PROPERTY VALUE EFFECTS OF INDIAN POINT LICENSE RENEWAL

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Table of Contents

PART TWO:

CRITICISM OF DR. SHEPPARD'S INDIAN POINT WORK

NYS-17B CONTENTION RESPONSE DRAFT
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Summary

A number of previous studies have been carried out attempting to determine if proximity to nuclear power plants reduces the value of surrounding properties. These studies done prior to the present case pertain to nuclear plants other than at the Indian Point Energy Center (IPEC). These studies are reviewed in Section 1. They give no basis for concluding that proximity to a nuclear power plant negatively impacts residential property values.

The findings from previous studies have been supplemented by an original analysis of properties surrounding IPEC carried out for the present report. The results from this analysis are presented in Section 2. The analysis used asking prices for Multiple Listing Service (MLS) properties in 2011. The analysis applied hedonic estimation similar to that for other nuclear sites. The results for IPEC corroborate the findings reviewed in Section 1, indicating no basis for concluding that there is a negative effect.

The primary purpose of the present study is not to estimate effects in past years, but rather to estimate what will happen to property values as a result of deciding either to renew licenses for the IP2 and IP3 nuclear units for another 20 years or to deny the renewal of both licenses (*i.e.*, the no-action alternative). The effect on property values of this decision is the present value, looking to the future, of the difference in property value effects between the two situations. The effects of the presence of nuclear facilities in past years considered in Sections 1 and 2 are inputs into the required calculation but provide only the beginning. Full calculation of the present value requires taking account of future effects using a discount rate to allow for the fact that a given future change is valued less the farther in the future it occurs due to the time value of money.

The calculation of the present value of the effect on property values is considered in Section 3 and is as follows. First, given the 60-year Nuclear Regulatory Commission (NRC) decommissioning period, any property value effect would be delayed for up to 60 years after the units have stopped operating. In the no-action case, if proximity to a nuclear plant did in fact depress property values, the present value of every $1,000 of property value rebound from the supposed depressed values due to denial of license renewal would be $\$1,000/(1+r)^{60}$ in view of the time value of money. With an interest rate of 7 percent, the value at the present time of every $1,000 of future rebound in property values purported to occur is $\$1,000/(1.07)^{60}$ which is $17.26. If the licenses are renewed, the property value rebound, if in fact property values had been depressed by proximity to a nuclear plant, would be delayed another 20 years due to the 20 year extension of nuclear operations. The present value for license renewal of every $1,000 of purported future property value rebound becomes $\$1,000/(1.07)^{80}$ which is $4.46.

In this illustration, denial of license renewal increases the present value of the removal of supposed depressing effect of proximity to IPEC, but the increase in present value in the no-action case is only on the order of 1 percent of the purported future property value rebound. This

illustration demonstrates that the difference in present value due to possible dissatisfaction from living near IPEC would be a relatively small consideration, even if such a property value effect were to be found, of which there is no evidence.

Second, a more immediate effect operating in the opposite direction from possible dissatisfaction from living near IPEC arises from payments in lieu of taxes (PILOT payments) made by Entergy to Westchester County, the Town of Cortlandt, the Hendrick Hudson School District, and the Verplanck Fire District. By reducing tax burdens on property owners in these jurisdictions, the PILOT effect acts to raise property values. The payments will last unabated for another 20 years if the licenses are renewed, whereas they will fall immediately in the no-action case. The present value of the continuation of the payments in full force in the near term with license renewal will be great relative to their immediate fall in the no-action case. This PILOT effect occurs regardless of whether there is any property value effect due to possible perceived dissatisfaction from living near the plant.

Since Sections 1 and 2 indicated no discernible property value effect due to dissatisfaction from being near the plant, and PILOT considerations give a positive effect of renewal over the no-action alternative, a net positive effect of license renewal on property values is found. The amount is $183 million. The estimate is that granting of license renewal vs. no action will substantially increase, not decrease, property values.

Dr. Sheppard reached a different conclusion. In his 2007 report, reviewed in Section 4, Dr. Sheppard wrongly applied findings from a study of an old coal plant to IPEC, making it the cornerstone of his contention that there is a negative property value effect. Dr. Sheppard failed to note that nuclear generation of electricity does not have the health-affecting air pollutants associated with coal-fired power plants. Dr. Sheppard also failed to mention that that old coal plants were particularly heavy polluters before the introduction of air pollution regulations. The error of using a negative property value effect instead of a correct value of zero, indicated by studies of nuclear plants, alone is sufficient to invalidate Dr. Sheppard's results.

Dr. Sheppard's January 2011 report, reviewed in Section 5, discusses future scenarios. Dr. Sheppard's 2007 report, mentioned above, ignored the fact that delays due to the decommissioning period following cessation of power generation would substantially reduce the present value of any supposed adverse effect on property values. Dr. Sheppard's January 2011 report introduces delays in removal of the $576 million impact estimate in his 2007 report. Present value calculations are presented by Dr. Sheppard assuming alternative no-action and license renewal scenarios. None of his scenarios accurately depict effects to be expected.

Dr. Sheppard's decommissioning scenarios unjustifiably discriminate against granting of license renewal. Dr. Sheppard assumed that the decommissioning period is shorter for the no-action scenarios (baseline 32 years) than renewal scenarios (42, 72, and 102 years). Two of Dr. Sheppard's scenarios go to extremes of decommissioning times of 72 and 102 years, with no justification given. Dr. Sheppard makes no reference to the 60-year decommissioning period allowed by the NRC. Dr. Sheppard further biased his results by using too low of a discount rate.

Dr. Sheppard used 4 percent but should have used more realistic rates, such as 7 percent, as recommended by the NRC, or higher, with a 25-year cutoff.

Dr. Sheppard's most serious error was unrealistic treatment of PILOT payments. Dr. Sheppard incorrectly assumed they would be the same in the no-action case as with license renewal (Dr. Sheppard January 2011, p.4). The large positive effect of PILOT payments, due to their continuation if licenses are renewed, as compared to their immediate fall in the no-action case, swamps Dr. Sheppard's unjustified exaggerated estimate of a supposed negative disamenity effect on property values.

The final materials by Dr. Sheppard were his December 2011 report and pre-filed testimony, which are reviewed below in Section 6. In these materials, Dr. Sheppard introduced yet another approach purporting to show that IP2 and IP3 reduced property values when they began commercial operation in the 1974-1976 period. Dr. Sheppard offers an analysis purporting to show that the financial return to holding property near IPEC was lower during this period, which Dr. Sheppard takes as evidence that property values fell because of IP2 and IP3 operation. Dr. Sheppard's December 2011 report and testimony contain a very large number of errors.

Major fallacies, any one of which alone is sufficient to discredit Dr. Sheppard's findings, include:

First, an extraordinary number of data entry errors such that 425 of 1,511 observations, or over one-quarter of the observations (28 percent) were found to be ineligible for inclusion in the regression, as for example: a) return on purchase of an empty lot and a subsequent sale of a completed residence; b) typographical errors in transaction dates and prices; c) transactions between family members; d) inclusion of foreclosure and auction transactions; e) return on purchase of an intact residence followed by sale after destruction by fire or demolition; f) transactions of commercial properties; g) sales prices marked as "unverified" by the Assessor; h) sales prices noted by Assessor as "not indicative of market value"; i) transactions of large purchases of land subsequently subdivided; j) geo-coding errors that caused properties to be assigned to incorrect locations by Dr. Sheppard including some whose distance from the IPEC site was beyond the 5-kilometer zone of analysis.

Second, use of a "control group" that does not provide a valid comparison for the "treatment group," one manifestation of which is that the returns of a far greater portion of the "control group," were raised by general housing events in 1999-2009, long after the commencement of operations of the nuclear units at IPEC.

Third, neglect of anticipatory effects on property values of news about pending commencement of IP2 and IP3 operations long before 1974-76.

Fourth, departure from the recommended event study methodology of using an event that occupies a very small time window and can be unambiguously defined.

Fifth, failure to use Dr. Sheppard's own data to perform hedonic regression analysis used authoritatively in other studies of effects on nuclear plants, which corroborates the findings from other nuclear plants and from my hedonic regression analysis for Indian Point that the Indian Point site has no discernible effect on property values.

As noted, any one of these shortcomings alone would be sufficient to invalidate Dr. Sheppard's claim that property values are negatively affected by IP2 and IP3. In addition to the above shortcomings, technical errors abound that contribute further to the inaccuracies of Dr. Sheppard's results.

Due to PILOT payment effects neglected by Dr. Sheppard, the present value of properties will be *higher,* and *not lower*, if licenses are renewed than if the no-action alternative is chosen. The positive PILOT payment effect is approximately 10-fold greater than Dr. Sheppard's unjustified exaggerated estimate of a negative effect.

In conclusion, Dr. Sheppard's reports and pre-filed testimony are false. I have shown that the property value effect is unequivocally positive. Dr. Sheppard's work contains major independent fallacies, each one of which is sufficient to discredit his results. Sloppiness of theoretical and empirical procedures, technical errors and biases contribute further inaccuracies to his estimates

PART ONE:
STUDY OF THE EFFECT OF INDIAN POINT ON RESIDENTIAL PROPERTY VALUES

Section 1. Background - Regression Studies of Other Sites

1-1. *Hedonic Estimation*

Previous empirical site-specific studies of the effects of nuclear power generation facilities on property values make use of a technique known as hedonic regression. Hedonic pricing models are used to assess the impacts of house and neighborhood characteristics on property values. The price of a home depends on many characteristics of the individual property such as the number of rooms, total square footage, lot size, and proximity to amenities (such as parks and high-quality schools) or remoteness of disamenities (such as noisy freeways or polluting facilities). Hedonic regressions allow researchers to estimate the effect of a single attribute on the sale prices of homes while controlling for the other characteristics that affect property values. Boardman et al. provide a more detailed discussion of some of the technical aspects of hedonic pricing models.[1]

1-2. *California Studies*

Three studies of sales of individual properties surrounding the Diablo Canyon and Rancho Seco plants in California were published in the 1990s, two in 1997 and one in 1999.[2] They contain the most extensive previous analyses available on the effects of proximity to a nuclear plant on property values. Statistical regression equations were estimated using large samples of properties in which measures of property value were regressed on distance of each property from a nuclear plant and other variables. These variables include proximity to other attractive and unattractive sites, commuting time of the resident, and the political jurisdiction within which the property is located. The studies differ in the datasets used and in details of the regression specifications.

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[1] Anthony E. Boardman, David H. Greenberg, Aidan R. Vining, and David L. Weimer. *Cost-Benefit Analysis: Concepts and Practice* (Upper Saddle River, New Jersey: Prentice Hall, 2006), pp. 348-352.

[2] The three studies are: David E. Clark, Lisa Michelbrink, Tim Allison, and William C. Metz, "Nuclear Power Plants and Residential Housing Prices," *Growth and Change* 28 (1997), pp. 496-519; William C. Metz and David E. Clark, "The Effect of Decisions About Spent Nuclear Fuel Storage on Residential Property Values," *Risk Analysis* 17 (1997), pp. 571-582; and David E. Clark and Tim Allison, "Spent Nuclear Fuel and Residential Property Values: The Influence of Proximity, Visual Cues, and Public Information," *Papers in Regional Science* 78 (1999), pp. 403-421. A fourth study draws on these three studies but appears to contain no new estimates: William C. Metz, Tim Allison, and David E. Clark, "Does Utility Spent Nuclear Fuel Storage Affect Local Property Values?" *Radwaste Magazine* 4(3), pp. 27-33.

1-2.1 *California: Diablo Canyon*

Clark et al. (1997) included properties within a 25-mile radius of each plant. For Diablo Canyon, the estimate was obtained that an increase in distance from the plant acts to *decrease* property values (negative sign on coefficient of distance of residence from plant), implying that people will pay more to live closer to the plant. The result is contrary to Dr. Sheppard's hypothesis that proximity to a nuclear plant is a disamenity. The result is statistically significant. The authors speculate that workers at the plant bid up housing values near the plant in order to live closer to work. Lacking more evidence, the results are better laid more generally to unobserved variables. In any case, the result gives no support for the existence of a negative property value effect of proximity to the plant.

Metz and Clark (1997) included properties within a 15-mile radius, and split the observations into one subset of observations above the median sale value and the other below the median sale value. One of the distance coefficients is positive and the other negative, but neither is significant.

The unexpected sign in Clark et al. (1997) and the mixed significance results in Metz and Clark (1997) lead to the conclusion that Diablo Canyon provides no basis for estimating that proximity to nuclear plants have a depressing effect on property values.

1-2.2 *California: Rancho Seco*

Just as at Diablo Canyon, Clark et al. (1997) find that proximity to the plant acts with statistical significance to increase rather than decrease property values, which again can best be attributed to omitted variables that happen to be correlated with distance.

Metz and Clark (1997) again split the observations into high and low property value samples. The low property value observations gave the same result for Rancho Seco as for Diablo Canyon, namely that proximity to the plant increased property values, though the finding was not statistically significant. Only by using the high value property sample do the authors find a statistically significant result indicating that proximity to the plant depresses property values. This finding is an anomaly compared to the other results. Arbitrary assumptions would be needed if one were to try to use this result in a general study.

The weight of the evidence from Clark et al. (1997) and Metz and Clark (1997) on the residential property values in the area surrounding Rancho Seco provides no basis for concluding that proximity to nuclear plants depresses property values.

Clark and Allison (1999) provide more evidence on Rancho Seco but introduce further specification differences. Whereas Clark et al. (1997) and Metz and Clark (1997) used a flexible form for distance with a squared term allowing for the effect of distance to change as distance increases, Clark and Allison (1999) includes only a linear distance term and introduces a variable for effect of visibility of the plant. Proximity to the plant

is again estimated to have a positive effect on property values. The effect of visibility is significantly positive, indicating that visibility of the plant has a positive effect on property values, which was an expected result.

1-2.3 *Conclusion from California Studies*

The weight of the evidence from the coefficients in the studies of Rancho Seco and Diablo Canyon by Clark et al. (1997), Metz and Clark (1997), and Clark and Allison (1999) indicates that there is no reliable basis for concluding that proximity to a nuclear plant depresses property values. The variety of positive and negative estimated effects with sensitivity to different regression specifications precludes any claim that a nuclear plant depresses property values.

1-3. *Three Mile Island Studies*

Nelson[3] evaluated the impact of the well-known March 1979 accident at Three Mile Island in Pennsylvania on homes in two nearby residential communities, selected for their homogeneity. The author finds no statistically significant impact of either the plant itself or the Three Mile Island accident on the sale prices of homes in Oak Hills, three miles from the plant, or Green Valley Estates, four miles from the plant, from January 1978 to December 1979. Nelson indicates that this result may be due to the federal and state compensation expected by victims of the accident, as programs that protect homeowners against future losses due to accidents may be capitalized into the sale price of homes (Nelson 1981, p. 371).

In 1982, Gamble and Downing[4] estimated the effect of proximity to the Three Mile Island plant before and after the accident on the sales prices of single family homes within a 25-mile radius of the facility. In both the pooled (before and after the accident) and before (only sales before the accident) linear regression specifications, proximity to the plant is estimated to decrease property values with statistical significance at the 1 percent level. However, the authors attribute these findings to "the somewhat lower quality of housing in communities near the plant as compared to the more distant communities" (Gamble & Downing 1982, p. 469), since the Three Mile Island plant is located in an industrial and historically economically depressed area. The authors conclude that the distance variable is capturing a difference in the housing stock close to the plant predating the existence of the plant itself, evident in 1966 housing data (ibid, p. 496).

1-4. *Study of Four Northeastern Nuclear Power Plants*

Gamble and Downing (1982) also examined the effect on home sale prices of four nuclear power plants in the U.S. Northeast: Pilgrim near Plymouth, MA; Millstone, near Waterford, CT; Oyster Creek in Lacey Township, NJ; and R.E. Ginna near Rochester, NY. These plants

[3] Jon P. Nelson, "Three Mile Island and Residential Property Values: Empirical Analysis and Policy Implications," *Land Economics* 57 (1981), pp. 363-372.
[4] Hays B. Gamble and Roger H. Downing, "Effects of Nuclear Power Plants on Residential Property Values," *Journal of Regional Science* 22 (1982), pp. 457-478.

were selected by the authors "from those plants in the Northeast around which we felt property value effects would most likely be evident and around which residential development was quite homogenous" (ibid, p. 461). Sales records were collected for a total of 540 single family homes in residential developments with a high degree of homogeneity within 20 miles of one of the four nuclear plants.

The authors controlled for structural characteristics of homes sold, proximity to major employment sites, and proximity to other attractive sites. In their pooled analysis, the authors found the effect of visibility of a plant from the property was positive and statistically significant. This impact is not of the expected sign, and the authors believe the relationship between plant visibility and sales price of the property is spurious, capturing instead the amenity of waterfront or near-waterfront property. Distance to the plant is measured and included in the regression. While the coefficient is negative, indicating a local amenity, it is not statistically significant.

1-5. *National Sample Studies*

1-5.1 *Clark and Nieves: Noxious Facilities*

In 1994, Clark and Nieves[5] published a study of the influence of eight types of undesirable facilities, one being nuclear power generation plants, on property values over large geographic areas. They used the 1980 Census Public Use Microdata Sample to obtain individual level self-reported characteristics of 45,899 housing units in 76 Census Study Areas. The only locational information is an indicator (dummy variable) for observation presence within or not within the central city of a Standard Metropolitan Statistical Area (SMSA). The authors are therefore unable to calculate the distance between each observation and the undesirable facilities in their study.

Without access to specific geographic information for the observations in the sample, Clark and Nieves could not control for small-area influences on housing values. For example, the presence of nuclear power generating facilities was measured as a variable indicating whether or not a facility existed (or had been planned) by 1980 within 1,000 miles of the SMSA of the observation. Any effect of undesirable facilities on housing values was a common effect over study areas ranging from 22 to 7,218 square miles, with an average area of approximately 1,500 square miles.

The Clark and Nieves study includes seven types of so-called noxious facilities in addition to nuclear power generation plants. Chemical weapon storage facilities and hazardous waste facilities are counter-intuitively estimated to have positive property value effects. The negative impact on housing prices of the presence of nuclear plants is estimated to be three times that of coal-fired utility plants. The authors note that this

[5] David E. Clark and Leslie A. Nieves, "An Interregional Hedonic Analysis of Noxious Facility Impacts on Local Wages and Property Values," *Journal of Environmental Economics and Management* 27 (1994), pp. 235-253.

finding is inconsistent with those of the more site-specific hedonic studies (Clark and Nieves 1994, p. 250), such as Gamble and Downing (1982).

It is widely known that the potential influence of unobserved variables in statistical housing analysis is large. Unobserved variables could include distance effects of attractive and unattractive sites not considered. The potential for contamination of results by unobserved variables is increased by the use of wide geographic areas where details on numerous amenities and disamenities, including the specific characteristics of undesirable facilities, cannot feasibly be included. For example, coal-fired power plants can vary in a number of ways relevant for property value impacts, including the size and age of the plant, its location within an area, and if any pollution abatement equipment is installed.

Causality is another problem. The location of nuclear plants is not random, and the selection of the sites of plants by utility companies may be in part a response to the land values in particular areas. Clark and Nieves assume the opposite, that land values are affected by the presence of the plant. An additional problem is that the self-reporting of residential property value by survey respondents detracts from the reliability of estimates.

The lack of applicability of the Clark and Nieves study to areas directly surrounding nuclear plants in a local setting, as well as omitted variable problems and problems of interpretation of causality, preclude its use in cases such as this where the objective is to estimate possible property value impacts within approximately 5 miles of a nuclear plant.

1-5.2 *Folland and Hough: Agricultural Land Values*

A 2000 study by Folland and Hough[6] considered the effect of the presence of nuclear power plants on agricultural land values using a public use sample of the Census of Agriculture and a regression including data from 1945 to 1992. The large areas considered were Rand McNally Basic Trading Areas (BTAs), generally 3 to 4 counties per BTA, but with a range of 3 to 8 counties per BTA, selected by the authors due to their homogeneity as markets rather than arbitrary political or geographic divisions. Their measures of proximity to a nuclear plant were: (1) whether an operating nuclear plant was located within the BTA of the observation, or (2) within 60 miles of the center of the BTA.

After controlling for energy company tendency to purchase less expensive land, they find a significant negative effect of the presence of a nuclear plant on agricultural land value. The authors recognize, however, that local studies have found little to no effect of proximity to a nuclear plant on property value. The study relies on the large 60-mile radius used to calculate land value changes.

[6] Sherman Folland and Robbin Hough, "Externalities of Nuclear Power Plants: Further Evidence," *Journal of Regional Science* 40 (2000), pp. 735-753.

The problems with Folland and Hough are the same as already noted for Clark and Nieves. Being aggregative, their results are particularly susceptible to omitted variable bias and problems of causality, and they do not contain information needed to estimate effects of an individual plant in a local setting.

Further, the Folland and Hough study, being concerned with agricultural land values, is not applicable to the current issue which looks at residential housing values in the vicinity of IPEC.

1-6. *Conclusion on Regression Studies of Other Nuclear Sites*

The findings from the hedonic regressions in a local context reported in Section 1-2 through Section 1-4 give no basis for claiming that there is evidence of a negative effect of nuclear plants on property values. The methodologies of these studies have generally been acceptable. A defensible hypothesis is that any differences in results from the studies are due to small random effects of other variables that it was not feasible to include in the regressions but that by chance happen to be correlated with distance from a nuclear plant.

The national sample studies considered in Section 1-5 are for areas that contain hundreds and sometimes thousands of square miles. In my opinion the self-evident impossibility of including all of the important influences on property values in such large areas and of interpreting causality are such serious methodological flaws that their results cannot reasonably be applied in this case.

Section 2. A Regression Study of the Indian Point Site

2-1. *Introduction*

The hedonic regression approach described at the outset of Section 1 is a standard accepted approach and was used in the study of effects of nuclear plants on property values in a local setting reviewed in Section 1. It is the best tool available with which to infer whether there is sufficient evidence to conclude that property values are affected by proximity to a nuclear plant. As will be seen, the evidence does not indicate that property values are affected by proximity to nuclear plants. While property values *might* be affected, the best estimate from reviewing the evidence from other nuclear plants is that there is no discernible effect.

As reported in the present section, to provide direct evidence on property value effects of IPEC, an original hedonic price study was conducted for this report using current individual property-level data and other variables that measure site-specific characteristics.

2-2. *Description of MLS Dataset*

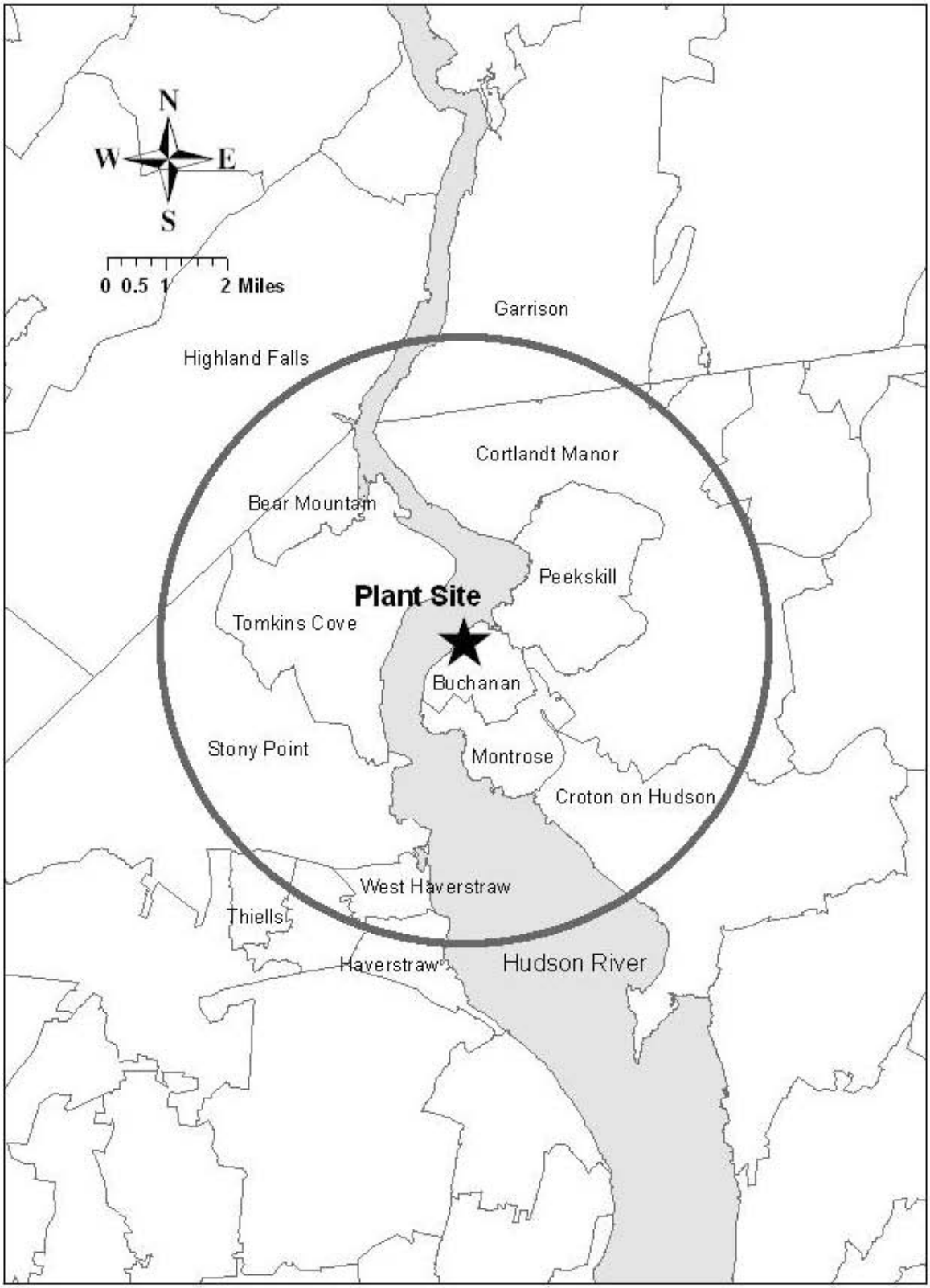
A Multiple Listing Service (MLS) dataset was collected on July 13, 2011, giving a database of residential properties listed for sale on that date on the Realtor.com website. Individual property characteristics for all listings in zipcodes falling within a 5-mile radius of IPEC were recorded[7]. The first accompanying map, Map 1, shows the area along with the names of the towns affected. Properties with obvious or clear data errors, unverifiable records, properties still under construction, observations missing data for some properties, and other anomalies were removed from the sample. The sample was then restricted to include only those homes within a 5-mile radius of IPEC and properties with homes built after 1936[8]. The final statistical analysis includes 296 observations. These observations were matched with data from the 2000 U.S. Census based on the Census Block Group ID, and spatial variables were created using the U.S. Census Shape files in ArcGIS, a standard, widely-used geographic information system program. A variable measuring the estimated per-household Entergy payments in lieu of taxes (PILOT) payments was calculated using data on anticipated payments in 2011 from the 2005 Levitan & Associates Report[9].

[7] Due to the large number of listings in two of the zip codes within a 5-mile radius of the plant site (10566 and 10567), a 50 percent sample was drawn from these zip codes.

[8] Properties with dwellings older than 75 years were excluded from the sample because the relationship between house age and price breaks down at a certain point due to heterogeneity in the quality of dwellings. Some of the residences in the original sample were built in the 18th century and are large and extremely well-maintained, while other old buildings have significantly deteriorated due to long-term neglect. Restricting the sample to include only those dwellings built in the last 75 years allows the relationship between age and asking price to be measured while limiting the influence of unmeasured variables such as the extremely inconsistent quality and condition of older homes.

[9] Levitan & Associates "Indian Point Retirement Options, Replacement Generation, Decommissioning/Spent Fuel Issues, and Local Economic/Rate Impacts," (2005): p. 102: Table 24.

Map 1. Communities Surrounding IPEC with 5-Mile Radius



2-3. *Results of Regression Using MLS Dataset*

Using the MLS dataset, a least squares regression was run using STATA v9.2, which is a standard general-purpose statistical program, to estimate the relationship between the price and a set of seven variables. It would be desirable to have closing prices, but asking prices are all that are readily available. Closing prices are generally below asking prices, but the effect may be similar among properties. For example, the effect of distance from IPEC on asking price may be higher than its effect on closing price, but if the difference is the same at 2 miles as it is at 1 mile, then the coefficient of distance in the regression will be unaffected. Results of the regression are summarized in Table 1 below, followed by discussion.

Table 1.
Hedonic Regression Results for Property Values Within 5 Miles of Indian Point Site[10]

Explanatory Variable	*Coefficient*
Distance to Indian Point	-79.323
	(1.14)
Distance to Indian Point Squared	19.901
	(1.85)*
Median Income	2.382
	(3.49)***
House Age	-5.319
	(7.44)***
Condo/Townhome	-263.214
	(8.43)***
Distance to Nearest Commuter Rail Station	-38.501
	(3.39)***
2011 PILOT Payments	10.388
	(0.66)
Constant	577.537
	(4.75)***
Number of Observations	296
R-squared	0.39

Distance in Miles, Dollars in Thousands of Dollars
Absolute value of t-statistics in parentheses:
* significant at 10%, ** significant at 5%, *** significant at 1%.

The coefficients of Median Income, House Age, the variable indicating whether a home is a condo or a townhome, and Distance to Nearest to Commuter Rail Station are all of expected sign and highly statistically significant.

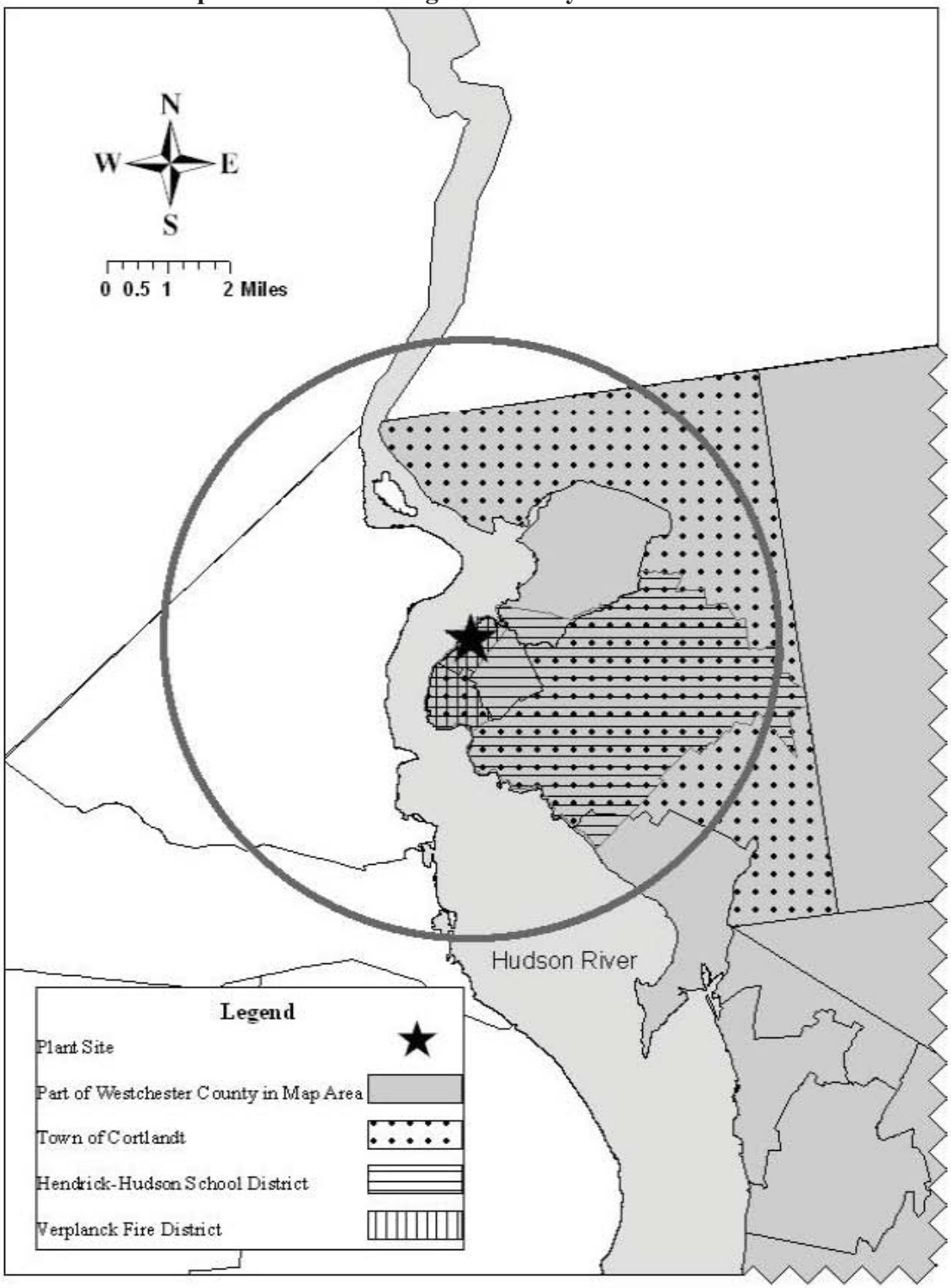
[10] Dependent Variable: Asking Price for Property on 07-13-2011.

The PILOT payments variable is an estimate of the per-household value of payments by Entergy to four taxing districts in 2011.[11] The payments are a notable source of revenue for the districts, scheduled to total approximately $23.99 million in 2011. For this analysis, the per-household payment was calculated by dividing the value of the payment to each district by the number of total occupied housing units in each taxing district in the 2000 U.S. Census, both rentals and owner-occupied units. The geographic borders of the taxing districts were determined using map shape files from the Westchester County GIS Office.[12]

The taxing jurisdictions receiving PILOT payments are Westchester County, the Town of Cortlandt, the Verplanck Fire District, and the Hendrick Hudson School District. The second accompanying map shows the jurisdictions. A given property in the MLS sample may fall within one or more districts receiving payments, or within none of the districts, based on the location of the property, as shown in Map 2.

[11] Levitan & Associates. "Indian Point Retirement Options, Replacement Generation, Decommissioning/Spent Fuel Issues, and Local Economic/Rate Impacts." (2005), p. 102: Table 24.
[12] Westchester County Geographic Information Systems Office. "Westchester County Fire District Boundaries" and "Westchester County School District Boundaries" (Cartographic boundary files wcschdst.shp and wcfirdst.shp [ESRI shapefiles]). (2007) Accessed July 30, 2011. http://giswww.westchestergov.com/wcgis/Districts.htm

Map 2. Areas Receiving PILOT Payments from IPEC

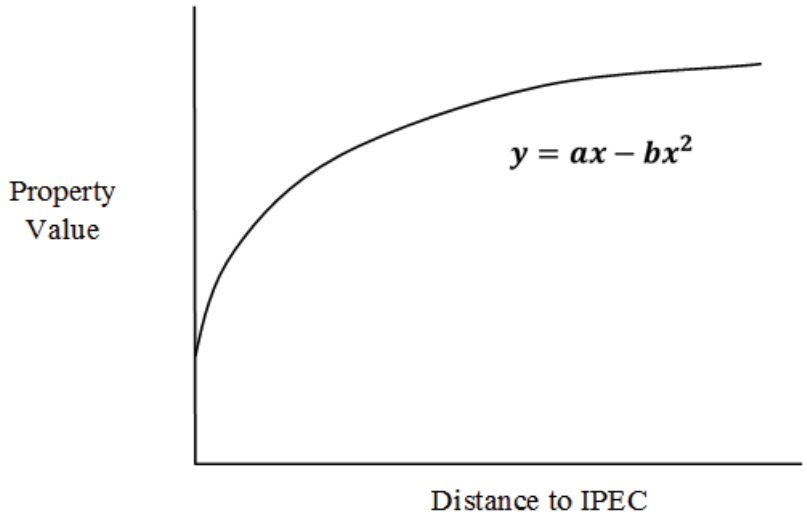


The 2011 per-household PILOT payments variable is the sum of the district-specific per-household payments for each property in the sample. It ranges in value from $9 per-household for properties in only one district (Westchester County) to $2,778 for properties in all four taxing districts. The variable is equal to zero for those properties that do not fall into any of the districts receiving payments.

The PILOT coefficient in the regression is of the expected sign. While it is not statistically significant, it supports the pattern of reasonable coefficients in the table above.

The results for the two remaining variables not yet discussed in the regression results reported in Table 1 pertain to distance of a property from IPEC. Figure 1 shows the relation between property values and distance to IPEC expected if Dr. Sheppard's hypothesis is true that proximity to IPEC depresses property values. The figure depicts the effect of a positive coefficient of Distance to Indian Point and a negative coefficient of Distance to Indian Point Squared. Property values increase moving away from the plant, reflecting the lessening of the negative impact of the supposed disamenity the farther away a property is from the plant. The property value increase is reflected in the positive coefficient of Distance to Indian Point in the regression. The impact of an increase in distance from the supposed disamenity gradually diminishes as the plant becomes a lesser concern at greater distances. The diminishing impact is imparted by the negative coefficient of Distance to Indian Point Squared. The positive slope of the relation between property value and distance from the plant diminishes as distance becomes greater. Eventually a maximum is reached where the distance is so great that there is no longer an effect of the disamenity.

Figure 1: Distance Relationship Expected if Nuclear Plant is a Disamenity

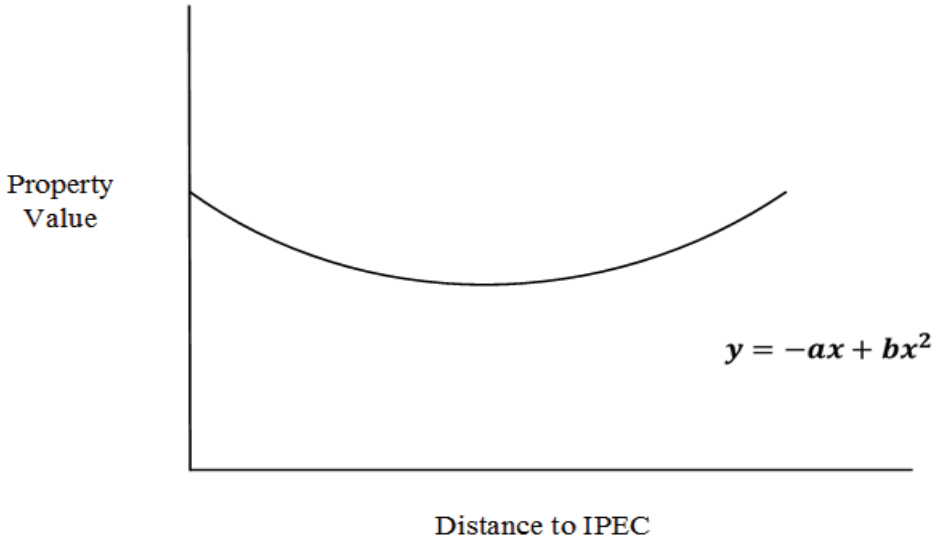


The expected relation in Figure 1, just described for the case where Dr. Sheppard's hypothesis is true, is the opposite of that obtained from the regression. The failure of the

distance results in the regression to conform to the pattern expected if his hypothesis is true indicates that the results do not support his hypothesis. In Table 1, giving the regression results, the negative coefficient of Distance to Indian Point indicates an initial negative effect of distance going away from the plant, that is, property values are lower the farther property is from the plant. If proximity to IPEC depresses property values as hypothesized by Dr. Sheppard, property values should become greater rather than less the farther property is from the plant. Acceptance of the negative linear effect would imply that being near IPEC is an amenity rather than a disamenity. The positive coefficient of Distance to IPEC Squared indicates that the negative effect of an increase in distance diminishes moving farther away from the plant. The depressing effect of distance becomes less moving away from the plant and turns up when the squared term becomes sufficiently powerful. The coefficients in Table 1 imply that nearness to IPEC is actually an amenity up to 1.99 miles from the plant, but then counter-intuitively becomes an increasingly great disamenity as distance from the plant becomes greater.[13]

Figure 2 illustrates the relation between property values and distance found in the regression results, taking account of the negative linear and positive squared distance coefficients in Table 1. Figure 2 illustrating the regression results may be compared with Figure 1 illustrating the relation expected if Dr. Sheppard's hypothesis is true.

Figure 2: Distance Relationship Found in Indian Point MLS Regression Hypothetical Amenity Relationship



If the linear term is ignored because it is statistically insignificant and the statistically significant squared term is retained, distance is everywhere a disamenity, with the disamenity effect becoming increasingly strong as distance from the plant increases. In either case, the

[13] From the regression results in Table 1, the calculation is dV/dD = -79.323- 2 x (19.901) x D = 0 where V is property value and D is distance from IPEC. The calculation gives the distance at which the effect of extra distance turns from negative to positive.

unexpected implication is that the disamenity effect is greater the farther away the property is from IPEC. The anomalous Distance to Indian Point and Distance to IPEC Squared relationship suggests the presence of an unobserved variable, but there is no reason to believe that such a variable is masking a large significant adverse IPEC property value impact.

2-4. *Conclusion*

Overall, the hedonic regression is highly reasonable. Hedonic regressions have generally given reasonable results for most variables but have sometimes encountered unmeasured effects that happen to be correlated with distance from a plant because of the difficulty of controlling for all relevant influences in a spatial context. Other examples were found in the review of previous hedonic studies in Section 1. It is often not feasible to include the many variables that depend on distance. If distance to the plant itself has no effect on property values, then the inclusion of distance to the plant in the regression is particularly likely to inadvertently pick up effects of other things affected by distance from a residence.

The important results from the hedonic regression reported in Table 1 are that it gives reasonable results and that the regression gives no support for the hypothesis that IPEC depresses property values. Sensitivity tests were run with alternative functional forms (log-log, semi-log, linear form without distance squared) that did not change the conclusion.

Section 3. Property Value Effect of Indian Point License Renewal

3-1. *Introduction*

3-1.1 *Effect of Distance from Nuclear Site*

The studies reviewed in Sections 1 and 2 were aimed at estimating how property values are affected by the distance to a nuclear plant, if at all. The estimates in Sections 1 and 2 apply to the particular time when the property value data were collected. These studies would only be directly relevant to a license renewal evaluation if the no-action alternative resulted in an instantaneously decommissioned site and if license renewal extended power generation for all time. But this is not the case. The real situation is that cessation of power generation—either with or without license renewal—will not remove effects of the plant immediately but rather will do so only after many years, due to the decommissioning period. The no-action alternative would result in cessation of nuclear generation upon a decision not to renew the operating licenses, while license extension will permit continuation of nuclear generation not for all time but for 20 years.

3-1.2 *Property Tax Revenue Effect*

If there is an effect of distance to IPEC on property values, the changed values could be expected to affect the taxable value of properties, resulting in changed property tax collections.

3-1.3 *Payments in Lieu of Taxes (PILOT) Effect*

A consideration in addition to the distance effect and property tax revenue effect is the PILOT effect of payments in lieu of taxes made to taxing jurisdiction. The no-action alternative can be expected to result in diminution of yearly PILOT payments immediately, while license renewal will permit them to continue without diminution for an additional 20 years.

3-1.4 *Total Effect*

The total effect is the sum of the distance effect, the property tax revenue effect and PILOT payment effect.

3-2. *Distance Effect in the No-Action Alternative*

The no-action alternative of license renewal denial gives a scenario in which IPEC nuclear power generation ceases, with IP2 operation assumed to cease in 2013 and IP3 in 2015. Cessation of nuclear power generation is followed by a decommissioning period lasting up to 60 years. The removal of any effect on property values of proximity to the site, if it exists, would not occur immediately but rather would be delayed until around 2073.

If there is an adverse effect of proximity to the plant, the no-action alternative therefore would not result in an impetus to a rise in property values until 2073 when decommissioning is complete. The property value effect of denial of license extension is the present value of the 2073 impetus to property value change.

From the evidence cited in Sections 1 and 2, it cannot be concluded that proximity to IPEC has an adverse effect on property values. The most defensible expectation is that the effect is zero. This finding is sufficient to end further concern with adverse effects on property values. However, to show that the conclusions of this report do not depend solely on the finding of a zero effect on property values, the results of assuming an adverse effect will be illustrated in Section 4.

3-3. *Property Tax Revenue Effect in the No-Action Alternative*

Since the most defensible expectation is that proximity to IPEC has zero effect on property values, there would be no effect on property tax revenues. Again, to show that the conclusions of the present report do not depend on the finding of a zero effect on property values, the property tax revenue in the presence of an adverse effect will be illustrated in Section 4.

3-4. *PILOT Payments in the No-Action Alternative*

PILOT payments raise property values because they can be used to provide public services which the occupants do not have to pay for through their property taxes, thereby increasing the amount that people are willing to pay for the property relative to property not benefiting from PILOT payments. PILOT payments are having a positive effect on property values at the present time. Denial of license extensions will give an impetus to a decline in land values due to effects on PILOT payments.

Full PILOT payments may be expected to continue from IPEC as long as nuclear power generation continues. At other nuclear sites where generation has been terminated, PILOT payments have also occurred during the decommissioning period but at a reduced rate. I am informed by Mr. Reamer and Mr. Cleary that, based on experience at other nuclear plants during decommissioning, a reasonable estimate is that the current level of PILOT payments could fall to a level that is 18 percent of the current PILOT payments, which amounts to a loss of 82 percent of the current PILOT payments when power generation ceases. This will act to reduce property values in jurisdictions receiving the payments in the no-renewal case.

An estimate of the effect of PILOT payments on property values, in the no-action alternative case, is the present value of the PILOT payments at a level equal to 18 percent of their existing yearly amount, or $4.32 million annually, until 2075 followed by zero PILOT payments thereafter.

PILOT payments were included in the regressions for IPEC presented in Section 2, where the source of information on IPEC PILOT payments was discussed.

PILOT payments act to increase property values, having an effect in the opposite direction from any adverse distance effects of a nuclear site. Therefore, the loss in PILOT payments, if nuclear operations are terminated, will act to reduce property values and will do so earlier in the no-action case than the license renewal case. The sooner nuclear operations are terminated, the greater will be the present value of the reduction in property values.

Note that, because the losses begin at the time generation ceases, assumed to be either 2015 with no-action or 2035 with license renewal, property value effects of loss in PILOT payments are discounted less heavily than any possible effects of proximity to the site because PILOT payments are affected in near term years, falling immediately in the no-action case while continuing with full force for the next 20 years if renewal is granted. The distance effects acting in the opposite direction of the PILOT effect occur only after completion of decommissioning many years in the future, either 2073 with no-action or 2093 with license renewal, whose present values are greatly reduced by discounting to those distant years.

3-5. *Distance Effects if Licenses Are Renewed*

The "License Renewal Alternative" refers to the scenario in which the licenses of IPEC are renewed for 20 years, with nuclear power generation extended to 2035. Given that NRC regulations allow for decommissioning to take up to 60 years, decommissioning of IPEC is assumed to be completed in 2093. As indicated in Sections 1 and 2, proximity to IPEC is estimated to have no discernible adverse impact on residential property values. Thus, the present value of the amenity impact of IPEC on property values between now and 2093 will also be zero, regardless of the discount rate used. Again, however, the effect of a nonzero distance effect will be considered in Section 4 to bring out the impact of other considerations.

3-6. *PILOT Payments if Licenses Are Renewed*

For the renewal alternative, it is assumed that PILOT payments would continue at their current levels, or $23.99 million annually, for another 20 years, i.e., until 2035. The payments then fall to an estimated 18 percent of the current levels, or $4.32 million annually, until 2095, after which they would be zero.

The contribution of PILOT payments to property values is the present value of continuation of payments until 2035, PILOT payments at 18 percent of current levels from 2036 to 60 years later, falling to zero in 2095.

3-7. *Discount Rate Applied to Future Values*

Estimation of both the effects of distance to the site and effects of PILOT payments requires calculation of present values using a discount rate. Because people favor benefits now to benefits later, and because the future is inherently uncertain, a $1 payment today is preferred to a $1 payment 60 years from now. Using a discount rate in the evaluation of future scenarios allows researchers and policy makers to properly weigh the costs and benefits of a proposed action when these costs and benefits either accrue over a period of many years or at a single point in time many years in the future. Discounting lessens the impact of the costs and benefits that arise further in the future relative to those costs and benefits that occur in periods closer to the present. This calculation gives the present value, or what these costs and benefits are worth today. The net present value is the sum of the future benefits less the sum of the future costs.

Seven percent is a discount rate recommended by the Nuclear Regulatory Commission best practices guidelines. It is a discount rate that broadly estimates the pre-tax rate of return to private capital.[14] This rate does not take into account the constraints consumers face since they cannot typically borrow and lend freely at this rate, and it does not allow for high rates of time preference. Seven percent will be used in the calculations here as a conservatively low estimate. The discount rate used by property owners in purchasing a residence is not directly observable but is almost certainly greater than 7 percent. Econometric studies estimating discount rates used by consumers in the purchase of durable goods on the basis of indirect evidence have estimated them to be well above observed market interest rates.[15]

The 4 percent discount rate used in Dr. Sheppard's report in my judgment is far too low. If intended as a real mortgage rate, it is a rate for a secured loan with house as collateral with strict limits on borrowing conditions. The use of a mortgage rate of interest to discount effects of future events on property values is inappropriate because the rate of interest charged on a mortgage is less than the discount rate of concern to buyers and sellers of real estate. A mortgage rate is a rate paid to a lender whose risk is reduced by the collateral of the residence to secure the loan, whereas the appropriate discount rate for the buyer of a residence is higher because the buyer's risk is actually increased rather than decreased by a mortgage loan. For example, the residence will be lost if the risk of missed mortgage payments materializes, causing a potentially greater loss to the buyer whereas the lender acquires a valuable tangible asset.

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[14] U.S. Office of Management and Budget, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Program.s* Circular No. A-94 (October 1992), pp. 7-10; U.S. Nuclear Regulatory Commission, *Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission.* NUREG/BR-0058 Rev. 4 (September 2004).

[15] Dr. Sheppard has ignored the distinction between a market borrowing rate and a discount rate used by consumers to balance present versus future outcomes in their personal decisions. Jerry A. Hausman, "Individual Discount Rates and the Purchase and Utilization of Energy-Using Durables," *The Bell Journal of Economics* 10 (1979), pp. 50-51 estimated individual discount rates between 14.8 percent and 26.4 percent. Jeffrey A. Dubin and Daniel L. McFadden, "An Econometric Analysis of Residential Electric Appliance Holding and Consumption*," Econometrica* 52 (1984), p. 354 estimated a discount rate of 20.5 percent.

In fact, empirical studies indicate that discount rates for consumers in their purchases of consumer durables are approximately 20 percent. *See* Jerry A Hausman, "Individual Discount Rates and the Purchase and Utilization of Energy-using Durables" (1979); Jeffrey A. Dubin and Daniel L. McFadden, "An Econometric Analysis of Residential Electric Appliance Holdings and Consumption" (1984). Thus, even allowing for inflation, the real rate of interest would be 18 percent, a far more appropriate discount rate than the four percent discount rate selected by Dr. Sheppard.

Furthermore, a discount rate should be applied using the standard procedure of a finite cut-off time horizon. The procedure is consistent with the idea people in their thinking about the future have limited horizons. The future becomes increasingly uncertain as increasingly distant years are contemplated, making the risk attached to distant outcomes higher. Beyond some point, the most realistic decision-making procedure is not to count them at all, but rather to focus instead on the more important near-term events that will affect well-being within buyers' lifetimes.

In the case of IPEC, current land use in the vicinity of the plant entails a variety of residential, industrial and public uses. It is difficult to predict land use changes 60 years in the future because so many unforeseen influences can emerge over this long time span. While the same factors that influence current land use patterns may continue to some extent in the future, the extent of their influence is uncertain. Post-closure land use in the vicinity of the plant site, as well as at the site itself, will be influenced by unpredictable considerations including: a) growth or lack of growth of economic activity influencing future industrial growth and its nature; b) the nature, density and extent of future residential development; and, c) behavior of local government entities regarding public uses of land as well as zoning, taxation and expenditure decisions.

Given the difficulty of grappling with imponderable future events, people have their hands full dealing with events closer at hand that are of more immediate importance. A 25-year cutoff may be a generous estimate of the horizon within which future events are of concern. If, contrary to the estimates in Sections 1 and 2 that there is no effect of plant proximity on property values, there were in fact a property value effect leading to a property value rebound after decommissioning, the rebounds would occur at the earliest in 2073. This is far beyond a 25-year cutoff and so realistically would be not be expected to influence current property values at all.

To arrive at a conservatively low estimate of the effects of discounting, my calculations assume a 7 percent discount rate with an infinite horizon where a cutoff horizon does not reduce present values.

3-8. *Property Value Effect as the Difference Between Present Value of Renewal and No Action*

The effect of license renewal on property values may be estimated as the difference between the present value if the licenses are renewed and the present value if not renewed, taking account of distance effects and PILOT payment effects. The calculation is:

Effect of Distance from Site

Difference in Present Value of Distance Effect Between Ceasing Operations in 2035 and 2015:

$0 *minus* $0 *equals* $0

Plus

Dr. Sheppard's Property Tax Revenue Effect

Difference in Present Value of Tax Revenue Between Ceasing Operations in 2035 and 2015:

$0 *minus* $0 *equals* $0

Plus

PILOT Payment Effect

Difference in Present Value of PILOT Payments Between Ceasing Operations in 2035 and 2015:

$279.04 million *minus* $96.33 million *equals* +$182.72 million

Equals

Total Effect

+$182.72 million

The total effect, as the sum of the distance effect and the PILOT payments effect is $0 + $182.72 million, or simply $182.72 million. Dividing by 12,933 housing units Dr. Sheppard addressed in his 2007 report, this gives a per-household net present value positive impact of license renewal of $14,128.

Because PILOT payments are reduced beginning in 2016 under the no-action alternative but continue in full force for an additional 20 years under license renewal, the present value is substantially *higher* rather than lower with license renewal. See Appendix for details of calculations.

PART TWO:

CRITICISM OF DR. SHEPPARD'S INDIAN POINT WORK

Section 4. Criticism of Dr. Sheppard's 2007 Report

4-1. *Dr. Sheppard's Negative Property Value Effect Should Have Been Zero*

Dr. Sheppard used an irrelevant and unjustified negative property value effect, instead of a correct value of zero. Dr. Sheppard's analysis for IPEC improperly assumed that the effect on property values of proximity to IPEC could be based on a 1974 study by Blomquist,[16] research that examined the effect on property values of a small, old coal-fired power plant in a densely populated wealthy suburb of Chicago.

Dr. Sheppard's estimate using the study by Blomquist is the basis of his claim that IPEC has a negative effect on property values. Building on Blomquist's findings, Dr. Sheppard developed the estimate that the presence of IPEC caused a $576 million property value loss.

Yet the review of evidence from studies at other nuclear sites (Section 1) and my direct estimate using IPEC evidence (Section 2) indicate that *the most likely estimate is zero*. The conclusion from these studies is that there is no reliable basis for concluding that proximity to a nuclear power plant has an impact on residential property values. This error in itself is sufficient to invalidate the basis of Dr. Sheppard's report.

The coal plant results are inapplicable to the area surrounding IPEC because of the nature of coal plants in general and because of the particular nature of the Winnetka power plant studied by Blomquist.

First, air pollutants from coal plants act to depress surrounding property values due to potential health effects. In contrast, nuclear plants emit no air pollutants as part of the electrical generation process.

Second, the Winnetka power plant and residential properties in surrounding areas are particularly bad choices for use in estimating the effects of IPEC on surrounding areas. This study of the impact of a coal-fired power plant overstates the effects even for contemporary coal plants. Blomquist (1974) estimated effects of a small, old coal-fired power plant on housing values in Winnetka, Illinois, one of the highest-income regions in the country. The Winnetka plant was over 70 years old at the time the Blomquist's article was written, and it was most likely not using what would have been clean technologies for the time. Additionally, the plant would have had no pollution abatement equipment installed, since the Clean Air Act leading to controls was not enacted until 1972.

[16] Glenn Blomquist, "The Effect of Electric Utility Power Plant Location on Area Property Value," *Land Economics* 50 (1974), pp. 97-100.

4-2. *Dr. Sheppard Over-Estimated Effects on Rental Properties*

Dr. Sheppard speculated that renters would exhibit the same valuation of the proximity of a nuclear power plant as owners. However, peer-reviewed studies have found that renters place a lower value on amenities than owners.[17] Linneman (1980) uses a sample of individual residential housing units from the American Housing Survey to compare the difference in the amount that renters and owners in Los Angeles and Chicago pay for housing units with the best and worst site characteristics. Linneman finds that owners place a higher value on desirable neighborhood characteristics than do renters (ibid, pp. 56-58). Dr. Sheppard attributes part of this difference to the fact that renters and owners are not randomly selected groups. Individuals decide to rent or own their dwelling based on factors such as household income and planned duration at the residence. These characteristics influence valuation of amenities and disamenities. Feitelson et al. (1996) used a willingness-to-pay survey to estimate the difference between renters and owners in their valuation of airport noise in their demand for housing. After noting explicitly the numerous demographic differences between renters and owners in their sample, the authors find that owners are willing to pay a higher premium than renters to avoid airport noise (ibid, pp. 9-12).

These results indicate that there is no justification for applying the same impact on rental and owner-occupied housing units. By doing so, Dr. Sheppard inaccurately inflates his estimated impact of IPEC on area housing values.

4-3. *Dr. Sheppard's Abnormally High Housing Prices Overstated Property Value Effects*

Dr. Sheppard's conversion of housing values from prices in the first quarter of 2000 to prices in the first quarter of 2007 incorporates the rise in house prices associated with the housing price bubble of that time. Dr. Sheppard uses the Office of Federal Housing Enterprise Oversight [OFHEO] House Price Index for single family homes in New York State.[18] Drawing on the House Price Index data current at the time of his writing, Dr. Sheppard uses a 93 percent increase in prices. These data have been subsequently revised by OFHEO, and the current change in housing prices between the first quarter of 2000 and the first quarter of 2007 is 84 percent. However, this price adjustment still incorporates the housing bubble that has since burst. Using the current OFHEO House Price Index for New York State to adjust housing values from the first quarter of 2000 prices to the first quarter of 2011 prices results in a 71 percent increase, which is substantially smaller than the increase in housing values used by Dr. Sheppard.

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[17] The hedonic price study is Peter Linneman, "Some Empirical Results on the Nature of the Hedonic Price Function for the Urban Housing Market," *Journal of Urban Economics* 8 (1980), pp. 47-68; the willingness-to-pay study is Eran I.Feitelson, Robert E. Hurd, and Richard R. Mudge, "The Impact of Airport Noise on Willingness to Pay for Residences," *Transportation Research* D 1 (1996), pp. 1-14.

[18] Office of Federal Housing Enterprise Oversight. House Price Index: Sales-Only, New York State. Accessed October 19, 2011. http://www.fhfa.gov/Default.aspx?Page=87

Section 5. Criticism of Dr. Sheppard's January 2011 Report

5-1. *Dr. Sheppard's Future Scenarios Discriminated Against License Renewal*

Dr. Sheppard appears to agree that you need to look well into the future when the plant is decommissioning to estimate any license renewal impacts. To do so, he calculated what he considered to be costs resulting from four scenarios relative to a baseline scenario in which licenses are not renewed. Dr. Sheppard defined the cost as the difference in present value of property values between a scenario and the baseline. Dr. Sheppard's $576 million estimate of the property value loss described in his 2007 report was discounted using his low discount rate for the number of years indicated by the assumed length of the decommissioning period in each scenario as follows:

Table 2. Dr. Sheppard's January 2011 Report Scenarios

Scenario	*End of IPEC Operations*	*End of IPEC Decommissioning*	*Length of Decommissioning Period*	*Difference between Scenario Impact and Baseline*
Baseline	2015	2047	32	-
1	2015	2077	62	$169,429,649
2	2035	2077	42	$169,429,649
3	2035	2107	72	$221,667,973
4	2035	2137	102	$237,774,023

In Dr. Sheppard's baseline scenario, reactor operations end in 2015 and decommissioning is completed by 2047. In the first alternative scenario, licenses are not renewed so that reactor operations again end in 2015, but decommissioning lasts to 2077. In the remaining scenarios, licenses are renewed, and reactor operations continue to 2035, with decommissioning in the scenarios lasting alternatively until 2077, 2107, and 2137.

The cost calculated by Dr. Sheppard of scenario one and scenario two is $169 million. Dr. Sheppard calculates the cost of scenario three as $222 million, and the cost of scenario four as $238 million.

Dr. Sheppard makes no reference to the NRC's allowance for up to a 60-year decommissioning period. Dr. Sheppard discriminated against license renewal, by assuming that decommissioning time is shorter for non-renewal than renewal. Dr. Sheppard used a baseline scenario with an unjustifiably short 32-year decommissioning period, half the decommissioning time permitted by NRC guidelines. Dr. Sheppard's last two scenarios assume extended decommissioning periods of 72 and 102 years, which are both greater than the decommissioning period permitted by NRC, without explanation.

5-2. *Dr. Sheppard's Discounting of Future Events Is Too Low*

One of Dr. Sheppard's most serious errors was to use too low a discount rate. Dr. Sheppard used 4 percent but should have used a more realistic rate, such as 7 percent or higher with a cutoff of 25 years or less. This issue was discussed at some length in Section 3-6 above.

5-3. *An Egregious Error by Dr. Sheppard is Treatment of PILOT Payments*

Dr. Sheppard assumed that PILOT payments would be the same under the no-action case as under renewal, without any justification. If Dr. Sheppard had included differences in PILOT payments, with PILOT payments ending sooner under no-action than renewal, his estimates of cost of renewal would be *not a cost*, *but a gain* to renewal. The positive PILOT effect is great enough to swamp all the worst case negative effects posited by Dr. Sheppard.

As demonstrated in Section 1 and Section 2 of this report, there is no justification for a negative distance effect. Even so, the magnitude of the combined negative effects used by Dr. Sheppard is small relative to the positive effects of PILOT payments.

5-4. *Dr. Sheppard's Method with Correct Decommissioning Period and Incorrect PILOT Payments*

Assuming that Dr. Sheppard's $576 million distance effect of IPEC on surrounding property values is correct, though there is no evidence to support his estimate, it is possible to calculate what Dr. Sheppard's net impacts would be if he used the NRC allowance for decommissioning period of 60 years and a discount rate of 7 percent. This calculation is:

Dr. Sheppard's Effect of Distance from Site

Difference in Present Value of Distance Effect Between Ceasing Operations in 2035 and 2015:

$2.57 million *minus* $9.94 million *equals* -$7.37 million

Plus

Dr. Sheppard's Property Tax Revenue Effect

Difference in Present Value of Tax Revenue Between Ceasing Operations in 2035 and 2015:

$0.87 million *minus* $3.35 million *equals* -$2.49 million

Plus

Dr. Sheppard's PILOT Payment Effect

Difference in Present Value of PILOT Payments Between Ceasing Operations in 2035 and 2015:

$282.06 million *minus* $282.06 million *equals* $0

Equals

Dr. Sheppard's Total Effect

-$9.86 million

By using a 60-year decommissioning period based on NRC's allowance, and a 7 percent discount rate instead of Dr. Sheppard's arbitrary values, his estimated impact of renewal on property values shrinks from a loss of between $169 million and $238 million in the scenarios in his 2011 report to just $9.86 million.

To isolate the discount rate effect, performing these same calculations using Dr. Sheppard's unjustifiably low 4 percent discount rate, but retaining the 60-year decommissioning period based on NRC's allowance results in an estimated loss of $47.33 million. See Appendix for details of calculations.

5-5. *Dr. Sheppard's Method with Correct Decommissioning Period and Correct PILOT Payments*

Dr. Sheppard's assumption that PILOT payments are identical under both the renewal and no-action scenarios is also incorrect. Including the correct assumptions about differences in PILOT payments and again using a 60-year decommissioning period shows that the magnitude of the combined negative effects used by Dr. Sheppard is very small relative to the positive effects of PILOT payments, the calculation of which is outlined in detail above. The result, even including all of Dr. Sheppard's unwarranted negative impacts of license renewal, is a net positive impact of license renewal on area residents. In other words, license renewal results in a net gain to residents in the area surrounding IPEC. Using a 7 percent discount rate, this calculation is:

Dr. Sheppard's Effect of Distance from Site

Difference in Present Value of Distance Effect Between Ceasing Operations in 2035 and 2015:

$2.58 million *minus* $9.94 million *equals* -$7.37 million

Plus

Dr. Sheppard's Property Tax Revenue Effect

Difference in Present Value of Tax Revenue Between Ceasing Operations in 2035 and 2015:

$0.87 million *minus* $3.35 million *equals* -$2.49 million

Plus

Correct PILOT Payment Effect

Difference in Present Value of PILOT Payments Between Ceasing Operations in 2035 and 2015:

$279.04 million *minus* $96.33 million *equals* +$182.72 million

Equals

Dr. Sheppard's Total Effect

+$172.86 million

In short, the $172.86 million positive effect on property values is the result of a $182.72 million gain from greater PILOT payments that occur with re-licensing, which swamps the -$9.86 million in unwarranted negative effects based on Dr. Sheppard's calculations. See Appendix for details of calculations.

Section 6. Criticism of Dr. Sheppard's December 2011 Report and Testimony

6-1. *Dr. Sheppard's New and Unprecedented Method*

In the December 2011 NYS filing, Dr. Sheppard has turned away from the commonly used hedonic regression approach. Studies were reviewed in Section 1 above that have used hedonic regressions to estimate land value effects of proximity to a nuclear plant by separating out the effects of other characteristics affecting property value. My hedonic regression results for the IPEC site were presented in Section 2 above.

Instead of directly estimating effects of a nuclear plant on property values, Dr. Sheppard adopts a new approach that attempts to infer effects by attempting to calculate financial returns to holding a property over various time periods. Dr. Sheppard used a sample of properties in the Village of Buchanan and the Towns of Cortlandt and Peekskill if the properties were located within 3.1 miles (5 kilometers) of the IPEC site and if they were sold between 1999 and 2009. Comparing the sales price when a property was sold with the sales price when the property had previously been sold, he estimated the financial return to holding the property from time of purchase to time of sale. Financial return was calculated as the annual yearly compounded rate of return from holding the property.

The records for properties sold in his 1999-2009 sample period contained historical information on sales of any of these properties that happened to occur prior to 1999, though not all properties in the sample contain pre-1999 sales. Properties that were bought and sold before 1999, but did not turn over after 1999 are excluded. Dr. Sheppard's sample is thus a partial sample of properties bought and sold over the period he analyzes. Using his partial sample, Dr. Sheppard was able to estimate earlier returns to holding properties in his sample that had turned over one or more times prior to the most recent sale, going back to before 1960. All of the properties had been sold at least twice, 9 being the largest number of repeat sales of properties in the sample and 5 being the average. Dr. Sheppard constructed a dataset based on 507 properties, almost exclusively from his 1999-2009 sample. According to Dr. Sheppard, a small number of properties not obtained from the 1999-2009 sample were also included. Dr. Sheppard does not identify these observations individually and did not discuss why they were included. Because of repeat sales among the 507 properties in his sample, Dr. Sheppard was able to calculate returns for 1,511 sets of transactions with sales from before 1960 to the last observation in the sample in 2009.

Dr. Sheppard's reliance on returns before the 1999-2009 period is crucial to his analysis. It is to be emphasized that his estimates of earlier returns are based on properties that were sold in the 1999-2009 period that also happened to change hands before 1999. With minor exceptions, Dr. Sheppard's sample does not include any properties that changed hands before 1999 unless they conformed to the special case of also happening to be sold in the 1999-2009

period.[19] Dr. Sheppard's sample is thus weighted toward transactions of properties that changed hands well after the period of interest in his analysis, 1974-1976.

Dr. Sheppard likens 1974-1976 to an "event." Dr. Sheppard defined the "event" as IP2 and IP3 commencing operations. Dr. Sheppard argues that anyone holding these properties within 5 kilometers of the IPEC site in 1974-1976 would have suffered a property value decline, resulting in a lower return on the property if the holding period was from *before 1974* to *after 1976* (the "treatment group") than if the holding period was entirely before 1974 or entirely after 1976 (the "control group").

Dr. Sheppard compares returns on properties for which the holding period was from *before 1974* to *after 1976* (the "treatment group") to returns for which the holding period was entirely before 1974 or after 1976 (the "control group.") He expects to find returns for the "treatment group" to be lower than for the "control group" with the difference reflecting the lowering of property values due to IP2 and IP3 commencing operations.

In reviewing Dr. Sheppard's method, simple averages were calculated for the control group and treatment group. 1,347 estimated returns in his sample are for the "control group" with holding periods either entirely before 1974 or entirely after 1976. Averaging over all the "control group" observations gives a return of 9.4 percent per year.

164 estimated returns are calculated for the "treatment group" with holding periods that begin before 1974 and end after 1976. Averaging over the "treatment group" observations gives a return of 7.2 percent per year.

The difference between the "control group" return and the "treatment group" return is an estimate of the effect of IP2 and IP3 on property values using Dr. Sheppard's approach.

Dr. Sheppard's logic appears to be that owners who held property during the 1974-1976 period suffered a property value loss that caused them to receive a lower rate of return to holding the property than owners who held property near IPEC but not during the 1974-1976 period. The difference between rates of return of 9.4 percent minus 7.2 percent, or 2.2 percent per year, is Dr. Sheppard's estimate of the annual loss if the property holding period included the 1974-1976 period.

The total property value loss if property was held during the 1974-1976 period is estimated to be the annual loss compounded over the years the property was held. Dr. Sheppard uses an average holding period of 8.19 years. An annual loss of 2.9 percent from Dr. Sheppard's regression reproduced below as Table 5 (which is similar to the 2.2 percent estimate in the

[19] Dr. Sheppard notes that the sample includes "a small number of other properties sold outside this time period" (p. 5). Dr. Sheppard does not discuss these properties sold outside the 1999-2009 period. As nearly as can be made out, there are 4 properties out of the total of his 507 properties that are only associated with sales prior to 1999. One would not expect them to materially affect the results given their small number. If they did make a material difference, one would expect a fuller discussion to be provided. One is left mystified as to why these observations are included and how they were selected for inclusion.

preceding paragraph) compounded over his assumed holding period of 8.19 years gives a total loss of 27 percent, which is Dr. Sheppard's estimate of the loss in property value due to proximity to IPEC. Dr. Sheppard applies his 27 percent property value loss to his estimate of the total value of affected property in 2000, inflated to adjust to 2011 values, arriving at an estimated property value loss of approximately $1 billion (Dr. Sheppard December 2011, p.12).

Dr. Sheppard did not predict when the alleged recovery of property values would happen, or apply a horizon cut-off or discount rate to estimate the difference between license renewal and the no-action alternative. Nor did his evaluation account for PILOT or property tax payments as was done in his January 2011 Report.

Taken uncritically, the foregoing comparison appears to corroborate Dr. Sheppard's hypothesis that holding properties within 5 kilometers of the Indian Point site during the 1974-1976 period acted to lower returns. But I will show that there is no basis for Dr. Sheppard's hypothesis and that the method he uses to test his hypothesis is invalid.

6-2. *Dr. Sheppard's Unexplained Abandonment of Coal Plant Approach*

Neither Dr. Sheppard's December 2011 report nor his pre-filed testimony mentions the article by Blomquist that had figured so prominently in his 2007 report.

Dr. Sheppard had relied on the article by Blomquist as the cornerstone of his claim that IP2 and IP3 depress land values. In the December 2011 filing, the only mention of coal plant effects is in a fleeting question and answer passage in Dr. Sheppard's pre-filed testimony (page 12, Prefiled Written Testimony of Dr. Stephen C. Sheppard, Contention NYS-17B):

> Q. Is there any difference, for purposes of your analysis, between a coal-fired electric generating facility and an electric generating facility that is nuclear powered?
> A. Not in the methodology used to measure the impact, although the actual impact itself might be very different.

Nothing is heard again of coal plants or the study by Blomquist. By stating that the impacts of a coal-fired and nuclear plant "might be very different" and by abandoning use of the study by Blomquist, Dr. Sheppard appears to be admitting that his earlier analysis was in error.

6-3. *Dr. Sheppard's Extraordinarily Large Number of Data Errors*

Dr. Sheppard's work contained an extraordinary number of data entry errors. Dr. Sheppard claims to have personally supervised the data entry process and to have been "in regular contact with [the] office undertaking the data entry" (Dr. Sheppard December 2011, p. 6). A

review of the Assessor's property cards, the source of Dr. Sheppard's data, reveals an error rate in the final sample so high that the usability of his empirical findings must be questioned.

The most common error was found to be the inclusion of a previous sale of an empty lot and a subsequent sale of a completed residence in the calculation of rate of return. These observations neglect the cost of building a residence on the property during the time it is held, thus grossly distorting the net return to holding the real estate by leaving out a major expense. Among other errors were inclusion of: a) typographical errors in the sale date or price for a transaction; b) transactions between family members, which should be excluded because they are not arm's length market transactions and are subject to personal family motivations; c) foreclosures and auctions, which are also not ordinary market transactions; d) properties in which the residence was destroyed in a fire or demolished between two transactions, leading to effect of losses in value not accounted for in the rate of return; e) transactions of commercial properties; f) sales prices marked as "unverified" by the Assessor; g) sales prices that were noted by the Assessor as FHA-subsidized purchases that are marked as "not indicative of market value"; h) transactions involving large purchases of land that were subsequently subdivided and developed into residential housing; (i) typographical errors in the address of the property or other geo-coding errors that caused properties to be assigned to incorrect locations by Dr. Sheppard; and, (j) incorrect inclusion of some observations whose distance from the IPEC site was greater than 5 kilometers.

The seriousness of the above errors is suggested by the following count. Out of a total of 1,511 observations in Sheppard's basic regression (reproduced below as Table 5 of the present report) 425 observations or over one-quarter of the observations (28 percent) were found to be ineligible for inclusion in the regression. As a breakdown of this total, out of the 164 of Sheppard's observations in the "treatment group," 86 observations or over one-half (52 percent) are ineligible for inclusion. Out of the 1,347 Sheppard observations in the "control group," 339 observations or one-quarter (25 percent) are ineligible for inclusion.

6-4. *Dr. Sheppard's Failure to Use a Realistic Control Group*

6-4.1 *Abnormality of 1999-2009 Housing Bubble*

Dr. Sheppard's use of the difference in average annual returns between the "treatment group" and the "control group" as a measure of the effect of 1974-1976 events would be straightforward if there had been one constant yearly rate of return to holding property in every year except for a lower rate of return for the1974-1976 period. This condition is not even approximately fulfilled over Dr. Sheppard's long sample period extending from before 1960 until 2009.

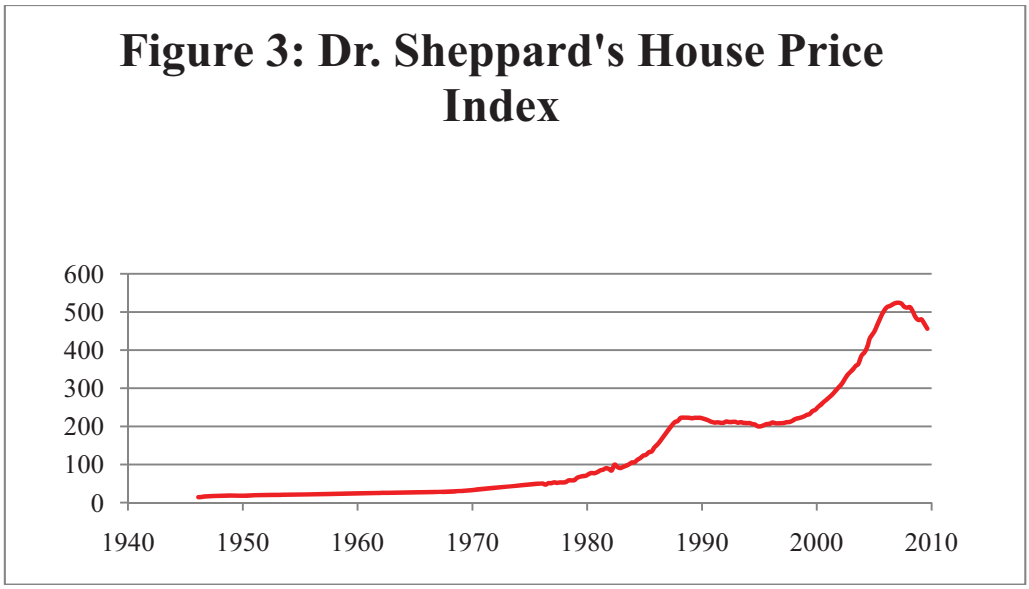
Dr. Sheppard's comparison is not valid because the distribution of holding periods for the "treatment group" and the "control group" are different, and returns to holding property varied over the sample period for reasons other than a possible 1974-1976 effect.

Periods of unusually high returns in years long after 1974-1976 that affected the "control group" more than the "treatment group" attest to the importance of this problem. The "control" group observations include 1999-2009, which is the period during which the housing bubble affecting all parts of the U.S. economy led to skyrocketing property values that were historically unprecedented. Returns to selling property in this period were correspondingly unprecedentedly high. Housing prices began to fall after 2006, but the price correction was far from complete by 2009. House prices in 2009 were still above their levels in 2000. Even those sales that occurred after the peak in 2006 gave unprecedented returns in many cases.

The phenomenon of historically different returns in different periods is reflected in the house price index for the metropolitan region in which Indian Point is located. A price index for this region was prepared by Dr. Sheppard himself, using an average of official OFHEO housing price indexes for the New York City-White Plains and Poughkeepsie metropolitan areas. The index is reproduced on the following page from Dr. Sheppard's work and is labeled Figure 3. Dr. Sheppard used this index for a different purpose, namely to translate his estimates of dollar property value effects for earlier years into 2011 prices. He failed to note that his price index gives evidence of the existence of differences in returns not connected with his 1974-1976 period that affect returns to the "treatment group" and the "control group" differently.

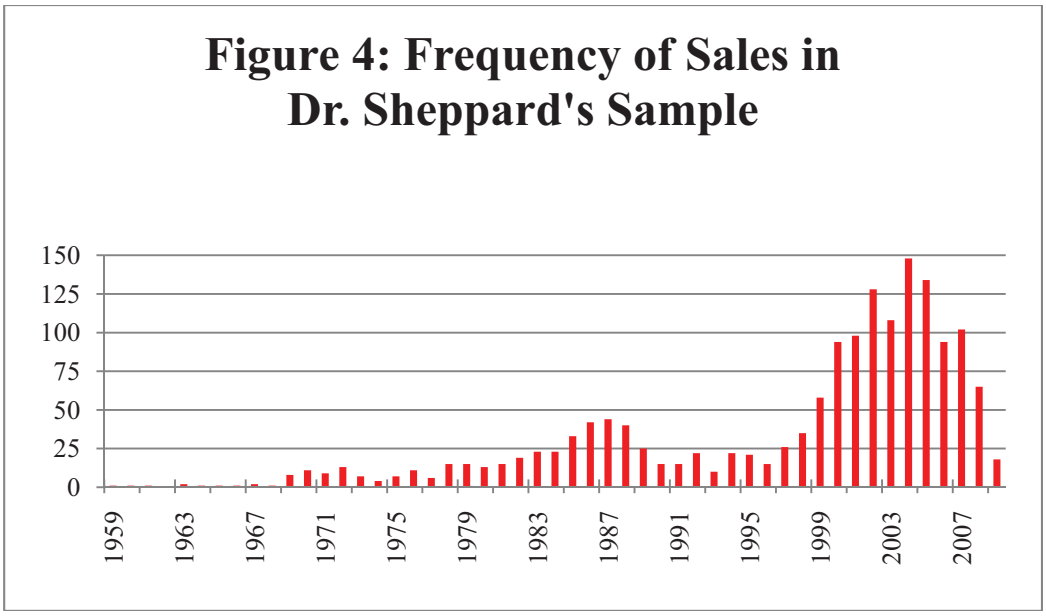
Of particular importance is the unprecedented national housing bubble in the early 21st century, reflected in the sharp rise in Dr. Sheppard's price index on the far right-hand side of the graph beginning in 1999 in Figure 3, replicated from the figure provided by Dr. Sheppard on page 10 of his December 2011 report. The "control group" observations were much more heavily weighted toward the post-1999 period than the "treatment group" observations. 958 of the 1,347 transactions in the "control group," or 71 percent, occurred after 1999, whereas 47 of the 164 transactions in the "treatment group," or 28 percent, occurred after 1999.

Even if holding a property during 1974-1976 had no effect whatsoever on returns, the average rate of return for the "control group" would have been made higher than for the "treatment group" because of the greater influence of the housing bubble on average returns for the "control group" which included more observations with abnormally high returns in later years than for the "treatment group," the great majority of whose observed returns occurred long before the abnormally high returns of the bubble years.



The effect of the housing bubble on the "control group" is made more pronounced by the odd nature of Dr. Sheppard's sample of housing returns which contains progressively fewer observations going back in time. The sample of observations is weighted especially strongly toward 1999-2009 transactions from which the sample of properties actually came. Figure 4 on the following page shows a plot of the number of observations by year of property sales in Dr. Sheppard's sample.

The declining frequency of sales in his sample going back in time demonstrates the sparseness of observations from the earlier periods which are of main concern in Dr. Sheppard's study. The heavy weighting of observations toward the 1999-2009 period accentuates the effect of later abnormally high returns on the return to the "control group." A valid "control group" must refer to returns that would have been realized in the absence of the 1974-76 "treatment." Since the returns to the "control group" as defined by Dr. Sheppard varied greatly over time, the question arises as to which returns to use in choosing a "control group." Dr. Sheppard's hypothesis is that property values suffered a permanent decrease from what they would have been in the absence of IP2 and IP3 and that this led to a lower return on holding property at that time within 5 kilometers of the site. Owners who divested themselves of properties prior to 1974-76 would not be affected. After 1974-1976, the land value effect would be capitalized into lower prices paid for the property and would be taken account of by buyers so that subsequent owners would not suffer the financial loss and their returns to holding the property would not be affected. Abnormally high returns due to a housing bubble that occurred more than 20 years after 1974-1976 patently have nothing to do with this process. Dr. Sheppard would need a "control group" not affected by confounding events.



While very far from perfect, eliminating returns to ownership during the 1999-2009 period would remove perhaps the worst offending period and represent some improvement. As shown in Table 3 below, deleting 1999-2009 reduces the number of observations in the "control group" from 1,347 to 389. The average yearly rate of return for the "control group" is reduced substantially, from the previous 9.4 percent to 4.8 percent. The number in the "treatment group" goes from 164 to 117, with a change in average yearly rate of return from 7.2 percent to 7.3 percent, which is essentially no change at all.

Table 3. The Effect of the 1999-2009 Housing Bubble Period on Mean Nominal Returns in Dr. Sheppard's Sample

	Control Group		*Treatment Group*	
	Full Sample	With 1999-2009 Removed	Full Sample	With 1999-2009 Removed
Number of Observations	1,347	389	164	117
Mean Nominal Return	9.4%	4.8%	7.2%	7.3%

The rate of return for the "control group" is now actually less than for the "treatment group." In short, the hypothesis that holding property within 5 kilometers of the Indian Point site in 1974-1976 lowered returns does not survive the common sense procedure of using a sample of returns from which the most anomalous observations have been removed.

6-4.2 *Abnormality of 1984-1987 Price Surge*

Inspection of the house price index in Figure 3 reveals that 1984-1987 was another period of high returns. As with 1999-2009, the 1984-1987 period had nothing to do with IP2 and IP3. The abnormality of the period is revealed in Figure 3 showing that the frequency of sales during the 1984-1987 price rise underwent a bulge similar to the bulge during 1999-2009. As shown in Table 4 below, by removing both 1984-1987 and 1999-2009 sales from the sample, the average yearly rate of return for the "control group," which now has 291 observations, is changed to 2.0 percent. The sensitivity of returns to definition of the "control group" is thus further revealed. The average yearly rate of return for the "treatment group," which now has 82 observations, remains fairly stable and is 6.8 percent.

Table 4. The Effect of the 1999-2009 Housing Bubble Period and 1984-87 Price Surge on Mean Nominal Returns in Dr. Sheppard's Sample

	Control Group			*Treatment Group*		
	Full Sample	With 1999-2009 Removed	With 1999-2009 and 1984-1987 Removed	Full Sample	With 1999-2009 Removed	With 1999-2009 and 1984-1987 Removed
Number of Observations	1,347	389	291	164	117	82
Mean Nominal Return	9.4%	4.8%	2.0%	7.2%	7.3%	6.8%

The deletion of 1984-1987 in addition to 1999-2009 strengthens the finding that removal of anomalous observations invalidates the argument that holding property within 5 kilometers of the Indian Point site in 1974-1976 lowered returns.

6-4.3 *Dr. Sheppard's Results as Affected by 1999-2009 and 1984-1987*

Dr. Sheppard's Regression as Reported

The foregoing results based on simple tabulations of returns for the "treatment group" and the "control group" are corroborated by Dr. Sheppard's econometric result. Dr. Sheppard's econometric analysis embeds the tabulations in an indicator variable as part of a multiple regression. Dr. Sheppard runs a regression in which the dependent variable being explained is the average annual rate of return in his sample of properties sold in the 1999-2009 period that includes not only returns on the 1999-2009 sales but also on sales prior to that period for any of the properties in his sample that had turned over in previous years going back to before 1960. The dataset was described in Section 6-1. Dr. Sheppard reports his regression result (December 2011, p. 9) as follows:

Table 5. Dr. Sheppard's December 2011 Regression Result Dependent Variable: Average Annual Rate of Return During Holding Period				
	Coefficient	Std. Error	t-statistic	P>|t|
Sale in treatment group	-0.02936	0.00842	-3.48	0.001
IPEC distance (km)	-0.01808	0.0056	-3.23	0.001
Constant	0.15855	0.01961	8.09	0.000

One of Dr. Sheppard's independent variables is the zero-one indicator variable, referred to as 'Sale in treatment group', specifying whether the observation is in the "treatment group" consisting of the subset of properties held in 1974-1976 (i.e., purchased before 1974 and sold after 1976) as opposed to being in the "control group" consisting of returns on sales of all other properties in the sample. The coefficient of interest is -0.02936 in the upper left corner for 'Sale in treatment group' implying that being in the "treatment group" lowers the yearly rate of return 2.9 percent below the average rate of return for the entire sample of 9.2 percent as reported on page 8 of Dr. Sheppard's December 2011 report. This regression result is similar to that obtained from the simple tabulation of descriptive statistics in the preceding subsection when Dr. Sheppard's full sample is used.

Dr. Sheppard's Regression without 1999-2009

If the same procedure is followed as with the descriptive statistics considered in the preceding subsection of assuming that it is not appropriate to include the abnormal housing bubble observations of 1999-2009, a new regression may be run that is the same as Dr. Sheppard's regression except that the 1999-2009 observations are removed. The results are then:

Table 6. Dr. Sheppard's December 2011 Regression without 1999-2009 Dependent Variable: Average Annual Rate of Return During Holding Period				
	Coefficient	Std. Error	t-statistic	P>|t|
Sale in treatment group	0.00874	0.01551	0.56	0.574
IPEC distance (km)	-0.03198	0.01198	-2.67	0.008
Constant	0.16822	0.03793	4.43	0.000

The negative effect of being in the "treatment group" is gone, with the coefficient of 'Sale in treatment group' now being 0.00874. The t-value indicates that being in the "treatment group" does not meet the usual standards for statistical significance, and the sign of the coefficient is actually reversed, which would say that returns are raised by being in the "treatment group." The effect of removing 1999-2009 sale observations in Dr. Sheppard's regressions is quite similar to the effect of removing them in the common sense calculations in the previous subsection.

Dr. Sheppard's Regression without 1999-2009 and 1984-1987

If both the 1984-1987 price surge and the 1999-2009 housing bubble are removed from Dr. Sheppard's regression, the results are then:

Table 7. Dr. Sheppard's December 2011 Regression without 1999-2009 and 1984-1987
Dependent Variable: Average Annual Rate of Return During Holding Period

	Coefficient	Std. Error	t-statistic	P>|t|
Sale in treatment group	0.03498	0.01935	1.81	-0.003
IPEC distance (km)	-0.03508	0.01307	-2.68	-0.061
Constant	0.14933	0.0419	3.56	0.067

Here the 0.03498 coefficient of 'Sale in treatment group' indicates that being in the "treatment group" actually raises the rate of return approximately 3.5 percent, instead of lowering it as Dr. Sheppard expects. The result is similar to that for the common sense calculations for the same set of observations.

Dr. Sheppard's regression result using his full sample, on which he bases his property value estimates, then do not stand up to the test of removing the most obviously inappropriate observations. It would appear then that Dr. Sheppard has based his property value estimate on an effectively nonsensical regression.[20]

6-5. *Dr. Sheppard's Wrong "Event"*

Dr. Sheppard's choice of the "event" causing a possible decline in property values is incorrect. As noted, he designates 1974-1976 when IP2 and IP3 commenced operations as his "treatment period" or event window. Dr. Sheppard asserts that the expansion of the Indian Point site is "a single significant change in the community whose location and timing can be determined unambiguously" (Dr. Sheppard's December 2011 Report, pp. 1, 3).

Dr. Sheppard has not shown that the "timing can be determined unambiguously." He has neglected to discuss anticipatory considerations. That IP2 and IP3 were going to commence operations was well known in advance of the dates Dr. Sheppard selected. Adverse property value impacts, if there were any, would have occurred prior to 1974. It is universally accepted that prices are affected by news of events. The phenomenon of housing prices

[20] The other independent variable in Dr. Sheppard's regression gives a distance gradient effect from IPEC within the 5-kilometer zone. Dr. Sheppard states that his "model does include a variable for distance from IPEC, but this variable measures a constant impact before, during and after IPEC opens. It is included to account for variations in the rate of return on housing that are sensitive to proximity to employment centers or other factors, but it does not capture a location-related impact of IPEC." (Dr. Sheppard January 20, 2012, Prefiled Testimony p. 36). The existence or not of this type of overall effect of distance on rate of return does not affect the contention that Dr. Sheppard's use of an invalid control group invalidates his estimate of a negative "treatment group" effect. The demonstration of the invalidity comes through in the common sense calculations as well as in the regressions.

going up or down in advance of construction of a facility, in response to news leading to anticipation of construction, has been documented many times over.[21] If the presence of IP2 and IP3 had been expected to have a disamenity effect, buyers would have taken account of the effect when news occurred, giving rise to the anticipation of construction. Dr. Sheppard makes no attempt to define the correct "event" as the time there would have been a property value effect. The "event" of the possible effect of the operation of IP2 and IP3 on property values dates to when knowledge that they would be built became known. The correct definition of the "event" dates to many years prior to the commencement of operation of the units that Dr. Sheppard uses to define the "event," as the following paragraph makes clear.

A few comments help to document Dr. Sheppard's neglect. Consolidated Edison's plans to build the IPEC facility were known to area residents as early as 1954[22], predating all but 15 transactions in the sample. Intentions to expand the facility to include reactor units 2 and 3 were known as early as 1965 and 1967.[23] Dr. Sheppard himself on page 3 states that the change in housing value occurs at the moment that buyers and sellers in the marketplace become aware of a change. Residents of the community certainly knew about IP2 well before the news that the facility had commenced operations. If there were disamenity effects of nuclear activities, Dr. Sheppard failed to sort out the timing of such announcements and other activities, including, for example, the earlier IP1 construction, operation, and shutdown.

6-6. *Inappropriate Analogy of Dr. Sheppard's Work to an Event Study*

The two major shortcomings of Dr. Sheppard's work considered so far, namely, failure to specify a realistic control group and choice of an inadequate event definition, are not the only problems with Dr. Sheppard's methodology. He characterizes his approach as similar to an "event study."

The most well-known use of an "event study" approach is in financial analysis to estimate how a discrete event has affected security prices, such as for example how an announcement that two firms will be merged affects their stock prices. An important literature exists on the methodology that needs to be followed in event studies. Dr. Sheppard shows no awareness of this literature.

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[21] See for example: Peter F. Cowell, C. Dehring, and N. Lash, "The Effect of Group Homes on Neighborhood Property Values," *Land Economics*, 76 (2000), pp. 615-37; David Damm, S. Lerman, E. Lerner-Lam, and J. Young, "Response of Urban Real Estate Values in Anticipation of the Washington Metro," *Journal of Transport Economics and Policy*, 14:4 (1980), pp. 315-36; Carolyn Dehring, C. Depken and M. Ward, "The Impact of Stadium Announcements on Residential Property Values: Evidence From a Natural Experiment in Dallas-Fort Worth," *Contemporary Economic Policy,"* 25:4 (2007), pp. 627-38.

[22] "Indian Point Park Bought By Edison," *New York Times*, (October 9, 1954), p.18; "Edison Will Build Atom Power Plant," *New York Times*, (February 11, 1955), p. 1.

[23] M. Folsom, "2nd Atom Generator Planned by Con Ed," *New York Times* (October 30, 1965), p. 1; P. Millones, "Con Ed Approves 3d Nuclear Unit at Indian Point," *New York Times* (April 26, 1967), p. 50.

I have not found any previous "event studies" for housing.[24] Nor have I found any studies, whether called event studies or not, that employ Dr. Sheppard's approach of trying to explain returns using a regression based on separating returns into a "treatment group" and "control group." Dr. Sheppard's approach is apparently unique.

The following review of some of the major points from the "event study" methodology literature serve to generalize the above examples of shortcomings of Dr. Sheppard's approach. The review indicates that even a well-designed event study cannot be validly applied to an event unless the event occupies a very small time window and can be unambiguously defined. The points apply to any study that purports to attribute a financial return to a single assumed cause, as Dr. Sheppard does.

When news unrelated to the event being studied is released in the same time period, this confounding information has the potential to "distort or camouflage the effect of the event of interest on the security's return."[25] According to McWilliams and Siegel (1997), isolating "the effect of an event from the effects of other events…is perhaps the most critical assumption of the methodology. . . . The longer the event window, the more difficult it is for researchers to claim that they have controlled for confounding events. . . . [F]ailing to control for confounding events causes serious doubts about the validity of the empirical results and calls into question any conclusions drawn."[26] Smith (1980 p. 392) warned that, in using a one-year event window, there was a danger "that the period under examination is so long that other events might occur which could incorrectly confirm or refute the test hypothesis."[27] In a review of event studies whose context is corporate litigation, Bhagat & Romano (2002 p. 164) discuss the detrimental effects of the length of the event window on statistical power, stating that "it is very difficult to have much confidence in the results of event studies that consider long-horizon returns of several years."[28]

In contrast to Dr. Sheppard's average holding period of over 8 years, the typical event study uses sampling intervals of one day. Campbell et al. note (1997, p. 175) that "the decrease in power [of the test statistic] going from a daily interval to a monthly interval is severe."[29]

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[24] In their analysis of effects of announcements of stadium construction, Dehring et al. (2007) used hedonic pricing models in conjunction with which they claimed to introduce event study methodology. However, they point out (pp. 631-632) that they "cannot track daily changes in the value of a single house but must draw inferences from prices of different houses," and that they "are not calculating the return relative to the general market as one would do when analyzing abnormal stock returns."

[25] Mark P. Kritzman, "What Practitioners Need to Know about Event Studies," *Financial Analysts Journal*, 50 (1994) 6, pp. 17-20.

[26] Abagail McWilliams and Donald Siegel, "Event Studies in Management Research: Theoretical and Empirical Issues," *The Academy of Management Journal*, 40 (1997) 3, pp. 626-657. McWilliams and Siegel reexamined three published event studies and, after controlling for confounding events, "found that the abnormal returns for all three studies were *all* statistically insignificant" (p. 646).

[27] Richard L. Smith II, "The 1958 Automobile Information Disclosure Act: A Study of the Impact of Regulation," *Journal of Industrial Economics* 28 (1980) 4, pp. 387-403.

[28] Sanjai Bhagat and Roberta Romano, "Event Studies and the Law: Part I: Technique and Corporate Litigation," *American Law and Economics Review*, 4 (2002)1, pp. 141-167.

[29] John Y. Campbell, Andrew W. Lo, and A. Craig MacKinlay. *The Econometrics of Financial Markets* (New Jersey: Princeton University Press, 1997), pp. 149-180.

Binder (1985, p. 185) warns that a "problem with the monthly tests may be that excess returns on the announcement dates are overwhelmed by noise in the monthly returns" and that the effect of the information of the event being studied may be "hidden in the noise during" the test period.[30]

Binder (1998, p. 123) discusses event studies where the event date is unknown, concluding that "for regulatory events where the event date is not known, the event study methodology appears to have little statistical power to detect the abnormal returns because the formal announcements in the process are generally anticipated by the market."[31] Campbell et al. (1997, pp. 179) came to the same conclusion, stating that "[i]n cases where the date is difficult to identify or the event is partially anticipated, event studies have been less useful."

Dr. Sheppard's event definition problems bring out the difficulty in making inferences using "event analysis" except for very short-lived events. Dr. Sheppard fails to account for or even mention confounding events affecting the 1974-1976 time frame such as the oil embargo and national recession. Dr. Sheppard's use of "treatment group" and "control group" observations for holding periods that cover many years confounds the problem. Examples considered above are the 21st century national housing bubble and the middle 1980s housing price surge. More generally, other socioeconomic factors subject to change that are unrelated to the presence of IPEC affecting housing values are neglected.

6-7. *Dr. Sheppard's Avoidance of Hedonic Approach*

Previous studies of effects of nuclear facilities on property values have used hedonic regression analysis. These were reviewed in Section 1 above for facilities other than IPEC. Section 2 reported on a hedonic regression for IPEC undertaken for the present report under my direction.

In his December 2011 report, Dr. Sheppard reports on only two previous studies of property value effects of nuclear facilities. One is an unpublished study by an undergraduate student under Dr. Sheppard's direction.[32] The study purports to show that the Pilgrim Nuclear Power Station depresses values of surrounding residential properties. The results are however sensitive to whether effects of individual years are allowed for by inclusion of 0-1 ("dummy") variables for years, and the model specification contains the anomalous counter-intuitive result that the announcement of the building of the plant increased land values. Furthermore, the results of this undergraduate student study are not consistent with the findings of the peer-reviewed published study by Gamble and Downing (1982) that included the Pilgrim Station and found no negative distance effect. While the undergraduate student regression study is inadequately specified and therefore questionable as evidence, it is

[30] John J. Binder, "Measuring the Effects of Regulation with Stock Price Data," *RAND Journal of Economics*, 16 (1985) 2, pp. 167-183.
[31] John J. Binder, "The Event Study Methodology Since 1969," *Review of Quantitative Finance and Accounting*, 11 (1998), pp. 111-137.
[32] Brian Prest, *Measuring the Externalities of Nuclear Power: A Hedonic Study*, unpublished undergraduate thesis, Williams College, 2009.

nonetheless a hedonic study. Dr. Sheppard refers to it only as using "a different statistical methodology." The other study of effects of nuclear facilities referred to by Dr. Sheppard is also a hedonic-type study though it is not referred to as such by Dr. Sheppard. This study was reviewed in Section 1 of the present report, where I noted that the scope is great for omitted variable bias introduced by using inordinately large geographical areas.

Dr. Sheppard's avoidance of the standard procedure of using hedonic analysis is all the more puzzling because he could have done so with his dataset based on local government Assessor's property cards.

6-8. *Hedonic Regression Results Using Dr. Sheppard's Data Source*

To conduct the hedonic analysis that Dr. Sheppard could have done, I directed the assembling of a dataset based on Assessor's property cards. Using the information in Dr. Sheppard's December 2011 dataset and the Assessor's property cards used by Dr. Sheppard, a dataset was assembled giving a sample of sales of 283 single family residential properties in Buchanan, Cortlandt, and Peekskill, within 5 kilometers from the IPEC site. Multiple occupancy properties, commercial properties, and other anomalies were dropped. As with the MLS regression described in Section 2, these observations were matched with data from the 2000 U.S. Census based on the Census Block Group ID, and spatial variables were created using the U.S. Census Shape files in ArcGIS. A variable measuring the estimated per-household PILOT payments was again calculated.

While properties in Dr. Sheppard's December 2011 analysis may appear in his regression more than once, only the most recent sale of each relevant property is included in my regression using his data. The sample is further restricted to include only sales that occurred in the first quarter of 1999 or later, eliminating the few properties that only had transactions before that time.

Using the Assessor's Cards Dataset, a least squares regression was run using STATA v9.2 to estimate the relationship between the sale price of the property and a set of eight explanatory variables. Results are summarized in Table 8, with a discussion following.

Table 8. Results of Hedonic Regression Based on Sheppard's Dataset[33]	
Explanatory Variable	*Coefficient*
Distance to Indian Point	19.680
	(0.58)
Distance to Indian Point Squared	-1.303
	(0.19)
Median Income	(2.332)
	(7.68)***
House Age	-3.457
	(11.53)***
Condo/Townhome	-146.765
	(13.98)***
Distance to Nearest Commuter Rail Station	-1.851
	(0.12)
2011 PILOT Payments	19.356
	(2.34)**
Year and Quarter of Sale	14.781
	(6.46)***
Constant	-29,313.335
	(6.39)***
Number of Observations	283
R-squared	0.74
Distance in Miles, Dollars in Thousands of Dollars	
Absolute value of t-statistics in parentheses	
* significant at 10%; ** significant at 5%; *** significant at 1%	

While the coefficients of Distance to Indian Point and Distance to Indian Point Squared have the expected pattern for a disamenity as illustrated earlier in Figure 1 (positive linear and negative squared distance effects), they are statistically insignificant. The lack of statistical significance means that the probability that the distance coefficients are different from zero is too low to provide reliable evidence that IPEC depresses property values. Sensitivity tests were run with alternative functional forms (log-log, semi-log, linear form without distance squared) that did not change the conclusion.

The same variables are used in my hedonic regression that was reported in Table 1 in Section 2 as in the hedonic regression using Dr. Sheppard's data source. When the results are compared, it is clear that the results in the two regressions are highly reasonable and consistent. Although the signs are different for the Distance to IPEC coefficients, neither are statistically significant. Differences in the magnitude of the other coefficients in the two regressions can easily be due to the fact that the sampling criteria are different. My hedonic

[33] Dependent Variable: Nominal Sale Price for Property

regression used a sample of properties for sale in 2011, while the hedonic regression based on Dr. Sheppard's data source was for transactions covering the period 1999 to 2009, with a variable included to control for the year and quarter of the sale. The distance criterion in my hedonic regression was a full 5-mile (8.05 kilometers) distance radius from IPEC and for the regression using Dr. Sheppard's data was 3.1 miles (5 kilometers), restricted to Buchanan, Cortlandt, and Peekskill.

As noted, the coefficient patterns in Tables 1 and 5 are similar and reasonable. Although the signs for the Distance to Indian Point coefficients are different, neither is statistically significant. The two best pieces of evidence available on the effects of IPEC on property values are the two hedonic regressions. The same conclusion is indicated by both pieces of evidence. No scientific basis is found that IPEC has a depressive effect on property values.

6-9. *A Litany of Additional Errors*

Sections 6-1 through 6-8 have discussed fundamental errors in Dr. Sheppard's December 2011 report, each of which is independently sufficient to discredit his conclusion.

Beyond these fundamental errors, a litany of additional errors further calls into question the accuracy of Dr. Sheppard's results. A partial list of the additional errors is: (1) A logical consequence of Dr. Sheppard's theory is that the average annual return to a property owner holding real estate during the 1974-76 "treatment" period is affected by the number of years prior to and following the treatment period. Average annual returns would be depressed more if holdings included only a few years of normal returns before or after 1974-1976 than if holdings were for more years before and after when normal returns could be realized for a longer time, leading to a higher average annual return because of the greater weight of normal as opposed to depressed returns. Dr. Sheppard's failure to account for this effect introduces measurement error in the dependent variable of his regression reducing the reliability of the result; (2) The entire theoretical basis of Dr. Sheppard's approach is not explained adequately and contains errors; (3) Free-standing homes are under-represented in Dr. Sheppard's sample relative to condos and townhomes; (4) Even if his new unprecedented estimation method was accepted, there are inaccuracies in Dr. Sheppard's conversion of a supposed 27 percent decline in property values to a $1.07 billion property value loss.

The following subsections explain these additional errors more fully.

6-9.1 *Problem with Empirical Definition of Rate of Return*

Dr. Sheppard's dependent variable contains unrecognized measurement error. This is because if the ownership period before and after the hypothesized decline in property values was very short, the average annual rate of return would have been more severely affected than if there were a longer holding period surrounding the time of the property value decline. Thus, a person holding the property for many years before and many years after the period of asserted property decline would have experienced many more years of normal returns unaffected by the decline than a person buying the property shortly before

the decline and selling it shortly afterward. The periods during which returns were received but not affected by Indian Point dilute any effect of the more short-lived period of property decline visualized by Dr. Sheppard. The dilution varies for each observation in the "treatment group" since the properties were held for different numbers of years.

As a numerical illustration, with the type of effect hypothesized by Dr. Sheppard, suppose that the decline in land values took place entirely within Dr. Sheppard's event period 1974-1976, that the decline in property values was 27 percent in line with Dr. Sheppard's estimate, and that the normal rate of return in the absence of the "event" was 9 percent. If the holding period was 4 years (approximating the minimum holding period in Dr. Sheppard's "treatment group"), a normal annual rate of return of 9 percent was earned for two of the years, and an annual rate of return of -7 percent was received over 1974-1976 (normal 9 percent per year for two years minus the 27 percent loss over two years due to property value decline gives an annual average return over the four year period of 2 percent). If the holding period was 60 years (approximating the maximum holding period in Dr. Sheppard's "treatment group"), a normal annual rate of return of 9 percent was earned for 58 of the years, and an annual rate of return of -7 percent was received over 1974-1976 (normal 9 percent per year for 58 years minus 27 percent loss over two years due to property value decline gives an annual average return over the 60-year holding period of 8 percent). In this case, of two owners who suffered the same decline in property value of 27 percent in 1974-1976, one had an average annual return of 8 percent while the other had an average annual return of 2 percent. This provides an illustration of the measurement error problem.

If the variation in effect of holding period conformed to the type of symmetric bell-shaped distribution typical of many random variables, or so-called normal distribution, it would introduce random error into measurement of the dependent variable of Dr. Sheppard's regression. The effect of such error is to increase unexplained variation in the regression. The statistical significance of the coefficient estimates is reduced and perhaps eliminated. With this type of variation, the coefficient estimates are not necessarily biased. But there is no reason to assume that the variation in the present case is of the normal bell-shaped kind. There is unknown bias, making the estimated "treatment group" effect either too high or too low. Thus, the usefulness of Dr. Sheppard's property value impact estimate is reduced even in the absence of all of Dr. Sheppard's other errors.

6-9.2 *Inadequacy and Carelessness of Dr. Sheppard's Theoretical Model*

Dr. Sheppard's exposition of his theoretical model at the beginning of the report is both inadequate and careless. First, he does not explicitly define his lambda term. From the context it appears to be the constant rate of appreciation in residential real estate values. The major theoretical flaw of the model is that lambda is assumed to be constant, whereas it is clear from the data that this is not true. Second, in Dr. Sheppard's equation (4) (Dr. Sheppard December 2011, p.4), the rate of return ρ is defined as the proportionate change in price during "time period j" where from the formula the length of the time period is one year. The notation should be ρ_j instead of just ρ, where j is the year to which the

value refers. In equation (11) (Dr. Sheppard December 2011, p.7), unsubscripted ρ again appears, this time referring to the different concept of the average annual rate of return over the multi-year period for which a property is held. This is different from the ρ in equation (1) (Dr. Sheppard December 2011, p.2) and calls for a different symbol, as for example $\rho_{v,t}$ where v is date of sale and t is date of purchase. Third, much of the theoretical exposition is unnecessary and is irrelevant to the empirical work.

6-9.3 *Under-Representation of Free-Standing Homes in Dr. Sheppard's Sample*

Dr. Sheppard's procedure of using repeat sales of properties introduces sample selection bias. Dr. Sheppard utilized only properties that changed hands in the 1999-2009 period, relying on repeat sales of these properties from earlier years to estimate returns to holding periods that covered periods before and after his 1974-1976 "event." The procedure leads to over-representation of condos and townhomes, since these properties apparently turned over more frequently than free-standing homes. Among the 507 properties in Dr. Sheppard's 1999-2009 sample, some were sold noticeably more times than others in earlier years. As an example of bias arising from using repeat sales, free-standing single family homes account for 51 percent of the properties in his 1999-2009 sample, while condos and townhomes account for 34 percent of the properties. However, the mean number of observations per property in the 1,511 observations of transactions during the entire 60-year period used in his regression analysis is higher for condos and townhomes than for free-standing, single family homes. The difference between the means of the two groups is statistically significant at the 1 percent level.

6-9.4 *Inaccuracy of Dr. Sheppard's Conversion of Percent Loss to Dollar Loss*

To convert the fallacious 27 percent reduction in property values from his unprecedented method to a loss in dollar terms, Dr. Sheppard obtained an estimate of the total value of residential properties within 5 kilometers of the IPEC site in 2000, using 2000 U.S. Census data. He applied the supposed 27 percent loss to the estimated value of residential property in 2000 to arrive at the dollar loss expressed in 2000 prices. Then, using his housing price index for the area, described above in Section 6-4.1, he inflated the loss to 2011 values (unnecessarily deflating first to 1976 values and then inflating from 1976 to 2011). According to Dr. Sheppard, the loss expressed in 2011 housing prices comes to $1.07 billion, as reported in Table 3 (p. 12) of his December 2011 Report.

The $1.07 billion estimated property value loss is inaccurate for several reasons: (a) the calculation incorrectly uses a mean sample holding period of 8.19 years to calculate the loss, while the actual sample mean holding period for the properties that appear in Dr. Sheppard's analysis is 8.05 years; (b) the loss is based on the coefficient from Dr. Sheppard's regression, which was calculated for a sample of properties in Peekskill, Buchanan, and Cortlandt only, but the loss is applied to the value of all housing in the 5-kilometer radius; and (c) Dr. Sheppard claims to include owner-occupied and renter-occupied housing, but in fact he generates a number that includes residential housing listed as vacant in the 2000 Census.

6-10. *Positive Effect of IPEC on Property Values, No Matter What*

The inaccuracy of the conversion of Dr. Sheppard's 27 percent loss to a $1.07 billion loss comes on top of the basic invalidity of Dr. Sheppard's unprecedented method leading to the 27 percent estimated loss. Dr. Sheppard argues that his December 2011 estimated loss is sufficient to show that the loss in property value is large, without considering present values. He did consider present values in his January 2011 report though in an invalid way as discussed in Section 5 above, but he makes no mention at all of present values in his December 2011 report.

It will now be shown that license renewal can be expected to increase property values and that even the acceptance of Dr. Sheppard's unbelievable estimate of a $1.07 billion loss associated with proximity to IPEC is many multiples short of what would be required for a contrary result.

In the no-action case, nuclear operations may be assumed to cease in 2015 followed by a 60-year decommissioning period leading according to Dr. Sheppard's estimate to a $1.07 billion rebound in property values in 2075. Using a 7 percent discount rate, the present value of the rebound is actually estimated to be $18.47 million. If licenses are renewed, nuclear operations will cease in 2035 with the decommissioning period then giving a property value rebound in 2095 whose present value is $4.77 million. License renewal as compared to the no-action alternative gives a present value effect equal to the difference or a -$13.69 million effect on present value. The tax revenue effect is analogous but smaller and gives a -$4.62 million effect on present value

These losses are paltry compared to the increase in present value from continuing PILOT payments at their full amount for an additional 20 years if licenses are renewed, as compared to their immediate near term reduction in the no-action case. With license renewal, yearly PILOT payments of $23.99 million continue for 20 years followed by a fall to $4.318 million for another 60 years, giving a present value of $279.04 million. In the no-action case, yearly PILOT payments fall immediately to $4.318 million where they remain for 60 years, giving a present value of $96.33. The difference is a net gain in present value due to PILOT payments of $182.72 million.

The loss of the $18.31 million sum of Dr. Sheppard's property value and tax revenue effects would need to be approximately10-fold greater to reverse the finding of a positive effect.

A summary of the demonstration that license renewal will have a positive effect on property values is:

Dr. Sheppard's Effect of Distance from Site

Difference in Present Value of Distance Effect Between Ceasing Operations in 2035 and 2015:

$4.77 million *minus* $18.47 million *equals* -$13.69 million

Plus

Dr. Sheppard's Property Tax Revenue Effect

Difference in Present Value of Tax Revenue Between Ceasing Operations in 2035 and 2015:

$1.61 million *minus* $6.23 million *equals* -$4.62 million

Plus

Correct PILOT Payment Effect

Difference in Present Value of PILOT Payments Between Ceasing Operations in 2035 and 2015:

$279.04 million *minus* $96.33 million *equals* +$182.72 million

Equals

Total Effect

+$164.41 million

The -$18.31 million in unwarranted negative effects based on Dr. Sheppard's $1.07 billion effect of distance from the IPEC site is swamped by the $182.72 positive effect due to the continuation of PILOT payments. The result is a $164.41 million positive effect of license renewal.

In sum, Dr. Sheppard's conclusions are false. License renewal can be expected to increase property values. Dr. Sheppard's work contains multiple fundamental errors, each one of which would have to be refuted to be able to take his results seriously. Sloppiness of theoretical and empirical procedures, technical errors and biases contribute further to inaccuracy of his estimates.

Section 7. Conclusion on Shortcomings of Dr. Sheppard's Submissions

Dr. Sheppard's 2007 report unjustifiably assumes that a 1974 study of property value impacts of a small old coal plant can be used to estimate effects of IPEC. Dr. Sheppard ignores the serious air pollution problems of the coal plant and the lack of air pollution from nuclear operations at IPEC, making them completely noncomparable. In addition, he biases his results toward exaggerating the supposed deleterious effects of IPEC. He does this by assuming that renters and owners attach the same values to disamenities, contradicting studies showing that this is not the case, and by over-estimating the property value base to which supposed losses are applied. Dr. Sheppard's estimate is at odds with studies of other nuclear sites and two studies of IPEC, one using Multiple List Service data and the other using the very Assessor record source that Dr. Sheppard used. All these studies have found no discernible adverse effects of nuclear plants on property values.

Dr. Sheppard's January 2011 report is the only one of his reports that deals with the needed comparison of the present value of choosing license renewal over the no-action alternative. He adds insults to injury by using a low a discount rate of 4 percent instead of a more reasonable rate of at least 7 percent with a cut-off horizon. The insults are his assumptions about decommissioning timeframes and PILOT payments. He contradicts the 60-year decommissioning period allowed by NRC, and he unrealistically assumes that PILOT payments will be the same under license renewal and the no-action alternative. The reality is continuation of PILOT payments unabated for 20 years under license renewal as compared to an immediate fall under the no-action alternative. Because a near-term dollar is worth more than a long-delayed dollar, the PILOT Payment Effect is responsible for a $183 million *positive* effect on property values of license renewal over the no-action alternative. This finding of positive effects of PILOT payments that are many fold larger than Dr. Sheppard's supposed negative effects is sufficient to establish that the present value of property will *rise* as a result of license renewal and *will not fall* as Dr. Sheppard claims.

Dr. Sheppard's December 2011 report was the sole report considered in his pre-filed testimony. In his December 2011 report, Dr. Sheppard abandoned without explanation his earlier invalid attempt to apply findings for a small, old coal plant to the Indian Point nuclear site and substituted a new estimate. The new estimate in the December 2011 report purports to show that the rate of return to holding properties within 5 kilometers (3.1 miles) of the Indian Point site was lowered during the 1974-1976 period. Dr. Sheppard infers that the supposed lower rate of return was due to a loss in property values due to the commencement of IP2 and IP3 operations.

Dr. Sheppard's December 2011 report raises far more concerns than the 2007 report for which it was substituted. It presents a complex and unprecedented analysis. It is full of errors. The summary of major points here in Section 7 will concentrate on several major fallacies, any one of which is sufficient to discredit the validity of Dr. Sheppard's findings.

First, Dr. Sheppard's work contained an extraordinary number of data entry errors. Dr. Sheppard claims to have personally supervised the data entry process and to have been "in regular contact with [the] office undertaking the data entry" (Dr. Sheppard December 2011,

p.6). A review of the Assessor's property cards, the source of Dr. Sheppard's data, reveals an error rate in the final sample so high that the usability of his empirical findings must be questioned.

The most common error was found to be: a) the inclusion of a previous sale of an empty lot and a subsequent sale of a completed residence in the calculation of rate of return. These observations neglect the cost of building a residence on the property during the time it is held, thus grossly distorting the net return to holding the real estate by leaving out a major expense. Among other errors were inclusion of: b) typographical errors in the sale date or price for a transaction; c) transactions between family members, which should be excluded because they are not arm's length market transactions and are subject to personal family motivations; d) foreclosures and auctions, which are also not ordinary market transactions; e) properties in which the residence was destroyed in a fire or demolished between two transactions, leading to effect of losses in value not accounted for in the rate of return; f) transactions of commercial properties; g) sales prices marked as "unverified" by the Assessor; h) sales prices that were noted by the Assessor as FHA-subsidized purchases that are marked as "not indicative of market value"; i) transactions involving large purchases of land that were subsequently subdivided and developed into residential housing; and j) geo-coding errors that caused properties to be assigned to incorrect locations by Dr. Sheppard including some whose distance from the IPEC site was beyond the 5-kilometer zone of analysis.

The seriousness of the above errors is suggested by the following count. Out of a total of 1,511 observations in Dr. Sheppard's basic regression of rate of return on his indicator variable estimating the effect of being in the "treatment group," 425 observations or over one-quarter of the observations (28 percent) were found to be ineligible for inclusion in the regression. As a breakdown of this total, out of the 164 of Dr. Sheppard's observations in the "treatment group," 86 observations or over one-half (52 percent) were found to be ineligible for inclusion. Out of the 1,347 Sheppard observations in the control group," 339 observations or one-quarter (25 percent) were found to be ineligible for inclusion.

Second, Sheppard's "control group" does not provide a valid comparison for his "treatment group." A manifestation of this fact is that the returns of a far greater portion of the "control group" used to compare returns of the "treatment group" holding properties during 1974-1976 were raised by general housing events occurring in 1999-2009, long after the commencement of operations of the nuclear units at Indian Point. Holding housing in these later periods was in no way a meaningful alternative to holding housing in 1976 or prior years. Eliminating sales in 1984-1987 and 1999-2009 invalidates the relationship estimated by Dr. Sheppard.

Third, Dr. Sheppard wrongly defines the "event" whose effect is being estimated to be the period 1974-1976. The plans for regulatory approval and construction of IP2 and IP3 were well publicized, long before commercial operations. If there was a property value effect, buyers would have taken it into account when the likelihood that IP2 and IP3 would be built became known. To use Dr. Sheppard's approach, the holding period for the "treatment group" would have to be extended backwards in time by 10 years or more. The number of observations in the "control group" would be correspondingly reduced, leaving an even higher

proportion of the "control group" observations in the most obviously invalid later years in the 1999-2009 periods. In addition, the problem of reduced reliability due to lengthening of the event window noted as part of the next major point would be exacerbated.

Fourth, as brought out in discussions of the methodology of "event studies," to which Dr. Sheppard likens his study, even a well-designed event study cannot be validly applied to an event unless the event occupies a very small time window and can be unambiguously defined. The points apply to any study that purports to attribute a financial return to a single assumed cause, as Dr. Sheppard does. While conceptually Dr. Sheppard's event definition needs to occupy a longer time, even the 1974-1976 (strictly, 1974Q2-1976Q3) event period chosen by Dr. Sheppard is too long, because it leaves a two-year period during which events not related to IP2 and IP3 could have affected returns. The event definition problem brings out the difficulty in making any sort of inferences from historical events without a thorough-going time series analysis accounting for myriad influences on property values over the years and requiring far more analysis of events affecting housing. Dr. Sheppard undertook nothing of this kind.

Fifth, Dr. Sheppard's own data accompanying his submission but not used by him provided information for hedonic regression analysis. Hedonic regression analysis using Dr. Sheppard's own data corroborates the findings from other nuclear plants and from my hedonic regression analysis for Indian Point that the Indian Point site has no discernible effect on property values.

As noted, any one of these fundamental shortcomings alone would be sufficient to invalidate Dr. Sheppard's claim that property values are negatively affected by IP2 and IP3.

Beyond these fundamental errors, a litany of additional errors further calls into question the accuracy of Dr. Sheppard's results. A partial list of the additional errors is: (1) A logical consequence of Dr. Sheppard's theory is that the average annual return to a property owner holding real estate during the 1974-1976 "treatment" period is affected by the number of years prior to and following the treatment period. Average annual returns would be depressed more if holdings included only a few years of normal returns before or after 1974-1976 than if holdings were for more years before and after when normal returns could be realized for a longer time, leading to a higher average annual return because of the greater weight of normal as opposed to depressed returns. Dr. Sheppard's failure to account for this effect introduces measurement error in the dependent variable of his regression reducing the reliability of the result; (2) The entire theoretical basis of Dr. Sheppard's approach is not explained adequately and contains errors; (3) Free-standing homes are under-represented in Dr. Sheppard's sample relative to condos and townhomes; (4) Even if his new unprecedented estimation method was accepted, there are inaccuracies in Dr. Sheppard's conversion of a supposed 27 percent decline in property values to a $1.07 billion property value loss.

The inaccuracy of the conversion of Dr. Sheppard's 27 percent loss to a $1.07 billion loss comes on top of the basic invalidity of Dr. Sheppard's unprecedented method leading to the 27 percent estimated loss. Dr. Sheppard argues that his December 2011 estimated loss is sufficient to show that the loss in property value is large, without considering present values. He did consider

present values in his January 2011 report though in an invalid way as discussed in Section 5 above, but he makes no mention at all of present values in his December 2011 report.

Contrary to Dr. Sheppard's contention, license renewal can be expected to increase property values and would do so even in the presence of Dr. Sheppard's unbelievable estimate of a $1.07 billion loss due to proximity to IPEC.

The demonstration of a positive effect is as follows. In the no-action case, nuclear operations may be assumed to cease in 2015 followed by a 60-year decommissioning period, leading according to Dr. Sheppard's estimate to a $1.07 billion rebound in property values in 2075. Using a 7 percent discount rate, the present value of the rebound is actually estimated to be $18.47 million. If licenses are renewed, nuclear operations will cease in 2035, with the decommissioning period then giving a property value rebound in 2095 whose present value is $4.77 million. License renewal as compared to the no-action alternative gives a present value effect equal to the difference, or a -$13.69 million effect on present value. The tax revenue effect is analogous but smaller and gives a -$4.62 million effect on present value

These losses are paltry compared to the increase in present value from continuing PILOT payments at their full amount for an additional 20 years if licenses are renewed, as compared to their immediate near term reduction in the no-action case. With license renewal, yearly PILOT payments of $23.99 million continue for 20 years followed by a fall to $4.318 million for another 60 years, giving a present value of $279.04 million. In the no-action case, yearly PILOT payments fall immediately to $4.318 million where they remain for 60 years, giving a present value of $96.33. The difference is a net gain in present value due to PILOT payments of $182.72 million.

The loss of the $18.31 million sum of Dr. Sheppard's property value and tax revenue effects would need to be approximately10-fold greater to reverse the finding of a positive effect.

In sum, Dr. Sheppard's conclusions are false. License renewal can be expected to increase property values. Dr. Sheppard's work contains multiple fundamental errors, each one of which would have to be refuted to be able to take his results seriously. Sloppiness of theoretical and empirical procedures, technical errors and biases contribute further to inaccuracy of his estimates.

APPENDIX: Calculations of Differences in Present Value

A: Calculations for Section 3-8. Property Value Effect as the Difference Between Present Value of Renewal and No Action

Total Effect of Distance from IPEC Site

There is no evidence for an effect of distance from the IPEC site on property values. The total effect of distance from the IPEC site will be the difference in the present value between ceasing operations in 2035 and 2015. The present value of the total effect of distance is the difference in present value between the License Renewal and No-Action Alternative cases, or:

$$0 - 0 = 0$$

Total Property Tax Revenue Effect:

There is no evidence for a property tax revenue effect. The total property tax revenue effect is the difference between the property tax revenue effect in the License Renewal and No-Action Alternative cases. This calculation is:

$$0 - 0 = 0$$

Present Value of PILOT Payments in the No-Action Alternative Case:

In the No-Action Alternative case with operations ceasing in 2015, PILOT payments are assumed to drop to 18% of their current levels during the decommissioning period, or $4.3182 million per year from 2016 to 2075. Payments are assumed to cease completely at the end of decommissioning in 2075. The present value of these annual payments using a discount rate of 7% is:

$$PV = \sum_{t=0}^{1} (23,990,000/1.07^t) + \sum_{t=2}^{61} (4,318,200/1.07^t) = 96,325,698$$

Present Value of PILOT Payments in the License Renewal Case:

In the License Renewal case with operations ceasing in 2035, PILOT payments are expected to continue at their present level during the renewal period, or $23.99 million per year from 2016 to 2035. Then, PILOT payments are assumed to drop to 18% of their current levels during the decommissioning period, or $4.3182 million per year from 2036 to 2095. Payments are assumed to cease completely at the end of decommissioning in 2095. The present value of these annual payments using a discount rate of 7% is:

$$PV = \sum_{t=0}^{21} (23,990,000/1.07^t) + \sum_{t=22}^{81} (4,318,200/1.07^t) = 279,042,793$$

Total PILOT Payment Effect:

The total PILOT payment effect is the difference in present value between the License Renewal and No-Action Alternative cases, or:

$$279,042,793 - 96,325,698 = 182,717,094$$

Total Effect:

The total effect in this case is the sum of the total effect of distance from the site plus the total property tax revenue effect plus the total PILOT payment effect. This calculation is:

$$0 + 0 + 182,717,094 = 182,717,094$$

B: Calculations for Section 5-4. Dr. Sheppard's Method with Correct Decommissioning Period and Incorrect PILOT Payments

Effect of Distance from IPEC Site in the No-Action Alternative Case

Dr. Sheppard assumes a $576 million distance effect of IPEC on surrounding properties, and assumes that property values in the region will increase by $576 million at the end of the decommissioning period. There is no evidence for an effect of distance from the IPEC site on property values. However, it is possible to calculate what $576 million purported increase in property values in the No-Action Alternative case, with an end of decommissioning in 2073, is worth today using a discount rate of 7%. This calculation is:

$$PV = (1/1.07^{60}) * 576,026,601 = 9,940,675$$

Effect of Distance from IPEC Site in the License Renewal Case

The present value of the $576 million purported increase in property values in the License Renewal case, with an end of decommissioning in 2093, using a discount rate of 7% is:

$$PV = (1/1.07^{80}) * 576,026,601 = 2,568,859$$

Total Effect of Distance from IPEC Site

The total effect of distance from the IPEC site on property values will be the difference between the present value of distance in the License Renewal and No-Action Alternative cases. This calculation is:

$$2,568,859 - 9,940,675 = -7{,}371{,}816$$

Property Tax Revenue Effect in the No-Action Alternative Case

Dr. Sheppard assumes that property taxes will increase by $13.6 million at the end of the decommissioning period. In the No-Action alternative case with decommissioning complete in 2073 and using a discount rate of 7%, this calculation is:

$$PV = (13,594,228/.07) * (1/1.07^{60}) = 3{,}351{,}428$$

Property Tax Revenue Effect in the License Renewal Case:

The present value of the $13.6 million purported increase in property taxes at the end of the decommissioning period in 2093 in the License Renewal case, using a discount rate of 7%, is:

$$PV = (13,594,228/.07) * (1/1.07^{80}) = 866,073$$

Total Property Tax Revenue Effect:

The total property tax revenue effect is the difference between the property tax revenue effect in the License Renewal and No-Action Alternative cases. This calculation is:

$$866,073 - 3,351,428 = -2,485,355$$

Value of PILOT Payments in the No-Action Alternative Case:

Dr. Sheppard assumes that annual PILOT payments in the No-Action Alternative case are $25.5 million until 2035. The present value of these annual payments using a discount rate of 7% is:

$$PV = \sum_{t=0}^{20} (25,500,000/1.07^t) = 282,061,633$$

Value of PILOT Payments in the License Renewal Case:

Dr. Sheppard assumes that PILOT payments in the License Renewal case are $25.5 million until 2035. The present value of these annual payments using a discount rate of 7% is:

$$PV = \sum_{t=0}^{20} (25,500,000/1.07^t) = 282,061,633$$

Total PILOT Payment Effect:

The total PILOT payment effect is the difference in present value between the License Renewal and No-Action Alternative cases. Since Dr. Sheppard assumes that PILOT payments are the same under the No-Action Alternative and License Renewal cases, this calculation is:

$$282,061,633 - 282,061,633 = 0$$

Total Effect:

The total effect in this case is the sum of the total effect of distance from the site plus the total property tax revenue effect plus the total PILOT payment effect. This calculation is:

$$-2,485,355 + -7,371,816 = -9,857,171$$

C: Calculations for Section 6-10. Dr. Sheppard's Method with Correct Decommissioning Period and Correct PILOT Payments

Effect of Distance from IPEC Site in the No-Action Alternative Case

Dr. Sheppard assumes a $576 million distance effect of IPEC on surrounding properties, and assumes that property values in the region will increase by $576 million at the end of the decommissioning period. There is no evidence for an effect of distance from the IPEC site on property values. However, it is possible to calculate what $576 million purported increase in property values in the No-Action Alternative case, with an end of decommissioning in 2073, is worth today using a discount rate of 7%. This calculation is:

$$PV = (1/1.07^{60}) * 576,026,601 = 9,940,675$$

Effect of Distance from IPEC Site in the License Renewal Case

The present value of the $576 million purported increase in property values in the License Renewal case, with an end of decommissioning in 2093, using a discount rate of 7% is:

$$PV = (1/1.07^{80}) * 576,026,601 = 2,568,859$$

Total Effect of Distance from IPEC Site

The total effect of distance from the IPEC site on property values will be the difference between the present value of distance in the License Renewal and No-Action Alternative cases. This calculation is:

$$2,568,859 - 9,940,675 = -7{,}371{,}816$$

Property Tax Revenue Effect in the No-Action Alternative Case

Dr. Sheppard assumes that property taxes will increase by $13.6 million at the end of the decommissioning period. In the No-Action alternative case with decommissioning complete in 2073 and using a discount rate of 7%, this calculation is:

$$PV = (13,594,228/.07) * (1/1.07^{60}) = 3{,}351{,}428$$

Property Tax Revenue Effect in the License Renewal Case:

The present value of the $13.6 million purported increase in property taxes at the end of the decommissioning period in 2093 in the License Renewal case, using a discount rate of 7%, is:

$$PV = (13,594,228/.07) * (1/1.07^{80}) = 866,073$$

Total Property Tax Revenue Effect:

The total property tax revenue effect is the difference between the property tax revenue effect in the License Renewal and No-Action Alternative cases. This calculation is:

$$866,073 - 3,351,428 = -2,485,355$$

Present Value of PILOT Payments in the No-Action Alternative Case:

In the No-Action Alternative case with operations ceasing in 2015, PILOT Payments are assumed to drop to 18% of their current levels during the decommissioning period, or $4.3182 million per year from 2016 to 2075. Payments are assumed to cease completely at the end of decommissioning in 2075. The present value of these annual payments using a discount rate of 7% is:

$$PV = \sum_{t=0}^{1} (23,990,000/1.07^t) + \sum_{t=2}^{61} (4,318,200/1.07^t) = 96,325,698$$

Present Value of PILOT Payments in the License Renewal Case:

In the License Renewal case with operations ceasing in 2035, PILOT payments are expected to continue at their present level during the renewal period, or $23.99 million per year from 2016 to 2035. Then, PILOT payments are assumed to drop to 18% of their current levels during the decommissioning period, or $4.3182 million per year from 2036 to 2095. Payments are assumed to cease completely at the end of decommissioning in 2095. The present value of these annual payments using a discount rate of 7% is:

$$PV = \sum_{t=0}^{21} (23,990,000/1.07^t) + \sum_{t=22}^{81} (4,318,200/1.07^t) = 279,042,793$$

Total PILOT Payment Effect:

The total PILOT payment effect is the difference in present value between the License Renewal and No-Action Alternative cases, or:

$$279,042,793 - 96,325,698 = 182,717,094$$

Total Effect:

The total effect in this case is the sum of the effect of distance from the site plus the property tax revenue effect plus the total PILOT payment effect. This calculation is:

$$-7,371,816 + -2,485,355 + 182,717,094 = 172,859,924$$