Current analytical capabilities

Table 1 provides an overview of the different models that are used by or are accessible to the Nicholas Institute for energy and climate analysis, and examples of their specific applications in climate and policy analysis.

Table 1. Nicholas Institute Economic Modeling Tools.

Model	What it does	Notable applications	Model developer(s)	Nature of NI/Duke involvement
NEMS-NI: National Energy Modeling Systems (for Nicholas Institute)	Comprehensive model of the U.S. energy sector, with detail on emissions of GHG and other pollutants and links to macroeconomic feedback	Used for EIA's Annual Energy Outlook and for all EIA analyses of climate and energy policy USCAP analyses of cap-and-trade proposals NI/Ga Tech energy efficiency study Analysis of coal plants likely to capture CO_2 at different allowance prices	Energy Information Administration (EIA)	Customized in-house version of the NEMS model. Etan Gumerman and Eric Williams both have considerable experience running the NEMS model and adapting inputs to represent a wide range of policy scenarios
ADAGE – Applied Dynamic Analysis of the Global Economy model	General equilibrium model of the global economy, with focal detail on U.S. economy, energy sectors and greenhouse gases	Core model for EPA analyses of climate policy including all recent cap-and-trade proposals USCAP analyses of cap-and-trade proposals Pew Center study on Lieberman-McCain bill Select studies of environmental policies in Brazil, Costa Rica	RTI International	Strategic alliance memorandum of understanding between Nicholas Inst. and RTI, a not-for-profit research institution founded by Duke and other Triangle universities.
FASOMGHG	Dynamic model of the U.S. forest and agricultural sectors with specific focus on GHGs and bioenergy	Model used by EPA to develop offset supply functions for all recent climate policy analyses and to assess bioenergy policy options (e.g., Renewable Fuels Standard) Used as source of widely cited EPA (2005) report on mitigation options in U.S. forestry and agriculture Used as to estimate climate change impacts on Agriculture 2000 National Climate Assessment Report	Texas A&M Oregon State Duke U.S. Forest Service RTI International EPA	Brian Murray and Justin Baker on core model development team
TREMOVE-US	Transportation policy scenario model that examines emissions, costs, vehicle sales and scrappage, and multimodal transportation demand. Examines interactions between climate policies and transportation policies.	EU version used to develop EURO V mileage and tailpipe emission standards. Core model for nearly 15 other EU-sponsored projects, including road pricing, vehicle tech policies, transit promotion, etc. U.S. version will fill gap in existing national models ability to (1) examine climate change policies' effects on transportation sector, and (2) transport policies' effects on climate policy implementation (i.e., allowance demand from trans sector). It incorporates most traditional transportation demand and emissions model features.	Duke	Developing in-house using TREMOVE-EU core code and structure, with U.S.-based data. Craig Raborn has previous experience developing transportation demand models. Preliminary U.S. version estimated fall 2009 (to allow timely evaluation of U.S. trans policy proposals); Final version late 2010.

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AURORAxmp Electricity Market Model	Regional electricity sector dispatch model for U.S and the portions of Canada with major transmission links to U.S.– Planning and analysis model that can be run for different geographies and time horizons	Used by many utilities, traders and other energy professionals for managing portfolios, price forecasting, risk analysis, and longer-term energy policy analysis. NI analysis of Electric sector initiatives to reduce GHG emissions in Utah	EPIS Inc.	Etan Gumerman & Chi-Jen Yang are experienced using this model for climate policy analysis.
Duke University Electricity Sector Model	Simple model to analyze optimal siting of low-carbon electricity generation sources and the corresponding transmission required to serve load centers.	Analyzing the siting tradeoff between ideal wind resources that need long transmission lines vs. average wind resources that need short transmission lines. Plans to expand model in logical steps to answer increasingly complex policy questions. For example, adding capability to model existing and new generation and transmission, grid power flow, electricity dispatch, distributed generation and intermittency. Potential to integrate with the CCS pipeline model, other sector models, and the Duke University Emissions Trading (DUET) model.	Duke	In-house model. Working with Duke faculty to develop.
CO_2 Pipeline Model	CO_2 pipeline network optimization and construction cost estimation model	GIS-GAMS based spatial economic model developed and used by Duke University for determining the feasibility of and estimating costs for regional and national CO_2 pipeline networks that link carbon capture plants with major geologic sequestration sites. Currently part of multi-year research project on carbon capture and storage systems. The model has been used to analyze CCS potential in North Carolina. The analysis will be extended to cover different states, regions and national level or utility company level. Model will be expanded to run in conjunction with a more sophisticated optimization platform over the next year.	Duke	In-house model.

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DUET	Duke University Emissions Trading model is a reduced form version of NEMS that can forecast emission reductions and allowance trading by sector at any given CO_2 cap	This model was recently developed to study the effect of transportation in or out of a carbon cap. This model will be used in conjunction with TREMOVE to provide an economy-wide carbon cap and allowance price feedback. This model can also eventually serve as an integrating platform to combine TREMOVE, the electricity sector model, and perhaps even the FASOM-GHG model.	Duke	In-house model.
NI CCSDeploy	Nicholas Institute CCS Deployment model (NI CCSDeploy) is designed to forecast CCS deployment under different carbon price and CCS technological progress scenarios in conjunction with Cap and Trade climate policy.	This model was recently developed to study the impact of different carbon prices and CCS technological progress on CCS deployment . Currently the model captures the essence of CCS deployment under Kerry-Lieberman and Waxman-Markey. However, this model can be quickly adjusted to analyze CCS deployment under any Cap and Trade climate policy. One of the outputs of the model is bonus ratio which can be utilized as NEMS CCS data pre-processing to analyze the impact of CCS scenario.	Duke	In-house model

Types of analyses that can be performed
There are many kinds of projects that can be undertaken with Duke's modeling capabilities:

- Cap-and-trade/GHG tax policy and implications for the overall economy with detailed results for the electricity sector, residential, commercial and industrial sectors, and the transportation sector
- Cap-and-trade/GHG tax policy and implications at the regional level
- Assessment of trade impacts on energy-intensive industries from alternate international engagement scenarios
- State and utility demand-side management and energy efficiency programs and the interaction with cap-and-trade policy
- Policies targeted to specific generating technologies (e.g., subsidies to CCS or wind or concentrating solar power)
- Policies targeted to specific demand-side energy efficiency technologies (e.g., lighting, HVAC, refrigeration, etc.)
- Biomass (electricity) policies
- Vehicle emissions standards
- Fuel efficiency standards
- Vehicle miles traveled (VMT) charges
- Infrastructure investment policies
- Low-carbon fuel standards
- Feebates
- Freight-related policies
- Vehicle technology policies (i.e., air conditioning refrigerant requirements, gear shift indicators, tire pressure monitoring systems, etc.)
- Biofuel (transportation) policies
- Design optimum CO2 pipeline network and estimate CCS transportation and injection cost for any combination of power plants or utility companies located in the 48 lower states.
- CCS deployment analysis under certain cap and trade climate policy.