The energy sectors are facing unprecedented changes and uncertainty related to factors such as technology improvements and environmental regulation. Therefore, it is vital for energy companies to have access to tools that can help them evaluate how these new and potential future changes will interact with each other and influence the key market drivers for the energy sectors. Given the interactions among industry sectors, it is also important to understand the economic consequences these changes may have on the other sectors of the economy, for which energy usage and costs are important factors.

The NewERA model is a unique tool for effectively measuring the full impacts of regulations and policies. Applying the expertise of leading economic modelers and the extensive energy industry experience of NERA Economic Consulting, the model captures policies’ effects as they ripple through all sectors of the economy. Unlike most other models designed to examine the impacts of environmental and energy regulations, the NewERA model integrates a macroeconomic model with a model of the electricity industry. By combining a macroeconomic model incorporating all sectors of the economy (except for the electric sector) with a detailed electric sector model, the NewERA model allows for a complete understanding of the economic impacts of different policies on all sectors of the economy.

### The NewERA Model

<table>
<thead>
<tr>
<th>Non-Energy Sectors</th>
<th>Other Energy Sectors</th>
<th>Electricity Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>Natural Gas</td>
<td>Electricity</td>
</tr>
<tr>
<td>Industry (Energy-Intensive, Motor Vehicle, All Other)</td>
<td>Crude Oil</td>
<td>Unit-Level Representation Technology-Specific</td>
</tr>
<tr>
<td>Transportation (Trucking, Other Commercial)</td>
<td>Refined Products</td>
<td>Coal Detailed Supply Curves 23 Coal Types</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Macroeconomic (National/Regional)</th>
<th>Primary Energy (National/Regional)</th>
<th>Electricity (National/Regional/Generating Unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welfare</td>
<td>Demand</td>
<td>Prices</td>
</tr>
<tr>
<td>GDP, consumption, investment</td>
<td>Prices</td>
<td>Builds, retrofits, retirements</td>
</tr>
<tr>
<td>Output by sector</td>
<td>Production</td>
<td>Load and Dispatch</td>
</tr>
</tbody>
</table>
NewERA Macroeconomic Model

The NewERA macroeconomic model incorporates all production sectors and final demanders of the economy, providing several key advantages:

• The model’s ability to track policy consequences as they are transmitted throughout the economy and substitution possibilities across sectors and regions make it a unique tool for analyzing energy and environmental policies.

• The production and consumption functions enable gradual substitution of inputs in response to relative price changes, thus avoiding all-or-nothing solutions.

• The forward-looking characteristic of the model enables businesses and consumers to determine optimal savings and investment levels while anticipating future policies.

• As a computable general equilibrium model, the NewERA macroeconomic model can analyze scenarios or policies that call for large shocks outside of historical observation.

Model Scope

NewERA Macroeconomic Model Regions

The NewERA model includes 11 regions and 12 sectors: five energy sectors (coal, natural gas, crude oil, electricity and refined petroleum products) and seven non-energy sectors (services, manufacturing, energy-intensive, agriculture, commercial transportation excluding trucking, trucking and motor vehicles). These sectors are aggregated up from the 440 IMPLAN sectors; the model has the flexibility to represent regions and sectors at different levels of aggregation.

Natural Gas and Oil Markets

The NewERA model is designed to address the key factors affecting future natural gas supply and prices at this time of great uncertainty in US natural gas markets. One of the major uncertainties is the availability of shale gas in the US. The NewERA model’s flexible natural gas supply curves allow it to incorporate this uncertainty and the ability to analyze subsequent effects it could have on domestic markets. The model also accounts for foreign imports and US exports of natural gas, by using a supply (demand) curve for US imports (exports) that represents how the global LNG market price would react to changes in US imports or exports.

The NewERA model represents the domestic and international crude oil and refined petroleum markets. The international markets are represented by flat supply curves with exogenously specified prices. Because crude oil is treated as a homogeneous good, the international price for crude oil sets the US price for crude oil.

Model Outputs

The NewERA model outputs include demand and supply of all goods and services, prices of all commodities, and changes in imports and exports. The model outputs also include gross regional product, consumption, investment, disposable income, and changes in “job equivalents” based on labor wage income.

NewERA Electric Sector Model

The operation of each unit in a given year depends on the policies in place, electricity demand, and operating costs. Our electric sector model accounts for all these conditions in determining when and how much to operate each unit. The model also considers system-wide operational issues such as environmental regulations, transmission limits, and annual reserve margin constraints, and considers future environmental regulations and forecasted energy prices in determining the optimal mix of new generation additions over time.

The NewERA electric sector model is a bottom-up model of the electric and coal sectors designed to determine the least-cost method of satisfying all specified constraints. In determining the least-cost method, the model determines investments to undertake (e.g., retrofits, new capacity and retirement), operations at each modeled unit (e.g., dispatch and fuel choice), and demand response.
Each unit in the model has certain actions that it can undertake. For example, for coal units these include retrofits to reduce emissions of \( \text{SO}_2 \), \( \text{NO}_x \), \( \text{Hg} \), and \( \text{CO}_2 \). Coal units can also switch the type of coal that they burn. Most of the coal units’ actions would be in response to environmental limits that can be added to the model. These include emission caps (for \( \text{SO}_2 \), \( \text{NO}_x \), \( \text{Hg} \), and \( \text{CO}_2 \)) that can be applied at the national, regional, state, or unit level. The model also allows for the specification of allowance prices for emissions, emission rates or heat rate levels that must be met.

**Electricity Demand**

The model represents electricity demand through load duration curves created by sorting the hourly demand for a region within a season and then aggregating together hours into a load block. Peak demand is also included and is used with reserve margins to determine capacity prices within the model.

Unlike standard linear programs that must maintain electricity demand at a fixed level, demand in the NewERA electric sector model can respond to changes in model inputs.

**Coal Representation**

For the steam coal sector, the NewERA electric sector model has great flexibility in selecting the number of coal types to include and how they can be mapped to individual coal generators. We can also model different scenarios for coal exports and/or non-electric coal demand.

The model currently includes 23 steam coals, including 3 Central Appalachian coals, 4 Northern Appalachian coals, 1 Southern Appalachian coal, 3 Illinois Basin coals, 1 Arizona/New Mexico bituminous coal, 1 Montana bituminous coal, 1 Wyoming bituminous coal, 2 Rockies coals, 3 Powder River Basin (PRB) coals, 2 Lignite coals, 1 Import coal, and 1 Waste coal.

The model includes supply curves and demand inputs that produce coal prices for each coal. It also includes a complete coal transportation matrix that maps each generating unit to the coals that can be delivered to it and assigns a transportation cost for each of the deliverable coals.

**Advantages of the Integrated NewERA Model**

By combining our electric sector and macroeconomic models, we complement the shortcomings of each model and created our fully-integrated NewERA model. The integrated framework combines a technologically-rich bottom-up model of the electricity sector with a top-down macroeconomic model of the rest of the economy to provide a consistent equilibrium.

The main benefit of this integrated framework is that the electric sector can be modeled in great detail and capture the interactions and feedbacks between all sectors of the economy. Electric technologies can be represented according to engineering specifications. Such a consistent
analysis is not possible in a partial equilibrium framework because it would miss or incorrectly represent the feedback effects from rest of the economy.

The integrated modeling approach provides consistent price responses since all sectors of the economy are modeled. For example, evaluating price response for natural gas, which is consumed in both the electric and non-electric sectors, by just considering the changes in the electric sector will miss the changes that happen to the non-electric sectors.

Policy Analysis Capabilities
The N_{\text{ev}}ERA model has the capability to evaluate a range of current and proposed market based and command and control policies, including:

- Emission taxes or prices;
- Emission cap-and-trade policy (e.g., Title IV, CSAPR);
- Renewable portfolio standards (state, regional or national);
- Clean energy standards
- Efficiency standards in electric and non-electric sectors (e.g., MATS, heat rate standards, CAFE);
- Mandated construction of new builds or retrofits (or requirements to retrofit or retire.);
- Financial incentives (e.g., for renewables or for electric vehicles); and
- Transportation fuel policies (e.g., Renewable fuel standards, Low carbon/renewable fuel standards).

About NERA
NERA Economic Consulting ([www.nera.com](http://www.nera.com)) is a global firm of experts dedicated to applying economic, finance, and quantitative principles to complex business and legal challenges. For over half a century, NERA’s economists have been creating strategies, studies, reports, expert testimony, and policy recommendations for government authorities and the world’s leading law firms and corporations. With its main office in New York City, NERA serves clients from more than 25 offices across North America, Europe, and Asia Pacific.