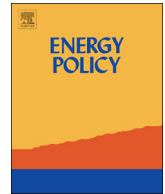




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Property values and tax rates near spent nuclear fuel storage

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ABSTRACT

This paper examines potential property value impacts when a nuclear power plant closes and spent fuel remains on site. We confirm earlier research that fails to find an impact on property values of proximity to a nuclear power site. Another contribution of this paper is our finding that a one percentage point increase in property taxes is associated with a 4.31% decrease in the sale price of a home. These results provide evidence for a positive impact of operating nuclear facilities on surrounding communities in the form of reduced residential property taxes for a given level of public expenditures.

1. Introduction

The Nuclear Waste Policy Act of 1982 assigned the responsibility for spent nuclear fuel disposal to the Department of Energy (DOE), with amendments selecting Yucca Mountain in Nevada as the primary candidate site for a permanent geological repository (U.S. Congress, 1983). The law requires the DOE to begin moving spent fuel to the repository by 1998. However, the project was terminated in 2010 before any spent fuel was moved, and all spent fuel will now remain at the reactor sites where it was produced in independent spent fuel storage installations (ISFSI) until a new solution is agreed upon and implemented.

At the same time, the combination of low fossil fuel prices, subsidies for wind and solar power, wholesale electricity markets, and high maintenance costs of aging plant infrastructures are influencing nuclear power plant operators to announce planned closures of these facilities in advance of the expiration of their operating licenses. Vermont Yankee was retired by Entergy Corporation in November 2014 in response to low energy prices (“Nuclear power plant announces layoffs,” 2014), raising concerns about future power system reliability in the Northeast (ISO New England, 2018, 4). In Illinois, Exelon Generation reversed its decision to shut the Clinton and Quad Cities Nuclear Generating Stations following state legislation that provides subsidies to support the maintenance and continued operation of the plants (Exelon Generation, 2016). In June 2016, PG&E Corporation withdrew their operating license renewal application for their Diablo Canyon Power Plant in San Luis Obispo County, California, citing the challenge of managing a large base-load power source in the presence of increasing reliance on intermittent power generation from wind and solar sources (PG&E, 2016). The plant is expected cease operating when the reactor

operating licenses expire in 2024 and 2025 (“California PUC OKs PG&E closing Diablo Canyon”, 2018). A deal between New York Governor Andrew Cuomo and Entergy Corporation announced in January 2017 will result in the Indian Point Energy Center in Buchanan, NY, closing in advance of the expiration of its operating license (Press Office of New York Governor Andrew M. Cuomo, 2017).

As these nuclear power plants begin the process of closing and decommissioning, an important policy question is raised: what happens to residential property values in communities when a nuclear power plant stops operating? This paper will investigate possible property value impacts via two mechanisms using a hedonic price model for residential properties in Lake County, Illinois, within a 10 km radius of the spent nuclear fuel storage at the site of the former Zion Nuclear Power Station. First, we will consider the impact on property values of proximity to spent fuel at the site of a former nuclear power plant. Second, we will consider what happens to property values in a town following a decline in property tax payments from a non-operating nuclear power plant.

Several characteristics of the spent nuclear fuel storage site in Zion, Illinois, allow us to overcome confounding factors in past research on nuclear power and fuel storage sites, as well as past research on property taxes. The Zion location was undeveloped land near a residential area at the time of its selection for a power plant rather than in an area already dominated by heavy industry. The plant stopped operating in 1997 (Nuclear Regulatory Commission, 1997), 15 years prior to the earliest sales records in our dataset. As a result, the plant is no longer a major employer, and the plant site is not a source of traffic noise or congestion, though the existence and location of the site is well-known in the community (Carpenter, 2017). Rather than reduce overall

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property tax revenues and public expenditures following the closure of the plant and the loss of its tax revenues, the taxing districts that had benefited from these tax revenues decided to keep revenues more or less constant—the lost revenues from the plant were replaced by increasing the taxes on other property tax payers. Results from our analysis may provide some insights into possible outcomes for residential property values at other sites where nuclear power plants are preparing to close or are undergoing decommissioning.

Founded in 1901 as a Christian utopian industrial cooperative community, Zion, Illinois, is located about 50 miles north of downtown Chicago and four miles south of the Wisconsin border on the shore of Lake Michigan. Undeveloped lakefront land in Zion was selected by Commonwealth Edison as the site for a nuclear power facility in the late 1960s. At the time the plant began operating, the small town was still struggling following the loss of a major employer, a mechanical lace factory, which closed in the early 1950s. The Zion Candy Factory, another major employer in the town that had its start as part of the Zion Institutions and Industries cooperative, was shuttered in the 1980s (Cook, 1996). The Zion nuclear plant stopped operating in 1997, 15 years prior to the end of its operating license in 2012 (Nuclear Regulatory Commission, 1997). In 1996 property tax payments from the Zion nuclear plant comprised 55% overall tax revenues in the township. Following the closure of the plant, the burden of approximately \$28 million in lost tax revenues from the plant (in 2016 dollars) was shifted to other local property owners, nearly doubling their total tax burden, while local public expenditures decreased by 10% (Knabel, 2017).

This paper uses a hedonic price model to examine the potential impacts on a community when a nuclear power plant stops operating and spent fuel remains on site, impacts that may persist long after the plant is shut down. Our research confirms the results of earlier studies that fail to find an impact on residential property values of proximity to a nuclear power facility or its associated spent fuel (Nelson, 1981, Gamble and Downing, 1982, Clark et al., 1997, Metz and Clark, 1997). A second contribution of this paper concerns the impact on home sale prices of changes in property taxes following a nuclear plant closure. The decision of city officials to keep total revenues relatively constant following the closure of the plant allows us to estimate the impact of property taxes on property values. We find that a one percentage point increase in property taxes is associated with a 4.31% decrease in the sale price of a home, or \$5371 in 2016 dollars for the mean property. Based on the estimated coefficient, the consumer's discount rate with respect to property tax differentials can be calculated as 6.95%.

We fail to find evidence of an impact of proximity to spent nuclear fuel and a former nuclear power generation facility on residential property values. However, these results suggest the existence of a positive impact of operating nuclear facilities on surrounding communities in the form of reduced residential property taxes for a given level of public expenditures. Stated a different way, when the property tax payments from a nuclear power generation facility cease, the subsequent increases in residential property tax rates required to maintain the previous level of public expenditures appear to have a negative impact on the sale prices of homes. These results are relevant not only for understanding the impacts of changing property taxes at other former nuclear power plant sites, but also for any communities whose property tax revenues are dependent on a large industrial or commercial tax payer.

2. Literature review

The theory of hedonic prices and the associated applied literature suggests that the final market price of a good or service can be broken down into constituent non-market characteristics that provide utility to the buyer. While consumers do not purchase product characteristics on the market directly, there exists an implicit market for these characteristics. Consumers have an implicit willingness to pay for

characteristics that is embedded in a good's final market price (Lancaster, 1966; Rosen, 1974). If the characteristics are well-defined and measurable, such as the average horsepower of a car, their implicit prices can be derived statistically (Griliches, 1961; Taylor, 2017). The location of residential properties in space adds additional dimensions to the analysis of implicit prices for product attributes. Levels of public services and property tax payments are determined by the tax districts in which a home is located. And home buyers will pay more to be close to things from which they derive utility, like parks, or to avoid being close to things that give them disutility, like unpleasant noises and smells.

Harris et al. (1968) provide an early empirical test of the theory of hedonic prices with respect to commuting times, residential property prices, and income elasticities. Environmental disamenities were another pioneering application of this technique, with studies like Blomquist (1974) measuring the impact on property values of proximity to a municipal coal fired power plant and Ridker and Henning (1967) measuring the impact of air pollution levels on residential property values. The impact on residential property values of environmental amenities, such as proximity to open space (Lutzenhiser and Netusil, 2001), parks (Espey and Owusu-Edusei, 2001) and clean air (Harrison and Rubinfeld, 1978) have also been studied. More recently, Kinnaman (2009), Guignet (2013), and Kiel and Williams (2007) have measured the negative impacts on home prices associated with proximity to noxious facilities and toxic waste, and Muehlenbachs et al. (2015) finds evidence of a negative impact on housing values of shale gas development that is mitigated by the positive impacts of lease payments to land owners from energy companies. An important recent development in the analysis of housing markets is the incorporation of equilibrium sorting into hedonic models (Kuminoff, 2013).

A large body of published work using hedonic price analysis has demonstrated statistical associations between home prices and proximity to amenities and disamenities. However, the existing literature investigating the impact on housing values of nuclear power facilities and spent fuel has failed to establish a link between proximity to these sites and a decline in home prices (Nelson, 1981, Gamble and Downing, 1982; Clark et al., 1997; Metz and Clark, 1997; Yamane et al., 2013). The lone exception of which we are aware is Clark and Allison (1999), which finds a disamenity impact of proximity to the former Rancho Seco plant site near Sacramento, California, the magnitude of which had been decreasing with time. Several factors have been suggested as contributing to these overall results, including positive income and employment spillover impacts of the plants, and countervailing disamenity impacts associated with traffic from plant employees traveling to and from work. There is evidence that home owners and buyers have negative perceptions of nuclear power plants and spent fuel storage (Webb, 1980; Hageman, 1981; Bassett et al., 1996), and that public opinion of nuclear facilities following the Fukushima Daiichi incident was poor (Huang et al., 2013; Bird et al., 2014). However, these perceptions of risk and stigma do not appear to translate into systematic evidence of a reduction in home sale prices associated with proximity to a nuclear power plant or fuel storage.

An additional characteristic of a home that may influence its sale price is the basket of property taxes and public services associated with its location. Nuclear power plants may influence home values in their surrounding communities through payments, either property taxes or negotiated payments in lieu of taxes, made by the plant that allow for a higher level of public services for a given level of property taxes. During its last full year of operation, property tax payments associated with the Zion Nuclear Power Station comprised 55% of overall tax revenues in the township of Zion, effectively reducing the residential property tax liability for a particular level of public services. Holding the level of public services constant, one can expect that a lower residential property tax rate will be reflected in higher property values, as the differential stream of future liability payments is capitalized into the final sale price of a home. This positive influence of industrial tax payments

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