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Employment trends in the U.S. Electricity Sector, 2008–2012

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HIGHLIGHTS

- We examine shifts in the U.S. electricity industry from 2008–2012 by sector.
- We use an economic input–output model to estimate direct and indirect jobs.
- We conducted an analytical, county level geospatial analysis using ArcGIS.
- The coal sector suffered significant job losses, mainly in traditional coal regions.
- Those losses were offset by gains, but typically not in the same geographic areas.

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ABSTRACT

Between 2008–2012, electricity generated (GWh) from coal, the longtime dominant fuel for electric power in the US, declined 24%, while electricity generated from natural gas, wind and solar grew by 39%, 154%, and 400%, respectively. These shifts had major effects on domestic employment in those sectors of the coal, natural gas, wind and solar industries involved in operations and maintenance (O&M) activities for electricity generation. Using an economic input–output model, we estimate that the coal industry lost more than 49,000 jobs (12%) nationally over the five-year period, while in the natural gas, solar, and wind industries, employment increased by nearly 220,000 jobs (21%). We also combine published ratios for jobs per unit of fuel production and per megawatt of power plant capacity with site-specific data on fuel production and power plant retirements, additions and capacity changes to estimate and map direct job changes at the county level. The maps show that job increases in the natural gas, solar and wind industries generally did not occur where there were significant job losses in the coal industry, particularly in West Virginia and Kentucky.

1. Introduction

Through the summer of 2007, total demand for electricity in the United States (U.S.) was growing. The 2008–2009 recession then beset the country, and electricity demand underwent a significant decline, failing to return to pre-2008 levels until 2011 (US EIA, 2014a). Electricity demand since then has been relatively flat, in part because of the following ongoing shifts in the U.S. electric power industry that began between 2008–2012:

- Even though it maintained its historical place as the number one source of fuel for electricity generation, coal experienced a 24% (GW h) decline in use (US EIA., 2014a). Construction of new coal plants was effectively halted, 5.2 GW or 1.5% of U.S. coal plant capacity was retired, and another 60 GW or 18% of capacity was slated for retirement by 2020 (US EIA, 2013a, 2013b).
- Electricity generated using natural gas, on the other hand, grew by ~40% (GW h), and captured a 30% share of U.S. electricity generation by the end of 2012. At the same time, U.S. natural gas plant capacity climbed by 46.6 GW or 9%, and more natural gas plants were used to provide base load power, displacing coal capacity traditionally used for this purpose (US EIA, 2013b).
- New wind generating capacity grew even faster than new natural gas capacity, exceeding the latter in 2012 to total 59 GW (US EIA, 2013b). Electricity generation with wind also rose substantially, increasing by 154% (or 85,459 GW h).
- And despite remaining one of the most expensive forms of electricity generation, new solar generating capacity grew fastest of all, expanding 491% over the period to 3.2 GW (US EIA, 2013b). Electricity generated from solar also rose,

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increasing 400% or 3463 GWh to achieve a 3.5% share of the total U.S. electricity produced in 2012.

The reasons for these ongoing shifts are varied and complex. One driver has been changes in fuel costs. Coal prices rose through 2014 due to higher costs associated with mining deeper for subsurface coal (US EIA, 2013c). At the same time, large-scale deployment of directional drilling and fracking made it economical to produce unconventional shale gas reserves, raising supplies and dropping the price of natural gas through the end of 2012 (US EIA, 2014c).

Environmental Protection Agency (EPA) regulations governing power plant emissions were a second driver for the shifts (US EPA, 2013d; US EPA, 2014d). Although federal climate change legislation was effectively shelved in 2009, tighter EPA regulations on emissions, have threatened fossil fuel plant economics, especially coal plants, which emit more of these pollutants than natural gas plants (Pratson et al., 2013). Along with the fuel price changes, the current regulatory regime has chilled investment in not only building new coal plants, but also upgrading existing ones to meet emission standards, contributing to the large number of coal plant retirements (Institute for Energy Research, 2012).

Finally, a third cause for the shifts in the electric power industry has been the combination of government incentives plus innovations in private financing for electricity generation from renewable energy, principally wind and solar (Database of State Incentives for Renewable & Efficiency, 2014a, 2014b). At the start of The Great Recession, the federal government enacted a major stimulus plan, much of which focused on facilitating the development and deployment of "green" energy (US DOE, 2013). The production tax credit for renewable energy was also extended, bolstering investment in large-scale wind and solar plants (Database of State Incentives for Renewable & Efficiency, 2014c). And as expansion of state renewable portfolio standards lowered the cost of smaller-scale investment in solar, the growth of third party power production agreements made it possible for homeowners to shoulder little if any upfront capital costs in return for solar energy at fixed, competitive electricity rates (US EPA, 2014d).

In contrast to their causes, the transitions that the U.S. electricity industry has been experiencing appear to have had a clear impact on jobs not only within the industry, but also in supporting industries. Job losses in the coal industry have received considerable press, as has the growing demand for workers in the oil and gas industry, and to a lesser extent, in renewable energy. Such job losses and gains are closely followed because they represent an important component of high-paying jobs in the U.S., are a proxy for growth or contraction of major U.S. energy industries, reflect associated growth or contraction of indirect jobs in other industries that support and/or rely on these energy industries, indicate the economic health of local economies where these industries have a dominant effect on direct and indirect employment, and are politically important to representatives of these areas elected to protect and improve economic well-being (Conca, 2012).

Among the most reliable job estimates are those produced by federal government agencies, such as the U.S. Energy Information Administration (EIA), Bureau of Labor and Statistics (BLS), and U.S. Mine Safety and Health Administration (MSHA). These employment figures are published on a monthly, quarterly, and/or annual basis, based on forms and surveys collected by each agency. Being aggregate, however, these numbers do not always partition changes among those sectors in various industries that are part of the electric power "supply chain", i.e. provide goods and/or services that contribute to the production of electricity. Consequently, the numbers fail to elucidate how the ongoing shifts in the electric power industry have affected overall employment across the industry, including indirect jobs.

This paper focuses on O&M jobs, including mining and extraction activities, transportation and distribution, plant workers, and maintenance and repair employment. We exclude construction, installation, and manufacturing (CIM) jobs, because the first two job types are typically short term and project based and thus nomadic in nature, while the third type of job can be non-domestic. In fact, much of the wind and solar technology installed in the U.S. has been manufactured overseas, particularly in China (Mathews and Tan, 2014). Another reason for why we focus on O&M jobs is because they are more numerous over the lifetime of power plants. For fossil fuel plants, O&M accounts for 3–25 times more jobs than CIM, thereby encompassing the bulk of permanent jobs in the coal and natural gas industries (Wei et al., 2010). For the wind energy industry, the number of O&M vs. CIM jobs is roughly the same. The solar industry is somewhat different. For solar thermal there are 1.5–2.5 more O&M workers than CIM, while for solar photovoltaic (PV) there are 1.5–3.5 more workers in CIM than in O&M (Wei et al., 2010). These ratios could be much different, and total domestic jobs in the solar and wind industries could be much higher, if not for significant outsourcing of renewable jobs to China (United Nations Environment Programme, 2010).

The goals of this paper are to (US EIA., 2014a) estimate, at a national level, the increases and decreases in direct and indirect employment associated with electricity generation that occurred in the coal, natural gas, wind, and solar industries between 2008 and 2012, and (US EIA, 2013a) map the changes in direct employment among these four industries at the county level. We use the Economic Input Output-Life Cycle Assessment (EIO-LCA) Model to estimate that on a national level operational hires in the natural gas, solar, and wind industries more than offset O&M layoffs in the coal industry (Carnegie Mellon University, 2009a). However, these job changes were not uniformly distributed about the U.S., as we show in maps of generating-plant additions and retirements, rail routes, and new gas wells coupled with county level job estimates derived from these activities.

2. Previous work

Attempts to constrain job changes in the coal, natural gas, and renewable energy industries have been carried out by many others. Bacon and Kojima (2011) detail the complexities of estimating energy sector employment, including the pros and cons of surveys, plant data, economic input–output models, and combinations of the three. They find that one of the most important steps in calculating energy jobs is separating long-term jobs from short-term construction and installation jobs. They also stress the importance of including indirect jobs, which are related to direct jobs by a multiplier that tends to be ≥ 2 for fossil fuel industries and between 4–11 for renewable energy (Bacon and Kojima, 2011).

Singh and Fehrs (2001) presented a detailed analysis of jobs in the electric power industry on a per-megawatt (MW) basis for coal and renewable energy using EIA, BLS, NREL, DOE and other data that spanned multiple sectors of each industry. The study did not include indirect job estimates, however, and according to Wei et al. (2010) is no longer accurate given the significant changes in energy efficiency and technology that have occurred since the study's publication. A similar problem exists with the modeling results reported on by Rose and Wei (2006). They estimated that the U.S. coal industry would employ between 400,000 and 9 million direct and indirect employees in 2015. The range is large because the authors' estimates included scenarios involving both expensive and cheap fuel alternatives to coal as well as 0%, 33%, and 66% displacement of coal generation by other types of power plants.