The Marginal Effects of the Price for Carbon Dioxide: Quantifying the Effects on Electric Generation

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Ted Kury
Director of Energy Studies
Public Utility Research Center
University of Florida

Public Utility Research Center

Research

Expanding the body of knowledge in public utility regulation, market reform, and infrastructure operations (e.g. benchmarking studies of Peru, Uganda, Brazil and Central America)

Education

Teaching the principles and practices that support effective utility policy and regulation (e.g. PURC/World Bank International Training Program on Utility Regulation and Strategy offered each January and June)

Service

Engaging in outreach activities that provide ongoing professional development and promote improved regulatory policy and infrastructure management (e.g. in-country training and university collaborations)

The Body of Knowledge on Infrastructure Regulation

Acknowledgements

This presentation is based on material from my papers with Julie Harrington at Florida State University.

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Summary

- Current state of carbon cap and trade policy and legislation
- Modeling the effects of CO_2 pricing
- Marginal effects of CO_2 pricing on electric generation emissions, costs, and cost structure

Cap and Trade in the U.S.

- Governor Crist proposed reduction targets for Florida in 2007 Executive Order
- Regional Greenhouse gas Initiative (RGGI) began auctioning permits in September of 2008. Compliance began in January 2009.
- Waxman-Markey Bill proposed the framework for a nationwide cap and trade program for CO_2
- Kerry-Boxer Bill refined the framework

Cap and Trade Emissions Targets

Florida Executive Order		Waxman-Markey		Kerry-Boxer	
Year	Emissions Level	Year	Emissions Level	Year	Emissions Level
2012	2005 (100% of 2005)	2012	90% of 2005	2012	97% of 2005
2017	2000 (~95% of 2005)	2020	83% of 2005	2020	80% of 2005
2025	1990 (~70% of 2005)	2030	58% of 2005	2030	58% of 2005
2050	20% of 1990 (~14% of 2005)	2050	17% of 2005	2050	17% of 2005

Cap and Trade Analysis in Florida

- Project for the Department of Environmental Protection under Florida's Energy Systems Consortium
  - Julie Harrington, FSU
  - Ted Kury, UF
- Quantification of the impact of meeting emissions goals in Executive Order
- Provisions of state cap and trade program
- Initial impact on electric generation, with expansion of scope to other sectors

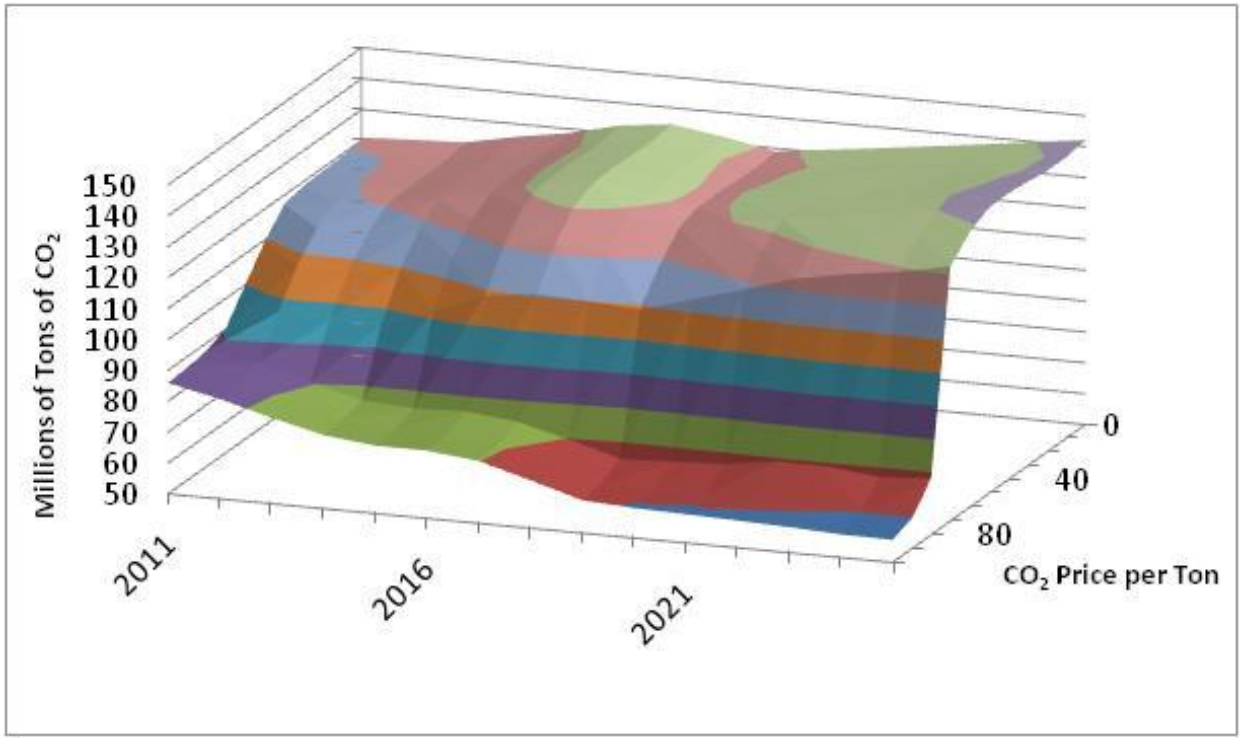
Economic Dispatch Model

- Transparent framework and logic
- Quantify the balance between level of the carbon cap and the shadow (or market) price of carbon
- Quantify the impact of RPS, energy efficiency, carbon offsets, and generation additions
- Supply stack dispatch methodology
  - State-wide scope
  - Monthly resolution of hourly load
  - Individual generating units (over 500 in FL, AL, GA)
  - Key operating characteristics for each unit
  - Ability to shape load for growth or DSM

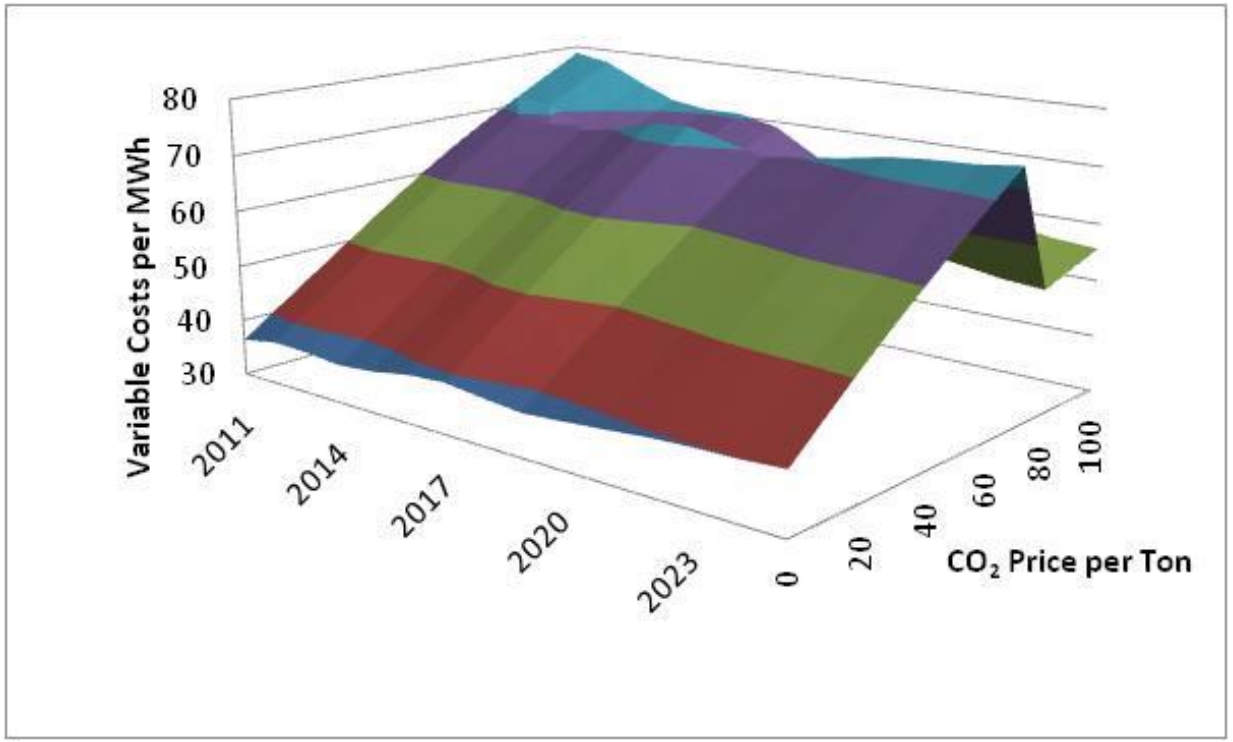
Model Data

- Generating unit data from utilities and public reports
  - Generating capacity
  - Fuel sources (and dual fuel capability)
  - Thermal efficiency
  - Retirement dates
- System data from state reliability council
  - Retail electric loads
  - Generating unit additions
- Annual load shape from federal reports

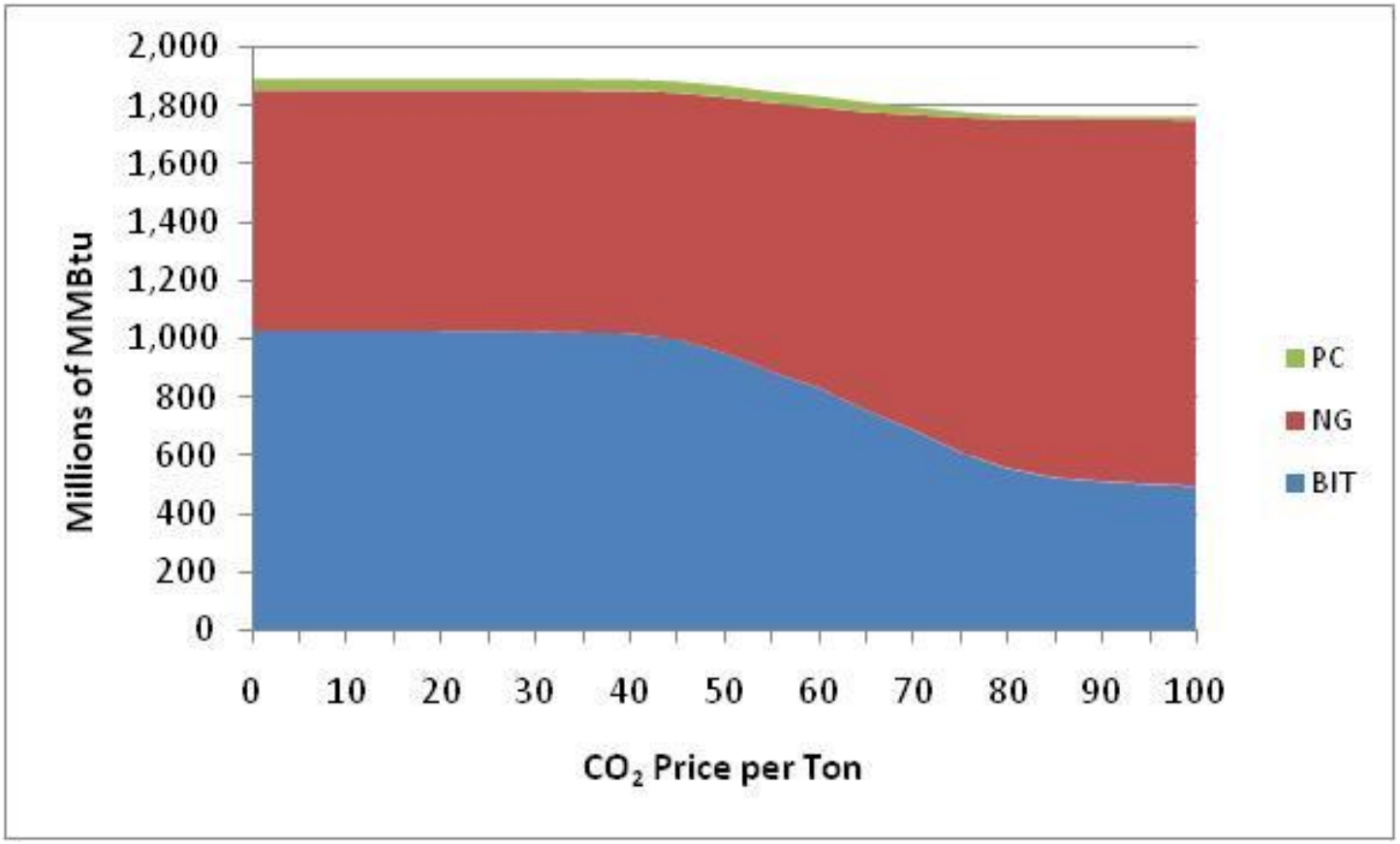
Marginal Effects of CO_2 Price



CO_2 Price and Energy Costs



2012 Fuel Mix



Marginal Effects on Generation

- Marginal effects of increasing emissions costs on variable costs are fairly constant
- Marginal effects on emissions vary widely
- ‘Flat spots’ on emissions surfaces denote areas where significant increases in emissions costs have very little effect on emissions, but drastic effects costs to producers or consumers
- These emissions curves will change over time

Conclusions

- Still much uncertainty surrounding climate and energy legislation
- Marginal effects of CO_2 pricing are dynamic
  - Vary across years
  - Vary depending on price
  - Vary depending on generation mix
- Modeling needs to address these marginal effects

Contact Information

- Ted Kury

  ted.kury @ warrington.ufl.edu