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SOCIOECONOMIC IMPLICATIONS OF NUCLEAR POWER

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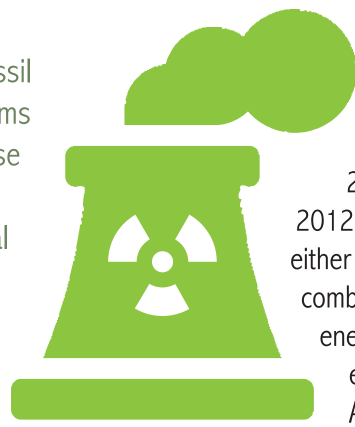
SUMMARY

Nuclear Power provides an alternative to fossil fuels. However, it also has numerous problems that have yet to be addressed. Many of these problems, and thus the burdens of nuclear power, are disproportionately borne by rural communities. The fuel cycle is primarily handled in rural areas, even though the majority of nuclear power plants and energy consumption are in urban or suburban communities. Nuclear fuel is acquired through mining, primarily in Western states. The long-term strategy for dealing with nuclear waste is to store it in an isolated geological repository. This results in substantial environmental inequities to rural communities.



Nuclear power currently produces approximately nineteen percent of the electricity in the United States (U.S. Energy Information Administration, 2012). Many consider it one of the essential components of a future non-carbon based energy mix.

While nuclear power provides the potential to transition away from more carbon-intensive energy sources, there are still significant problems with nuclear power that need to be addressed. These problems are: (1) safety; (2) management of the fuel cycle; (3) economics and cost; (4) aging workforce; (5) the need for new opportunities and technologies; and (6) negative public perceptions. Each of these must be sufficiently addressed before nuclear power can really be part of the future. This policy brief outlines some of the major impacts and concerns of nuclear power on rural communities in the United States.

Five years ago, many nuclear power experts anticipated an eminent nuclear renaissance (Nuttall, 2004; World Nuclear Association, 2011). With the widespread introduction of advanced drilling technologies such as hydraulic fracturing and horizontal drilling in the United States, the focus is now on natural gas and the expectation of a future of an abundant, cheap energy source (see for example, Institute for Energy Research, 2012; Kamalick, 2013; Kinnaman, 2011; The Economist, 2013; Weber, 2012). Though natural gas is a cleaner burning fuel than either coal or oil, it is still a carbon-based fossil fuel and its combustion still produces greenhouse gases. Renewable energy sources represent less than 10 percent of electricity production (U.S. Energy Information Administration, 2012), primarily because their intermittency in production (Anderson & Leach, 2004; Dell & Rand, 2001). Thus, renewables are unlikely to reliably and consistently meet all demands for energy. Nuclear power does not emit greenhouse gases directly. Thus, it provides a means to supply non-carbon base-load power. Nonetheless, there are substantial technical, environmental, and public concerns about nuclear power.

First among these are the concerns surrounding the safety of nuclear power. While nuclear power has the safest operating record relative to other conventional energy sources (Deutch et al., 2009), the inherent possibility of a nuclear meltdown and fears about exposure to radiation make nuclear power an ongoing safety concern for many people. In addition, examples of safety and environmental concerns – such as the power plant accidents at Three Mile Island in 1979 (Walker, 2004), Chernobyl in 1986 (Medvedev, 1991; Medvedev, 1990; UNSCEAR, 2008), Fukushima-Daiichi in 2011 (ANS, 2012), environmental contamination of land surrounding uranium mining sites and uranium enrichment facilities (Amundson, 2004; Malin & Petrzelka, 2010; Ringholz, 2002), and the collapse of the water tower at the Vermont Yankee Power Plant in August 2007 (Watts, 2012) – have raised concerns about the abilities of nuclear power plant owners and operators to address safety concerns and act in the best interests of public health and safety.

There are 103 nuclear power plants currently operating in the United States. Approximately one third of these power plants are sited in rural regions; most are either in suburban regions or urban areas (see Figure 1). Often these power plants were originally sited in more rural areas, but substantial population increases in the past fifty years have resulted in many of nuclear power plants now being sited in suburban areas (Dedman, 2011). For instance, since 2000, there has been an average increase of 10.9 percent in the population living within a five mile radius of nuclear power plants and a 27.4 percent increase within a 50 mile radius (Dedman, 2011). Thus, any expectation that isolation from urban centers would provide some measure of protection to the population from any nuclear accident is no longer valid.

At the same time, communities near nuclear power plants bear the risks of a nuclear accident or radiation leakages. There is not empirical evidence that this risk affects the price of property or houses near a nuclear power plant (see for example, Bezdek & Wendling, 2006; Gamble & Downing, 1982; Jackson, 2001; Kiel & McClain, 1995), or that people are reluctant to live near them (Donn, 2011). At the same time, these power plants provide economic benefits via property tax revenues and employment, even as there is a larger societal benefit to the use of reliable non-carbon based energy sources.

There are substantial economic and environmental concerns over the construction and operation of nuclear power plants. Cost over-runs and operations delays caused utilities to move away from nuclear power in the 1970s (Campbell, 1988). The operating life of many nuclear facilities has been extended for up to 80 years (World Nuclear Association, 2013). However, eventually these sites will need environmental remediation. There have been several successful examples of nuclear facilities being decommissioned and demolished and the surrounding lands being restored, including: the Big Rock Nuclear Power Plant in Charlevoix Michigan, the Connecticut Yankee in Haddam Neck Connecticut, Maine Yankee in Wiscasset Maine, Yankee Rowe in Rowe Massachusetts, and the Trojan Nuclear Power Plant near Rainier Oregon. Unfortunately, much of environmental history shows that corporations do not necessarily do an adequate job of protecting the environment or surrounding communities. In addition, nuclear power production is still partially dependent on carbon-based energy, as the mining and processing of uranium rely on petroleum and electricity produced by a variety of sources.

The strategy for dealing with nuclear waste has consisted of long-term storage of highly radioactive materials in dry cask storage, typically in an isolated rural location, such as Yucca Mountain, Nevada (Walker, 2009). Waste is really better considered fuel that has used some of the uranium and is no longer suitable as fuel for existing nuclear reactors. Thus, it is also called spent fuel. Spent fuel can be reprocessed and reused, as is done in France (Hecht, 1998), eliminating a large component of the waste problem. However, due to concerns about the proliferation of weapons-grade fissile material, reprocessing is prohibited under restrictions originally put in place by President Jimmy Carter (Mahaffey, 2009). Currently, it is stored in spent fuel pools or in dry cask storage, typically at nuclear power plant sites, because the Department of Energy has not yet worked out a long-term solution for spent fuel (World Nuclear News, 2009).

Communities and individuals surrounding nuclear power plants bear potential risks, without necessarily having any real democratic participation in the issues. Nuclear power plants are licensed and regulated by the federal government via the Nuclear Regulatory Commission (NRC). These regulations supersede state and local laws, which generally have little influence over nuclear power plants. Though environmental assessments and monitoring are required, it is unclear that these take into account the social and economic impacts of proximity to a nuclear

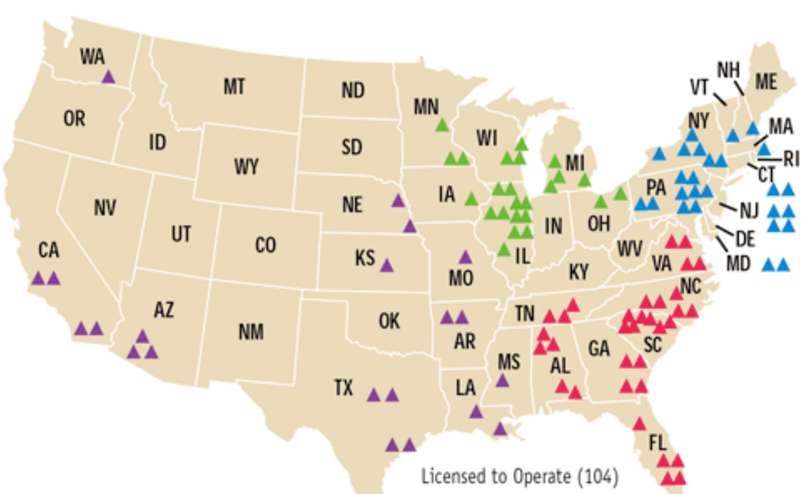


Figure 1.Location of Nuclear Power Plants in the United States by NRC regions. Source: Nuclear Regulatory Commission.

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power plant. However, the cases of the Shoreham Nuclear Power Plant on Long Island, NY, which was constructed, licensed, and then demolished without ever operating (McCaffrey, 2004), and the Vermont Yankee Nuclear Power Plant in Vernon, Vermont (Watts, 2012), which continues to struggle with active state and local attempts to shut the plant down, illustrate how local communities and stakeholders can have a significant impact on the operation and success of nuclear power.

The fuel for nuclear power plants, uranium, is mined and then processed and enriched. Mining is primarily concentrated in Western states, including Montana, Wyoming, Colorado, Utah, and New Mexico. In general, uranium mining has proven to be both individually and environmentally harmful (Amundson, 2004; Malin & Petrzelka, 2010; Ringholz, 2002). Rural communities have much greater exposure than urban communities to this environmental pollution. In addition, the raw fuel, enriched uranium, and waste are transported throughout rural areas as they are moved across the country (Walker, 2009). This places the burdens of environmental problems from mining on the rural areas in which they occur.

Food production is also at greater risk around nuclear power plants since much of the rural land around nuclear sites is used for agricultural purposes. On average, 38 percent of the land in the counties in which nuclear power plants are operating is used for farms and agricultural production (author calculations from U.S Census, 2013). Concerns over contamination and radiation of water resources and food supplies rose substantially after the Fukushima-Daichii accident (ASME, 2012; Klein & Corradini, 2012).

Lastly, climate change may have a significant impact on nuclear energy. The production of electricity through nuclear power plants requires a substantial amount of water for their operations (Feeley III et al., 2008; Fthenakis & Kim, 2010; Kirkwood, 1982). This water comes from either nearby natural water sources, such as lakes, rivers, or oceans, or from man-made reservoirs. With the expected increase in temperatures caused by global warming, two problems arise. First, the temperatures of these cooling water sources are expected to rise, meaning that less waste heat from energy production can be absorbed by the water (Sovacool & Sovacool, 2009). Second, as global temperatures increase, increased evaporation will mean that in many of these water sources, there will be less water available for cooling (Chandel et al., 2011). Both of these problems mean that nuclear power plants will have to reduce their water consumption, likely meaning reduced electrical output (unless power plant operators can figure out how to reduce their water consumption needs). The same considerations apply to fossil fuel power plants (coal and natural gas, mainly). These issues around water lead to further questions about the rights to water. Water is needed for electricity production. It is also needed for food production. If there are new restrictions on water availability, then there will need to be widespread agreements about priorities for water usage.

Nuclear power is not a panacea for energy problems nor is it likely to be a larger part of the U.S. energy mix in the short-term, unless its current problems are appropriately addressed. Nuclear power does provide an alternative to fossil fuels for base-load power. Thus, policymakers, utilities, and the general public will have to decide whether its continued, and even expanded use, is worth the costs.

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