be tied to the sector

Final energy consumption by fuel

Electricity driven by buildings

Gas, others driven by industry

Liquids are driven by transportation

input
1 liquids
2 gas
3 coal
4 biomass
5 electricity
Copper plate has huge effects for FL and TX

Another look at trade imbalance – do we still need this?