REMI E3+

ADVANCEMENTS IN ENERGY, ENVIRONMENT, AND ECONOMIC MODELING

Santa Fe Users' Conference
October 16th, 2019

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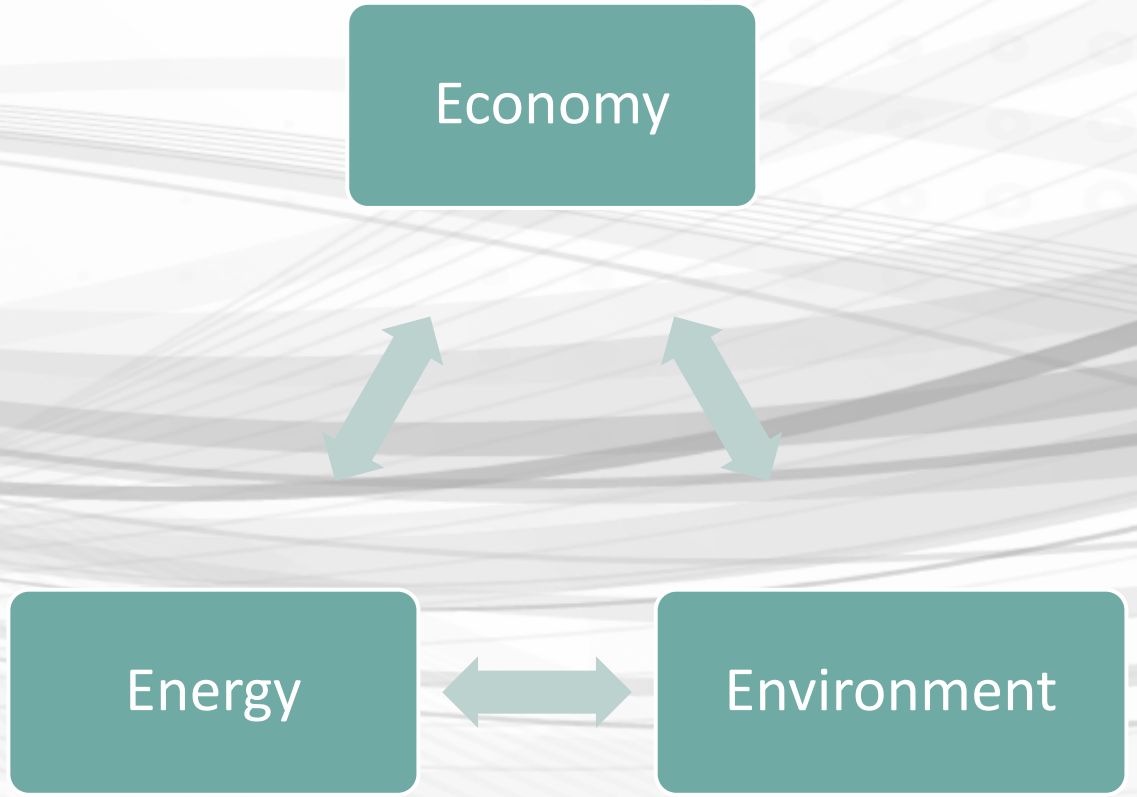
Regional Economic Models, Inc.

Introduction to E3+

REMI E3+ was designed to capture a more complete set of the linkages between the energy sector, the environment, and the broader economy

- Who it's meant for:
  - Utilities
  - State energy research departments
  - Consultants
  - Environmental regulators
- What it's meant for:
  - Integrated resource planning/energy policy
  - Energy efficiency/technology regulation
  - Air quality planning

Energy, Environment, and the Economy: E3+



What is E3+?

E3+ is *the leading off-the-shelf solution for analyzing the macroeconomic and demographic impacts of environmental and energy initiatives*

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Foundations for Energy and Environmental Analysis

E3+ builds on extensive experience analyzing the macroeconomic impacts of energy and environmental policies

REMI PI+ features for energy/environment

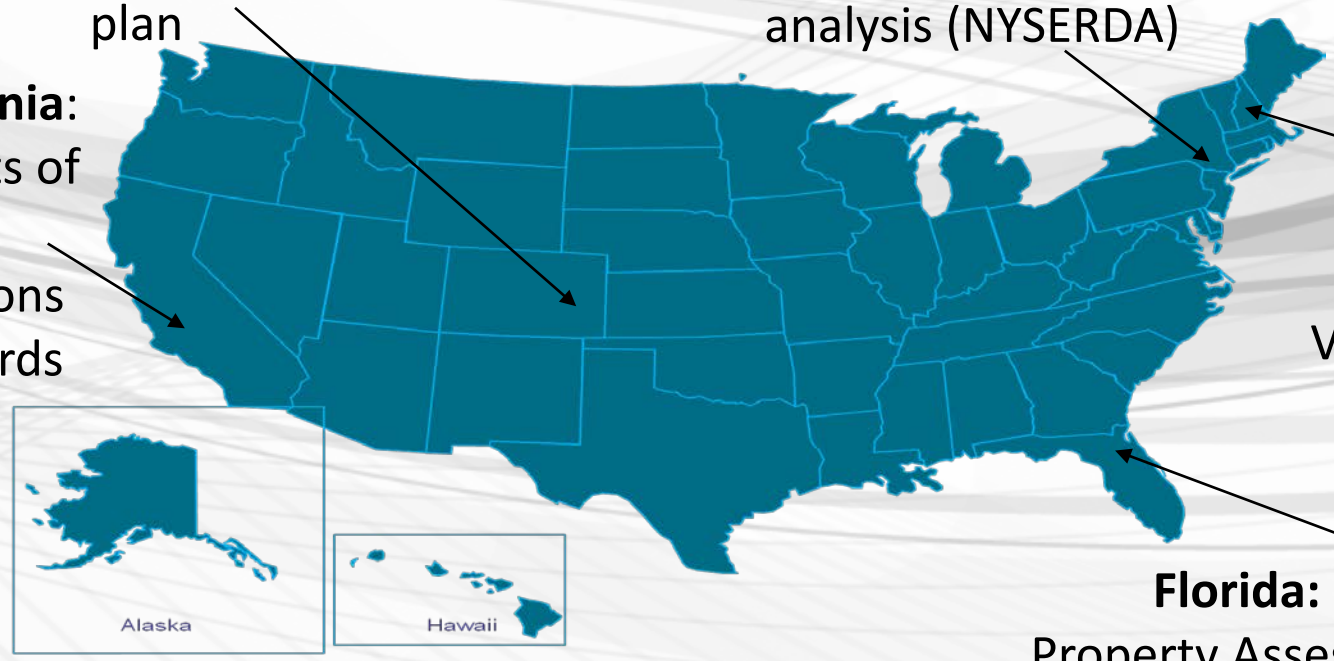
- Fuel costs, spending
- Consumption reallocation
- Estimating local sourcing of inputs through trade flows

Now, in E3+…

Colorado: Impacts of Xcel's Preferred Resource plan

New York: Energy Efficiency Programs analysis (NYSERDA)

California: Impacts of CAFE emissions standards



New Hampshire: Merrimack Valley energy reliability project

Florida: Impacts of Property Assessed Clean Energy (PACE)

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New Aspects Unique with E3+

REMI E3+ includes functionality to make energy and environmental analyses more comprehensive and more accessible to non-energy or environmental users

1. Construction and O&M Profiles for natural gas, solar, on/off-shore wind, coal and nuclear power plants
2. Energy Consumption and Carbon Dioxide Emissions Module
3. Emissions cost policy variable associated with five types of emissions
4. Resilience Module
5. Carbon Tax scenario
6. Allows for integration with third-party energy models

Custom Variables in the E3+ Model

- The model provides custom **construction and operations and maintenance** profiles of electrical power plants
  - previously clients needed this from operators or third party sources, hard to get

- Based on studies and data from several sources, including:
  - National Renewable Energy Laboratory
  - Energy Information Administration

Accounts for:
Nuclear, Solar, Natural Gas, Coal, and On/Offshore Wind Energy

REMI E3+ Energy/Emissions Module

Economic Impact
- Policies affect output by sector

Energy Consumption Impact
- Fuel demand changes by sector, source

Emissions Impact
- Sectors emit CO2 differently by fuel source

Uses EIA data to generate parameters that are applied to economic impact results

1. BTUs consumed by sector and source
2. CO_2 emissions by sector and source
3. Residential, Industrial, Commercial, and Transportation sectors

REMI E3+ Emissions Costs

Emissions affect the environmental and human health of a region, making it a more or less attractive place to live

E3+ translates changes in emissions into 'amenity value' impacts in a region, driving inward or outward migration

- Emissions costs for five different types of pollutants
  1. CO2
  2. SO2
  3. Nitrogen Oxides
  4. PM2.5
  5. PM10
- Based on data from US Government IWGSCC, National Academies of Sciences

Adam Rose & Dan Wei's Metric for Resilience Loss Reduction Potential

- E3+ can now produce an automatic calculation discussing resiliency through a forecast's "Resiliency Report"
  - This compares a no-action baseline disaster scenario to a resilience investment scenario

- The model produces a **Resilience Loss Reduction Potential** figure:

$$RLRP = \frac{Avoided\ Losses}{Maximum\ Potential\ Losses}$$

Source: *Modeling Economic Resilience to Disasters, Adam Rose and Dan Wei, Sol Price School of Public Policy and Center for Risk and Economic Analysis of Terrorism Events University of Southern California, June 2019*

Next Steps in Energy, Environment, Economic Modeling

- We continue exploring ways to refine and improve upon E3+. Some goals include…
  - Industry fuel switching
  - Energy/Emissions Module: forecasting impacts on other pollutants
  - Power plants translators: greater number of profiles, associated emissions
  - Emissions costs: add more pollutants, regionalize

- Untapped resources:
  - US EPA Greenhouse Gas Reporting Program (GHGRP)
  - EIA Survey Form 923 – Power Plant Operations Report
  - EIA Beta Electricity Data Browser

- Other suggestions, thoughts?

Model Demonstration

Model Demonstration

Vehicle Electrification Scenario:

-Reducing motor vehicle fuel spending by $100 million

-Increase electricity spending by $100 million