

Technology Choices in the U.S. Electricity Industry before and after Market Restructuring

Zsuzsanna Csereklyei*, David I. Stern†

Executive Summary

We study the drivers of the adoption of electricity generation technologies between 1970 and 2014 in the lower 48 U.S. states. Since the 1990s, major electricity market restructuring took place in some parts of the United States. Traditionally, electricity was generated and supplied by vertically integrated utilities, which were local monopolies. The retail price of electricity was typically regulated so as to provide a reasonable rate of return on capital employed by the utility. Deregulated wholesale markets on the other hand allowed generators to compete to supply electricity to electric retailers and other customers.

We explore the effects of changing from a regulated rate-of-return system to liberalized wholesale electricity markets on the choice of technology and fuel in new electricity generation investments. We find that electricity market deregulation at the wholesale level resulted in significant immediate investment in natural gas baseload technologies, due to higher expected profits, and in decreased investment in coal technologies, although high efficiency baseload coal generation was less negatively, or not impacted. Expectations of low natural gas prices, which were not fulfilled in the short-term, can explain the surge in natural gas generation in liberalized wholesale markets.

We find that after liberalization, investment in coal and natural gas baseload generation capacity declines in response to increases in the prices of those fuels, while fuel prices do not play such a strong role in rate-of-return markets. We also find that increases in expected natural gas prices tend to result in reduced investments in natural gas technologies but in increased generation capacity in all forms of coal and wind turbine technologies. In liberalized markets, natural gas prices tend to set the wholesale price of electricity, resulting in a relatively larger marginal profit especially for renewables, which operate at zero marginal cost. The U.S. Energy Information Administration (EIA) projects falling generation from coal-fired electricity in the coming decades, with limited capacity additions, partly due to emission regulations and to low natural gas prices. We find that high natural gas price expectations in the future could shift generation investment into both renewable or other baseload technologies.

While electricity demand was flat in recent years and only incremental increases are forecasted, around 40 GW of coal and nuclear baseload plants originating from the 1960s and 1970s are likely to be retired in the coming decade. A former wave of retirements in the early 2010s coincided with several environmental regulations on emissions control. The main question therefore is, what will these retiring plants be replaced with?

* Corresponding author. School of Economics, Finance and Marketing, RMIT University, B80, 445 Swanston Street, Melbourne VIC 3000, Australia, e-mail: zsuzsanna.csereklyei@rmit.edu.au, Phone: +61 3 9925 1518

† Crawford School of Public Policy, The Australian National University, 132 Lennox Crossing, Acton, ACT 2601, Australia. E-mail: david.stern@anu.edu.au. Phone: +61-2-6125-0176

While natural gas price expectations bear much less significance in rate-of-return markets, we believe that consistently and permanently rising natural gas prices would shift generation into primarily renewable energies, but also towards other fossil fuel generators, or at least would delay the closure of such generators, despite the EPA's environmental and emission requirements. However, the United States Department of Energy (DOE) currently sees little chance of rising natural gas prices, even though periodical or regional hikes and differences can be expected.

In summary, we show that market deregulation has a significant impact on the choice of electricity investment. In regulated cost-of-service markets fuel prices have generally less impact on the choice of the plant built, while in liberalized wholesale markets natural gas price expectations significantly impact on all forms of investment. Natural gas supply and prices therefore have the potential to significantly shape the power generation landscape of states with deregulated wholesale electricity markets in future.

Keywords Technology choices, electricity industry, market restructuring