The Impacts of Regional Natural Gas Prices on the Deployment of Renewable Energy Systems

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The recent developments in natural gas production have had substantial impacts on the electric power sector in the United States [1], [2]. How these developments unfold will impact the future deployment of renewable energy technologies [3] because natural gas represents (in most cases) the lowest-cost technology [4]. Renewable energy technologies are therefore most often competing with natural gas technologies when investment decisions are being made. This interaction is complicated by the fact that both natural gas prices and renewable energy resources are regional in nature [5]. The natural gas infrastructure is such that prices are dependent on the supply and demand within the region (e.g., because of pipeline constraints). Renewable energy resources are dependent on regional factors such as availability of sunlight, wind, geothermal resources, wave or tidal resources, etc. [6]. Therefore, capturing the interaction between regional natural gas prices with the available renewable energy resources is important in designing and operating the future U.S. electricity system.

In this work, we model the U.S. electricity sector using the Regional Energy Deployment System (ReEDS) capacity expansion model [7]. ReEDS is an optimization model that can assess the deployment and operation (including transmission) of the electricity sector of the contiguous United States from now through 2050. It emphasizes the integration of renewable energy technologies into the grid. ReEDS captures renewable energy resources through the use of 356 individual resource regions across the U.S. and is able to handle renewable energy issues such as variability in wind and solar output, transmission costs and constraints, and ancillary services requirements.

We develop regional natural gas supply curves for ReEDS to relate supply and demand for the nine census regions reported by the Energy Information Administration (EIA). The supply curves are created using the various scenarios presented in the EIA Annual Energy Outlook 2014 [4]. Using these regional natural gas supply curves, the impacts of regional supply and demand on renewable energy technologies are investigated. For example, a regional increase in natural gas production or consumption, such as might occur in the case of higher-than-expected natural gas recovery or natural gas exports, can impact which types of renewable energy technologies are built to meet future electricity demand. We also show which regions in the United States are most susceptible to local natural gas demand changes, and therefore the regions that may have higher investment risks when it comes to building additional electricity capacity.

This work also clarifies the interaction of renewable energy technologies with natural gas generators. For example, renewable energy technologies usually displace natural gas, which reduces demand for natural gas and keeps natural gas prices lower. And because electricity

market prices are often set by natural gas, this means wholesale electricity prices may be lower. The analysis in this work quantifies this interaction through the presentation of several case examples and demonstrates the interdependency of natural gas and renewable energy resources.

References

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