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The impacts of nuclear facilities on property values and other factors in the surrounding communities

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Abstract: This paper addresses the issue of the impact of the siting of nuclear facilities on the adjacent communities. It reviews previous studies on the issue and then empirically examines the impacts of seven major nuclear facilities located throughout the USA on the surrounding communities. The analysis focuses on the effects on local property values, economic growth, tax revenues, public services, community development, jobs and employment, and schools. Using published data, economic and statistical analyses, literature reviews and interviews, it finds that the impacts of these facilities have been largely positive. The findings are placed in perspective, caveats are noted concerning the generalisation of the conclusions derived and recommendations for required further research are provided.

Keywords: nuclear facilities impact; property values; nuclear energy benefits; local community tax revenues; nuclear facilities jobs.

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1 Introduction

The impacts of nuclear facilities on adjacent communities have long been a controversial issue – impacts on real estate, property values, employment, taxes, public and social services, economic development, cultural parameters, *etc*. Those opposed to the siting of nuclear facilities contend that they depress property values and have other negative effects on nearby communities, while the industry contends that the opposite is the case. While the debate among advocates, interest groups and industry has been intense, there has been insufficient empirical analysis of the issues involved. Here we assess the impacts of seven major nuclear facilities located throughout the USA on the surrounding communities. Using published data, economic and statistical analyses, literature reviews, and interviews, we find that the impacts of these facilities have been largely positive.

There are five major factors that influence property values, and the presence of nuclear facilities tends to have a favourable impact on all of these. First, the quality of the available real estate is important, and the jobs and incomes generated by the facilities often enable construction of quality housing. Second, jobs and incomes in the local economy are critical, and, as discussed in Section 4, the facilities provide jobs and incomes for local area residents. Third, good schools are a prime determinant of property values and, as discussed in Section 6, the tax revenues generated significantly improve the schools. Fourth, reasonable property tax assessments are important, and the taxes paid by the facilities permit lower commercial and residential real estate assessments. Finally, adequate public services and infrastructure are important and, as discussed in Section 5, the revenues generated by the facilities fund a higher level of public services. We found these factors to be positive for the facilities analysed.

However, we caution against making valuation decisions relating to any particular property's or groups of properties' market values on the basis of the research summarised here. This is not the intent, and individual property conclusions cannot and should not be drawn from this paper. Rather, we present findings that indicate that there are market experiences that are known and that should be considered.

2 Previous studies

Over the past three decades, there have been a number of studies on the impact of nuclear facilities on the adjacent regions, although some are now dated. Below, we summarise the more significant of these.

Nelson (1981) examined the effect on residential property values of the Three Mile Island (TMI) nuclear accident. He noted that, while two government reports argued that the accident caused a decline in property values, particularly in residential areas closest to the plant, neither report utilised even elementary statistical inference methods. His objective was to determine if the accident caused a statistically significant decline in prices (or a slower appreciation rate) for houses situated within five miles of the plant, and if a permanent, lasting concern about the accident had been capitalised negatively into property values. He first used a hedonic price model to examine the effect of TMI on sale prices of homes in two communities located within four miles of the plant, and then extended the analysis to include all multilisting sales within five miles of the plant.

He found that the accident at TMI caused neither an absolute decline in prices nor a slower appreciation rate for housing sales recorded during the period May–December 1979, and that there were no statistically significant differences between prices in the five-mile area and two control areas. His empirical analysis thus showed no statistically significant decline in residential property values in the vicinity of TMI. The results suggested that the cost of the accident was perceived as short-term, or that, at least, any expected future costs had not been capitalised into the value of residential property.

In a landmark study, Gamble and Downing (1982) presented statistical evidence for sales values of single-family properties in the vicinity of four nuclear power plants in the north-east during the period 1975–1977, and in the vicinity of the TMI nuclear plant during the period 1977–1979. They concluded that there was no significant impact on property values due to proximity to a nuclear power plant, even after the March 1979 accident at TMI.

Gamble and Downing used regression analysis with linear and log-log functional forms to determine whether proximity to the TMI nuclear facility after the TMI accident had any measurable effect on property prices. They compared 583 residences within 25 miles of the plant with homes in a control neighbourhood 75 miles away, both before and after the accident occurred using a hedonic model to isolate the pricing impacts of the event. Their analysis of all valid single-family house sales over a four-year period before the accident and over the nine months following the accident, and within a 25-mile radius of the plant and in two control areas, disclosed no evidence that the accident had measurable lasting effects on residential property values. Shortly following the accident, there was a sharp decline in the volume of residential sales within ten miles of the plant and there was a collapse in the property market around the plant, but the real estate market returned to normal within two months, considering the financial market conditions at that time. They thus found no statistically significant relationship.

They found that immediately after the accident there was a collapse in the property market around the plant, but within eight weeks, the market appeared to recover. Gamble and Downing reported that there was a large influx of clean-up workers and nuclear technicians after the accident and surmised that this influx may have had a positive effect on property prices. They also suggested that the absence of observed capitalisation effects from the accident may have been due to expectations of government compensation. However, these observations were speculative. In particular, the workers would have been short-term residents who may have put upward pressure on rents, but would not be expected to affect long-term expectations of capital growth in housing prices.

Galster (1986) analysed the Gamble and Downing findings and argued that their research overlooked potentially significant short-run impacts because it implicitly employed a long-run perspective. Galster contends that the Gamble and Downing findings and related research can only be interpreted as having demonstrated that nuclear power plants do not have any significant long-run impacts on proximate property values and that theory suggests that the short-run impact may be considerably higher. To test this hypothesis, he recommends empirical investigations which collect data on property values soon after a plant location is announced. He feels that just because a long-run impact is nil does not necessarily remove the issue from the agenda of public concern, and that the short-run adjustment costs borne by some located near nuclear power sites may be substantial.

Clark *et al*. (1997) used a hedonic model and geographic information system techniques to estimate housing prices around two nuclear power plants in California. Based on the evidence from the plants chosen, their findings did not support the contention that negative imagery surrounding nuclear power plants or stored nuclear waste has a significant detrimental influence on residential home prices in the immediate vicinity of these facilities. In fact, they found that the opposite was the case; that is, housing located closer to the plants commanded a premium in the market.

Their findings at Diablo Canyon indicated a housing price premium until the household is about 23 miles from the plant, and they found that any negative property value impacts resulting from perceived risks associated with the plant do not overwhelm accessibility and other desirable attributes, which are correlated with proximity to Diablo Canyon. For the Rancho Seco plant, which is no longer operating and which is more visible than the Diablo Canyon plant, they found that residential home prices actually rose with proximity to the plant for those properties closest to the plant (within 11 miles). Their research suggests that some individuals may actually be likely to place premiums on proximity to nuclear plants. They thus concluded:

> "Based on evidence from the two California plants studied, we conclude that any negative imagery associated with nuclear power plants or stored nuclear waste does not translate into a significant detrimental influence on residential home prices in the immediate vicinity of the facilities studied."

In Rephann (1997) noted that nuclear power plants tend to employ relatively few local residents, instead requiring trained specialists likely to be selected from national employment searches. They represent a small risk because of the known hazards associated with fission reactors. Because of their potential dangers, it is conceivable that they may deter residents and firms from locating to the area. However, such an assessment is not supported by hedonic price studies that show nuclear power plants having no negative impact on local property values. He hypothesised that the negative effects of nuclear power plants may be offset by the often huge surplus tax revenues that result from taxing the commercial facilities. In effect, the enterprise subsidises residents and firms, making the communities more attractive candidates for additional private investment than they would be otherwise.

The effects of nuclear power plants should be most noticeable in transportation, communication and public utility earnings because nuclear power plants are public utilities. In addition, state and local government earnings should be stimulated if the plant contributes generously to the local property tax base, as previous studies seem to indicate. Rephann's findings confirmed these expectations and also indicated that transfer payments are stimulated. However, he found that there were no corresponding employment effects and that secondary multiplier effects in tertiary sectors were also absent. Therefore, he concluded that the direct employment effects of nuclear power plants are relatively small and thus do not create ripple effects through the local economy.

Metz *et al*. (1997) used market-based techniques to interpret five years of historically generated property transaction data from around two California nuclear power plants. Their goal was to assess actual individual behaviour and choice in relation to a property's proximity to nuclear reactors, where high-level nuclear waste storage was an issue. Regression results were found to be statistically significant for properties within 15-mile and 25-mile circles of the Rancho Seco plant, based on distance-related variables in the

nuclear category; that is, they found that there was a premium associated with proximity to the plant. They reported no statistically significant findings on the effect of proximity to the Diablo Canyon plant.

In their analysis of the influence of general newspaper coverage, they found that only a very small number of property sales within 25 miles of Rancho Seco reflected a statistically significant aversion to the plant. When the effects of specific published announcements about plans to store current and future spent nuclear fuel at the plants on property sales within 15 miles were analysed, the results indicated only minor influences from media coverage, and the general shape of the housing-price gradient was unchanged. Their results thus suggest that any perceived risk, negative imagery or stigma that may exist with respect to the nuclear facility is overwhelmed by accessibility effects associated with a desire to reside close to the workplace or other local economic or environmental influences.

Clark and Allison (1999) analysed whether public knowledge of spent fuel storage at nuclear power plants, and any local adverse risk perceptions that may have occurred, affect the sale price of single-family residential properties. They presented evidence from the Rancho Seco, California, plant on residential property values using a hedonic modelling framework, and included a large number of control variables, data with a high level of spatial detail and a number of public information variables in order to model property market effects within a 15-mile radius of the plant. Their findings indicated that proximity and visual reminders of the plant have some influence on local property markets, and that there is a small media coverage effect on single-family home sale price.

Folland and Hough (2000) examined the effects of nuclear power plants on property values by assembling a large panel of all commercial market areas in the contiguous USA, observed 11 times over roughly equal intervals covering the span from 1945 to 1992. They found that the preponderance of significant, negative estimated effects across all varieties of models strongly suggested a negative nuclear externality and one that appears throughout the major portion of the nuclear era. Part of the observed negative effect on land prices is only apparent, most likely contributed by the actions of energy companies and governments who seek out cheap land for installations. Removing spurious effects nevertheless left a significant negative installation effect.

Their findings supported the hypothesis that the discrepant findings in literature derive less from error than from alternative study designs. Comparisons across areas, which reported a significant negative effect of nuclear power plant installation, are compatible with studies of variations within areas, which show little or no effect on housing prices due to the distance from the plant. They concluded that a meta study reexamining the distance gradient studies should show different asset price levels when compared to matched nonnuclear areas.

In Gawande and Jenkins-Smith (2001) utilised data on 9400 real estate transactions in South Carolina to model the effects of a series of highly publicised shipments of spent nuclear fuel to a storage facility at the Department of Energy's Savannah River Site. They obtained results with important implications for the kinds of effects that nuclear waste shipments may have on property values. In areas with lower risk perception and more experience with nuclear materials management, they found that the shipments did not affect property values. However, in more populous urban areas, property values appear to have been lowered in a substantial manner. They noted that, if shipments of radioactive waste are shown to lower property values due to public perceptions of risk, it might not matter whether public perceptions of risk are accurate.

3 The nuclear facilities analysed

Seven nuclear facilities, which cumulatively have about 140 years of operation, were analysed. Three are waste disposal facilities and four are nuclear power plants – (Table 1). They represent various types of major nuclear facilities located throughout the country, but they are not meant to be comprehensive and do not constitute a statistically valid random sample of all the nuclear facilities in the UA.

3.1 The Barnwell Nuclear Waste Disposal Facility

Barnwell is a low-level radioactive waste disposal facility operated by Chem-Nuclear Systems on 235 acres in Barnwell County, South Carolina, 103 acres of which are used for waste disposal, and is the only low-level radioactive waste management facility in the country that has operated continuously since its start-up. It commenced operations in 1971 and currently employs 300 persons. About 28 million cubic feet of low-level radioactive waste have been buried at the site since 1971.

3.2 The Waste Isolation Pilot Plant

The Waste Isolation Pilot Plant (WIPP) is a transuranic waste disposal facility located in Eddy County, New Mexico, 26 miles East of Carlsbad, and is the world's first deep geologic repository for long-lived radioactive waste. WIPP is a repository for US defense-related transuranic waste, which is disposed of in underground salt beds. WIPP is capable of holding up to 6.2 mcf of waste. WIPP began operations in 1988 and received its first shipment of waste in March 1999. It is managed by the Department of Energy and operated by TRU Solutions, and employs 800 people.

3.3 The Envirocare Facility

Envirocare of Utah, Inc. (1988) operates a low-level radioactive waste and mixed waste disposal facility in Clive, Utah that accepts waste that contain both radioactive and hazardous contaminants. It commenced operations in 1988.[1] It treats 150 tons of material per day, disposes of 12 320 000 cf of material annually and is licensed to dispose of 300 different mixed waste (Envirocare of Utah, Inc., 2001). The facility employs 400 workers.[2]

3.4 The South Texas Project nuclear generating station

The South Texas Project (STP) is located in Matagorda County, Texas, 90 miles South-west of Houston, and consists of two 1250 MW Westinghouse pressurised water reactors.[3] Unit 1 went into service in August 1988 and Unit 2 in June 1989. STP is the largest electricity-generating station in Texas, and is among the largest generating stations in the country. The site covers 12 200 acres, – including a 7000 acre cooling water reservoir, the largest above-ground reservoir in the world – provides enough electricity to serve 500 000 homes, and employs 1500 persons.

Table 1 Summary of the seven nuclear facilities examined

Facility	*Description*	*Location*	*Initial year of operation*	*Employees*	*Size* (acres)
Nuclear Waste Management Facility	Commercial low-level radioactive waste disposal facility	Barnwell County, South Carolina	1971	300	235
Waste Isolation Pilot Plant	Transuranic waste disposal facility	Carlsbad, New Mexico	1988	800	5100
Envirocare Mixed Waste Disposal Facility	Low-level radioactive waste and mixed waste disposal facility	Clive, Utah	1988	400	640
South Texas Project	2500 MW nuclear power plant	Matagora County, Texas	1988	1500	12 200
River Bend Nuclear Generating Station	940 MW nuclear power plant	West Feliciana Parish, Louisiana	1986	800	3400
Callaway Nuclear Power Plant	1150 MW nuclear power plant	Callaway County, Missouri	1984	750	7200
Wolf Creek Generating Station	1200 MW nuclear power plant	Coffey County, Kansas	1985	850	10 000

Source: Management Information Services, Inc. (2005)

3.5 The River Bend Nuclear Generating Station

The River Bend Station (RBS) is a nuclear electric power plant located in West Feliciana Parish, Louisiana, on the Mississippi river. The plant is owned by Entergy and has an electricity-generating capacity of 940 MW. It utilises a General Electric boiling water reactor, occupies 3400 acres, and serves 1 000 000 retail customers. The plant was completed in 1986 and employs 800 persons.

3.6 The Callaway Nuclear Power Plant

The Callaway Nuclear Power Plant (CNPP) is located in Callaway County, Missouri, ten miles south-east of Fulton. The plant is a pressurised water reactor using a Westinghouse nuclear steam supply system, and is owned by the AmerenUE company. It entered service in 1984 and produces 1150 MW. AmerenUE owns 7200 acres at the site, 6800 of which are administered by the Missouri Department of Conservation and Wildlife Management. The plant serves 750 000 customers, is the largest generating station in the AmerenUE system, and has 750 employees.

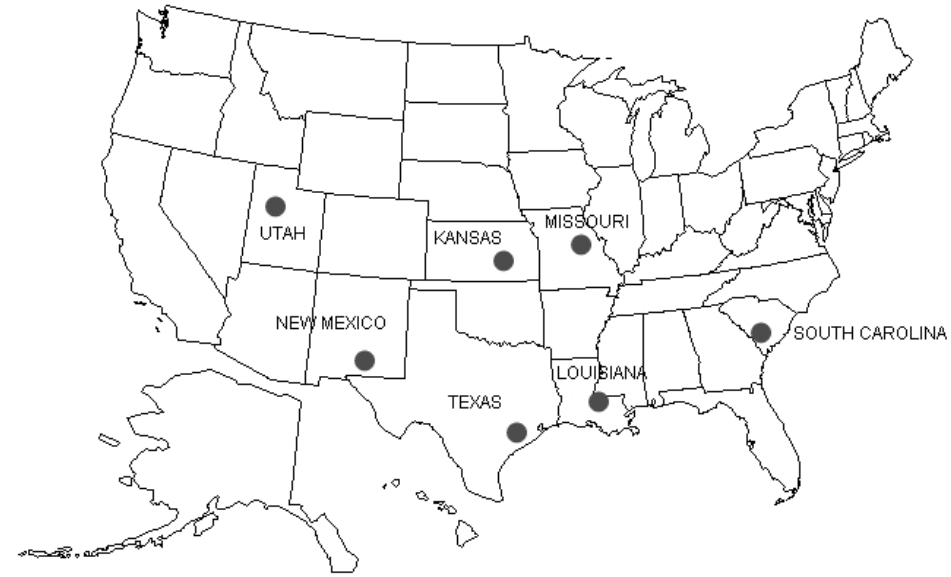
3.7 The Wolf Creek Generating Station

The Wolf Creek Generating Station (WCGS) is a nuclear electric power plant located in Coffey County, Kansas. The plant has an electricity-generating capacity of 1200 MW, utilises a Westinghouse pressurised water reactor, and occupies 10 000 acres, including a 5000 acre cooling reservoir.[4] The plant serves 700 000 customers in Kansas and Missouri and was completed in 1985. It has 850 employees.

3.8 Diverse site characteristics

The seven sites are highly diverse. First, as shown in Figure 1, they are located widely throughout the USA, although predominately in the south, Midwest, and west. Second, they include a high-level waste disposal facility, a low-level waste facility, a mixed-waste facility, and four nuclear power plants. Third, the facilities' employment ranges from 300 to 1500. Fourth, the site areas range from 200 acres to over 12 000 acres. Fifth, some sites, such as STP and RBS, account for a third of local area employment and income; others, such as WIPP and Barnwell, account for smaller portions of local area jobs and incomes. Finally, Barnwell has been in operation since 1971, whereas WIPP began accepting waste shipments in 1999. These sites thus represent a diverse – but not comprehensive – sample of US nuclear facilities, and analysis of their impacts on the surrounding areas can allow us to gain insights applicable to the local impacts of such facilities.

Figure 1 Location of selected US nuclear facilities examined



Source: Management Information Services, Inc. (2005)

4 Impact on property values

One of the most important and contentious issues is the impact of nuclear facilities on property values in adjacent areas. Concerns that the siting of nuclear facilities may depress property values and make it more difficult to sell real estate near the facilities have been raised. Our research indicates that the opposite is usually true.

For example, the Barnwell facility has over the past 30 years exerted a strong, positive effect on the local real estate market and on home values, and since it began operating housing values in the community have increased, on average, 3% to 5% annually, and commercial real estate has also appreciated significantly. New houses in subdivisions in proximity to the facility originally sold for $30,000 in the early 1970s. By the early 1990s, these homes were selling for $65,000 – $70,000, and by 2001, were selling for between $100,000 and $150,000.

One half-mile from the Barnwell facility, a new development was begun in the early 1990s, with new homes constructed on three- to five-acre lots selling for $100,000 to $200,000. By 2001, these homes were selling for $350,000 to $400,000. In general, the average price of homes close to the facility tends to be higher than the average price of homes in Barnwell County. Local government officials and real estate agents verify that the facility has had a positive effect on the local housing market, that it has not been a deterrent to new home buyers and that the incomes from the jobs created support the housing market.[5]

We also found that WIPP has had a substantial, positive impact on the local real estate market:[6] New home construction is booming in Carlsbad, and WIPP has been identified as the major factor responsible for the boom (Marshall, 1998,p.vi). The new homes built in Carlsbad over the past several years are larger and more expensive than the general housing stock in town. WIPP employees' desires for quality housing are responsible for a substantial portion of these new homes (Marshall, 1998,p.vi–vii), since much new construction is designed to meet the housing needs of management and professional level project staff.[7]

We derived similar findings with respect to the impact on real estate values of the other five nuclear facilities. For example, the Envirocare facility contributed to the construction boom and record construction of new homes in Tooele County in recent years. Local officials confirm that it has been responsible for at least a portion of this activity because the facility has given the county another source of income other than defense spending (which accounted for 85% of county income) at a time when defense spending in the county had been declining.[8]

STP has exerted a strong, positive effect on the local real estate market and home values, and since 1970, housing values in the surrounding area have increased more than six-fold. Average 2000 sq. ft. homes in Bay City were selling for more than $100,000 in 2001 and have been increasing in value steadily for the past decade, and the salaries and wages derived from STP have been an important factor in increasing the value of the area's housing.[9]

RBS has had a favourable effect on the local real estate market, and since 1970, housing values in the surrounding area have increased more than fivefold. The same is true for CNPP, and since 1970, housing values in the surrounding area have also increased more than fivefold.

Similarly, WCGS has exerted a strong, positive effect on the local real estate market and home values: real estate in the surrounding area has consistently increased in value, and the presence of WCGS allows Coffey County to assess real estate at much lower rates than surrounding counties. In addition, the plant has protected property values. During periods of economic decline, the economic stability and steady employment provided by the facility prevented property values from decreasing, as they did elsewhere in the state.

5 Economic and employment impacts

The most significant local impact of the facilities is on jobs and incomes. We found that all of the nuclear facilities generate substantial economic and employment benefits to the surrounding communities and are economic mainstays (Table 2).

STP creates significant economic benefits for the surrounding area.[10] It has a full-time staff of 1500, and there are over 2000 employees on the site, including contract labour. The project is the largest employer and largest taxpayer in Matagorda County, and 30% of county employment derives from STP.

With 800 employees, RBS is West Feliciana's second largest private employer. It is a mainstay of the local economy, directly employing 15% of the parish private workforce and indirectly creating jobs for another 12%. The plant's annual payroll constitutes 20% of the parish total annual wages.

Table 2 Summary of the facilities' jobs and incomes effects

Facility	*Percent of local area jobs created (%)*	*Percent of local area incomes created (%)*
Nuclear waste management facility	8	10
Waste isolation pilot plant	5	12
Envirocare mixed waste disposal facility	8	12
South Texas project	30	35
River bend nuclear generating station	27	20
Callaway nuclear power plant	15	15+
Wolf creek generating station	20	25

Source: Management Information Services, Inc. (2005)

With 750 employees, CNNP is the county's largest employer. Fifteen percent of those employed in the county owe their jobs to the plant, and plant-related income constitutes more than 15% of county personal income.

WCGS is Coffey County's largest employer and is a major factor in the local economy: Over 20% of county employment is generated by WCGS, and WCGS-related income constitutes more than 25% of total county personal income.

Envirocare, with 400 employees, is the tenth largest employer in the county (Knold, 2000,p.31), and the facility generates 900 jobs in the local area – about 8% of the total,[11] and the jobs the facility has created since 1988 have helped Tooele County compensate for the loss of 3300 defense-related jobs over the past decade.[12]

Similarly, the wages and salaries paid at WIPP are more than twice the local average, and it creates 5% of local area jobs, but 12% of earnings.

6 Community growth and development

The nuclear facilities have helped to revitalise the communities and to turn around declining local economies. For example, RBS has provided substantial benefits to West Feliciana: The parish population was 20% higher in 1999 than in 1970, employment increased 80%, personal income increased sevenfold, per capita income increased fivefold and the parish has become wealthier relative to the nation and the state. Significantly, the parish was willing to forego ten years of property tax payments (1986–1995) of $50 million/yr. to obtain the plant. In the early 1970s, West Feliciana Parish was the second poorest in Louisiana, a state that is one of the poorest in the nation, and the parish viewed RBS as an economic godsend.[13]

Similarly, WCGS has provided substantial benefits to Coffey County. The county's population had been declining for decades, but this decline has been reversed, and between 1990 and 2000 its population increased from 8400 to 8900 (6%). Further, since the early 1970s, employment increased substantially, personal income increased more than sixfold, per capita income increased more than fivefold, and the county has become wealthier relative to the nation and the state.

WCGS's taxes allowed the county to improve its infrastructure, attract new business, and lower its property tax rates while upgrading municipal services. The combination of low property taxes and efficient municipal services has attracted small- and medium-sized industries to Coffey County. The tax base, employment, and salaries that the plant provides have encouraged commercial development and have helped make the region's economy more stable. The plant's tax payments were responsible for improving the county's hospital, roads, sewers, schools and recreation facilities, and these improvements are a selling point to industrial prospects. The plant has also brought a more highly educated, technical work force to the county and its employees support community improvements.

WCGS provided an important psychological boost: it gave the county a new lease on life and reversed a 90-year economic and demographic decline. The economic base provided by WCGS has allowed Coffey County to develop one of the best school systems in Kansas. This is important for attracting new business, for quality education is a top selling point for enticing managers and professionals to relocate. The quality of the WCGS labour force is as important as the facility's payroll and taxes. Local officials emphasise that skilled workers and professionals contribute immeasurably to the quality of life: they support cultural, educational, and community activities at levels unlikely to exist if other types of industries of equivalent size were present in the area instead of WCGS.

In the late 1960s South Carolina promoted the development of nuclear energy facilities within the state, and Barnwell County officials encouraged Chem-Nuclear to locate near Barnwell. Since the initiation of commercial operations, Barnwell County's economy has been robust: the county's population has increased 30% since 1970, between 1990 and 2001 employment increased 20%, and personal income in the county increased more than eightfold over the past 30 years. Since 1970, per capita income in Barnwell County has increased fivefold, rising faster than the national and state averages. In 1988, Barnwell County's per capita income ranked 26th in the state; by 1998, it had risen to ninth in the state.

The Chem-Nuclear facility has played an important role in the area's economic development.[14] It has allowed surrounding jurisdictions to increase their services and the quality of their schools, it has allowed the county to establish a revolving loan fund that is used to finance economic development and it has attracted other industries to the area.[15]

Since the late 1980s, the Carlsbad economy has become stronger and more diverse, and WIPP has played an important role in this economic revival. Community leaders credit WIPP with revitalising the local economy; the facility has become a key agent of local economic development, and the improvements in transportation infrastructure made as a part of WIPP have opened up south-east New Mexico to increased commerce and are enhancing the region's economy.[16]

Since WIPP began operations, the populations of Carlsbad and Eddy County have increased substantially, and WIPP is responsible for a major portion of this growth (see Marshall, 1998,pp.ii–xii). Over the past decade, per capita personal income in Eddy County has increased at least as rapidly as the state and national averages. Since WIPP contributes 5% of the local area's wages but 12% of earnings, these higher-than-average earnings have increased average per capita income in Carlsbad (see Marshall, 1998,p.v). WIPP also helped the Carlsbad region overcome the closing of local potash mines.[17]

WIPP attracts large numbers of scientists, engineers, government officials and researchers for visits and hosts numerous scientific and technical meetings. Overwhelmingly, Carlsbad residents confirm that the facility has been positive for the community, providing employment, helping business and enhancing attitudes about the community.

Prior to WIPP, the Carlsbad Department of Planning concluded that the area lacked employment opportunities and was losing its best and brightest. WIPP changed this and has become a 'substantial economic boon' to the region by creating jobs that give young residents the option of remaining in the region. The 800 jobs at WIPP include a wide range of skills and offer opportunities for local residents, many of whom have already risen through the ranks. In addition, and of special importance to the local community, former Carlsbad residents (who had left the area to seek employment elsewhere) are returning to take advantage of the WIPP jobs (see Marshall, 1998,Chap.7).

The Envirocare facility has also had a favourable economic impact and has assisted Tooele County in expanding and diversifying its economic base (Knold, 2000,p.23). It generates a payroll of over $1.5 million annually (Knold, 2000,p.23) and, in addition to the taxes it pays, the facility pays 5% of its gross revenues each year to Tooele County – nearly $5 million annually (Knold, 2000,p.23). This is a substantial portion of the county's budget.[18]

STP has been the catalyst for growth in Matagorda County over the past three decades.[19] Comparison of the period since it began operation with that prior to construction (early 1970s) is salient: The county's population increased by 50%, employment increased more than 70%, personal income increased eightfold, and per capita income increased sixfold.

7 Effects on schools

One of the most important impacts we identified is on the local schools, for the tax revenues generated by the nuclear facilities have been critical in upgrading and transforming the quality of local schools. For example, the revenues generated by STP provide 70%–90% of the county and school district budgets. Similarly, the taxes generated by RBS provide substantial revenues for the parish and school district budgets. Since it began commercial operation, RBS has paid over $70 million in special sales tax assessments to the West Feliciana School Board, and this revenue has had significant impact: both teachers and students have consistently ranked higher than state averages for attendance, and high rankings have also been achieved in the number of teachers certified to teach the subjects they teach, the number of graduate degree teachers, and teacher-evaluation scores. West Feliciana teachers are among the highest paid in the state.

The taxes generated by WCGS provide a large portion of Coffey County's and the school district's budgets: the plant's tax payments constitute over 50% of the taxes levied by the Burlington School District and nearly 40% of the total revenues for Coffey County. An important advantage of the large tax base provided by WCGS is that it permits the District to generate capital funds for facilities and school purchases of equipment and materials, and Burlington has significantly better facilities than the surrounding school districts.

Chem-Nuclear pays $44 million annually to the local and state governments, and its property taxes are the mainstay of the Barnwell local government and school system. Over the past five years, Chem-Nuclear has generated $200 million in earmarked funds for local school districts in South Carolina, including Barnwell.[20]

8 Impacts in perspective

The impacts summarised above must be viewed in perspective, since over the past two decades all regions of the USA experienced impressive rates of economic growth, increasing personal incomes and rising property values. This is illustrated in Tables 3, 4 and 5. These data are at a more macro level than is ideal, and they compare trends for the USA as a whole, the seven states in question and the seven counties in which the nuclear facilities are located. Analysis of comparative data focusing solely on the areas in very close proximity to each facility would be preferable, but was outside the scope of the research. Nevertheless, these tables do provide some interesting perspectives.

Table 3 shows the increases in the median value of owner-occupied housing units during the 1990s. Increases in housing values in four of the counties in which nuclear facilities are located significantly exceeded the US average of 51%: Tooele County (112%), West Feliciana Parish (75%), Callaway County (75%) and Coffey County (74%). The increase in housing values in Barnwell County (48%) was about equal to the national average, and the increases in housing values in Eddy County (43%) and in Matagorda County (16%) were below the national average. Property markets are, of course, regional, and housing values in four of the counties – Tooele, West Feliciana, Callaway and Coffey – increased at least as much as those in the relevant states, whereas housing values in the other three counties increased less than those in the relevant states.

Table 3 Median value of owner-occupied housing units: 1990–2000

Median value of owner-occupied housing units	*1990 ($)*	*2000 ($)*	*Change (%)*
Barnwell County	44,900	66,600	48
South Carolina	61,100	94,900	55
Eddy County	44,800	64,200	43
New Mexico	70,100	108,100	54
Tooele County	60,400	127,800	112
Utah	68,900	146,100	112
Matagorda County	53,000	61,500	16
Texas	59,600	82,500	38
West Feliciana Parish	61,300	107,500	75
Louisiana	58,500	85,000	45
Callaway County	48,900	85,800	75
Missouri	59,800	89,900	50
Coffey County	34,800	60,700	74
Kansas	52,200	83,500	60
USA	79,100	119,600	51

Source: US Department of Commerce, Bureau of the Census (2001c)

Table 4 shows the increases in median household incomes during the 1990s. Increases in median incomes in four of the counties in which nuclear facilities are located significantly exceeded the US average of 40%: Tooele County (52%), West Feliciana Parish (104%), Callaway County (47%) and Coffey County (55%). Increases in median incomes in the other three counties were below the national average – Barnwell County (22%), Eddy County (37%) and Matagorda County (27%). Median incomes in three of the counties – West Feliciana, Callaway and Coffey – increased more than in the relevant states, median income in Tooele County increased about the same as in Utah overalland median incomes in Eddy County and Matagorda County increased less than the relevant state averages.

Table 4 Median household incomes: 1990–2000

Median household income	*1989 ($)*	*1999 ($)*	*Change (%)*	
Barnwell county	23,501	28,591	22	
South Carolina	26,256	37,082		41
Eddy County	23,418	31,998	37	
New Mexico	24,087	34,133		42
Tooele County	30,178	45,773	52	
Utah	29,470	45,726		55
Matagorda County	25,368	32,174	27	
Texas	27,016	39,927		48
West Feliciana Parish	19,402	39,667	104	
Louisiana	21,949	32,566		48
Callaway County	26,663	39,110	47	
Missouri	26,362	37,934		44
Coffey County	24,435	37,839	55	
Kansas	27,291	40,624		49
USA	30,056	41,994		40

Source: US Department of Commerce, Bureau of the Census (2001c)

Table 5 shows the increases during the 1990s in per capita incomes. Increases in per capita incomes in each of the counties in which nuclear facilities are located, except in Matagorda County, equaled or exceeded the US average of 50%. Per capita incomes in three of the counties – West Feliciana, Callaway and Coffey – increased more than in the relevant state, median income in Eddy County increased about the same as New Mexico overall and median incomes in Barnwell County and Matagorda County increased less than the relevant state averages.

Table 5 Median per capita incomes: 1990–2000

Per capita income	*1989 ($)*	*1999 ($)*	*Change (%)*	
Barnwell County	10,611	15,870	50	
South Carolina	11,897	18,795		58
Eddy County	10,490	15,823	51	
New Mexico	11,246	17,261		53
Tooele County	10,568	16,321	54	
Utah	11,029	18,185		65
Matagorda County	11,374	15,709	38	
Texas	12,904	19,617		52
West Feliciana Parish	6,796	16,201	138	
Louisiana	10,635	16,912		59
Callaway County	11,024	17,065	55	
Missouri	12,989	19,936		53
Coffey County	11,451	18,337	60	
Kansas	13,300	20,506		54
USA	14,420	21,587		50

Source: US Department of Commerce, Bureau of the Census (2001c)

The two major outliers appear to be Matagorda County and West Feliciana Parish. The former county underperformed both the national and state averages with respect to the three economic indices analysed. On the other hand, West Feliciana Parish greatly outperformed the respective national and state averages. For example, in this parish, during the 1990s, median housing values increased 50% more than the national average and 67% more than the Louisiana average, median household income increased 2.5 times more than the national average and more than twice as much as the Louisiana average, and per capita income increased nearly three times as much as the national average and more than twice as much as the Louisiana average.

9 Summary, conclusions and implications for further research

We found that the nuclear facilities tend to be economic mainstays of the local communities. They provide hundreds, and in some cases thousands, of professional and skilled jobs paying wages and salaries above the average community wage; the facilities are responsible for as much as 20% or 30% of the total employment in the respective counties, and for as much as 35% of local area incomes. The taxes and fees the facilities pay often fund over half of the county and school district budgets and provide levels of public and educational services that are far above those of surrounding counties and greater than the state averages.[21]

In each of the seven regions, housing and real estate values have benefited from the operations of the nuclear facilities: total property values, assessed valuations and median housing prices have often increased at rates above the national and state averages. In each local area, housing prices were several times higher than prior to the opening of

the nuclear facilities, and there is evidence that in Barnwell, proximity to the nuclear facility may actually increase housing values.[22] Further, the presence of a nuclear facility has protected property values: during periods of relative economic decline in the local region, the economic stability, including steady employment, provided by the facility prevents property values from decreasing, as elsewhere in the state and the surrounding communities.

In each case the nuclear sites have contributed to robust economic growth. Economic development in the seven local areas has usually exceeded national and state averages by most quantifiable measures: per capita incomes have (with the exception of Matagorda County) increased faster than the national and respective state averages, employment and jobs have increased faster than national and respective state averages and local area unemployment rates have generally been below the national and state averages. Each county has grown progressively wealthier and the economic stability provided by the facilities helped the local areas avoid cyclical downturns and 'boom-bust' development. This economic performance has been widely shared by all sectors of the local economies.

Finally, local government officials, civic leaders and community activists have generally confirmed the beneficial effects which the facilities have had, for example:

- Local officials originally campaigned hard to get Chem-Nuclear to locate in Barnwell, and have never regretted it; they feel that it is the best thing that ever happened to the local community.
- West Feliciana Parish officials wanted the River Bend Station within the Parish strongly enough to grant it a ten-year exemption from property taxes. The local Chambers of Commerce and the Parish Tourist Commission have made the nuclear plant a part of their campaigns to increase economic development in the area, feeling that the plant is a major attraction.
- In Callaway County, the local Chambers of Commerce have also made the nuclear plant a cornerstone in their campaigns to increase economic development, feeling that the presence of the plant benefits the region.
- In Coffey County, the WCGS is credited with 'saving' the local area, stopping and then reversing the economic decline of the County (Many other rural Kansas counties have suffered from economic decline, but WCGS has saved Coffey county from this fate.), and with leading an economic/industrial revival.
- In public opinion polls, Carlsbad residents say that WIPP has been positive for the community, in providing employment, helping business and in intangible attitudes about the community.

In sum, while we do not contend that the research reported here is comprehensive or definitive with respect to the topic of proximity effects of nuclear facilities on property values or other community factors, it does call into question the perception that nuclear facilities have detrimental effects on adjacent communities and property owners. As noted, we present findings of actual market experiences that are known and that should be considered.

However, a number of caveats are in order. First, and most important, this paper reports general findings about specific factors, effects and implications of the impacts on adjacent communities associated with the siting of various nuclear facilities. We must again emphasise that it does not purport to derive conclusions with regard to any

particular property's or groups of properties' market values. It is not the intent that conclusions regarding individual property valuations should be drawn from the results reported here. The local community impacts differ according to the characteristics of the facility and of the local communities, and the local area impacts – including impacts on property valuations – of any specific existing, new or planned facility will be unique and must be assessed and evaluated on an individual basis. Market value opinions must be based on specific property and analysis and the circumstances that constitute that property's physical and economic composition.

Second, while the seven sites examined are diverse and geographically dispersed, they account for only a small portion of the hundreds of nuclear facilities located throughout the USA and do not necessarily constitute a statistically representative sample of these facilities. Further, the sites analysed are located throughout the USA, have different nuclear usage, greater or lesser numbers of workers, larger or smaller acreage parcels and diverse dates of initial operation, and the findings reported here do not necessarily allow us to develop general conclusions.

Third, as discussed, most of these nuclear facilities were sited in areas with depressed or blighted economies and, indeed, were actively courted by local government officials as a means of rejuvenating the local economy. While the facilities succeeded in doing so, it should be realised that the economic benefits reported here are based on local economies that were often severely depressed prior to the siting of the facility. That is, some of these local economies were so relatively poor at the time of facility siting that only acceptance and positive economic benefit were bound to result. Indeed, most nuclear facilities are located in more rural, sparsely populated, and often economically depressed locations, rather than more prosperous metropolitan areas, and the siting of such a facility will almost inevitably generate higher-paying jobs, an influx of technical and professional staff, *etc*. Our findings confirm this. Further, while the nuclear facilities provided a major stimulus and continuing economic benefits to the local areas, similar benefits would also likely have resulted from the siting of other types of major facilities, such as a large manufacturing plant, telemarketing/call centre, casino, government operations facility, *etc*. In addition, since all of the facilities are located in rural sites, the employees probably have no other realistic housing choices. If the facilities had been in urban areas, the results might be different, and our findings thus cannot be generalised to nonrural areas.

Fourth, while property values increased significantly after the siting of the nuclear facilities, it must be realised that the entire country has experienced a surge in housing construction and property values over the past three decades. When viewed in this perspective, the impacts of several of the nuclear facilities on local property values, while still positive, are somewhat less impressive.

Moreover, most of the facilities studied are located in the sunbelt or south-west – two regions that have experienced above average growth rates, and, for example, the positive effects shown for STP may reflect, at least in part, its relative proximity to the rapidly growing Houston metropolitan area.

Finally, additional research is required to assess and extend the findings reported here. One useful extension would be to analyse how the increases in property values, employment, tax revenues and cultural amenities compare to other counties or parishes in the specific state that do not benefit from a nuclear facility. This would test the hypothesis that the facility is responsible for the improvements and benefits documented

here. In addition, the large increases in property values, salaries and revenues could be compared directly to property appreciation in other counties that are comparable except for the nuclear facility. Thus, a type of 'paired sales' approach using another similar community outside the influence of the nuclear facility could be utilised to assess the favourable impact the latter has on the housing market. These further analyses could be conducted on the facilities described here as well as on other facilities located in other parts of the country. This would allow the development of more robust conclusions with respect to the impact on local communities and property valuations based on paired sets of empirical data about technically and geographically diverse nuclear facilities.

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Notes

1 *A Brief History of Envirocare of Utah, Inc.*, http://www.envirocareutah.con

2 Based on discussions with Envirocare officials, April 2001.

3 It is owned 16% by Austin Energy, 25% by Central Power and Light, 28% by City Public Service of San Antonio and 31% by Reliant Energy.

4 WCGS is owned by three utilities: KGE (a Western Resources Company) and Kansas City Power and Light Company each own 47%, and Kansas Electric Power Cooperative, Inc., owns 6%.

5 Based on discussions with local real estate agents and with officials from the County Tax Assessor's Office and from the Barnwell Chamber of Commerce, April 2001.

6 The significant impact of WIPP on the local real estate market is documented in Marshall (1998, Chap. 4), and in discussions conducted in April 2001 with the Director of the Eddy County Board of Assessors and with local real estate agents.

7 Based on discussions with Carlsbad real estate agents, April 2001.

8 Based on discussion with the Executive Director of the Tooele County Chamber of Commerce, May 2001.

9 Based on discussions in April and May 2001 with the President of the Bay City Chamber of Commerce and Agriculture and with local real estate agents.

10 These estimates were derived on the basis of information from Management Information Services, Inc., 1992, and discussions in April and May 2001 with staff from STP, officials from Matagorda County and Bay City, officials from the Bay City Chamber of Commerce and Agriculture and the Bay City Conventional and Visitors Bureau, and local real estate agents.

11 There are about 11 100 jobs in Tooele County; see Utah Department of Workforce Services (2000–2001).

12 Based on a discussion with the Executive Director of the Tooele County Chamber of Commerce, May 2001.

13 Based on discussions in April and May 2001 with officials from West Feliciana Parish and St. Francisville, officials from the West Feliciana Parish Tourist Commission and the Greater St. Francisville Chamber of Commerce, and local real estate agents.

14 Based on discussions with officials from the County Tax Assessors Office, the County Department of Economic Development and the Barnwell Chamber of Commerce, April 2001.

15 For example, a laundry facility has been established to service the Chem-Nuclear facility and an industrial park is being developed next to Chem-Nuclear – the European firm Cronotex invested $160 million in the park to construct a wood laminate plant.

16 Research has shown this resurgence of the Carlsbad economy to be, to a significant degree, the result of the economic activity generated by WIPP (see Marshall, 1998,pp.2–20).

17 Based on discussions with Carlsbad real estate agents, April 2001.

18 In 1999, county expenditures for general government functions totaled $5.5 million and for public safety totaled $5.8 million (see Tooele County, 1999).

19 Based on discussions in April and May 2001 with staff from STP, officials from Matagorda County and Bay City, officials from the Bay City Chamber of Commerce and Agriculture and the Bay City Conventional and Visitors Bureau, and local real estate agents.

20 Aside from the taxes paid, the nuclear facilities also provide substantial in-kind and pro bono support to local school systems. For example, WIPP employs a full-time educational outreach specialist to talk to students and educators about WIPP, careers, science and math, and teaches educators how to apply for grants. WIPP also provides support to schools and educational consortia for website development, supports math and science nights at local schools, donates excess equipment and computers to schools, supports numerous school programmes, conducts summer intern programmes and sponsors work-study students. Chem-Nuclear funds transportation costs for Barnwell County special-needs children attending a summer camp programme coordinated by the Barnwell County Health Department. Similarly, the Callaway plant has been active in supporting the local community and schools: it has provided pro bono management and technical assistance to local area governments and has sponsored a Partners in Education Programme, which provides assistance to local schools.

21 This is not unique to the seven facilities studied here. For example, during the 1990s, revenues generated by the Clinton Nuclear Power Plant, in Clinton, Illinois, accounted for 73% of the budget of the Clinton School District (see Ingram, 2000).

22 This finding is similar to that reported by Clark, Michelbrink, Allison and Metz, who found that housing prices increased with proximity to the Diablo Canyon and Rancho Seco nuclear power plants in California.