From: Tom Foulkes [mailto:tfoulkes9@gmail.com]
Sent: Wednesday, December 28, 2016 8:12 PM
To: Monroe, Pamela
Cc: Madelyn Foulkes
Subject: Additional Testimony of Tom and Madelyn Foulkes

Dear Ms. Monroe,

Our additional testimony given below includes four supporting documentation links used to determine our response to the applicant's application in particular to the cost benefit analysis as it impacts the value of property to those who will be living along the corridor of this project. Technical limitations will require this to be sent in three separate groups. Paper copies have been delivered to your office.

Any questions or concerns please contact us.

SEC Docket 2015 #06

Joint Application of Northern Pass Transmission, LLC and Public Service Company of New Hampshire d/b/a Eversource Energy for a Certificate of Site and Facility

Additional Pre-filed Testimony of Thomas and Madelyn Foulkes

December 30, 2016

Madelyn and Thomas Foulkes submit additional pre-filed testimony to substantiate the original document of November 15, 2016. The purpose is to clarify and bring to the committee the supporting documentation for why we believe the benefit aspects of this project are substantially over stated by the applicant and the more inclusive cost of this project is understated. That being particularly true related to the impact this project will have on property values along the proposed high power towers.

Included are references that span several decades of data and studies as to the impact towers have on property values. The degree of the impact varies based on proximity to the lines and towers, urban or rural environment setting, and the quality of the property.

Two factors - primary factors reduce the value of property that view the structures and lines. One being the visual impact - the closer to the lines the greater the property loss. The attached map from the Sudbury Massachusetts study gives a clear illustration to that relationship. The second reason is the Fear Factor. Real or not the public perceives high voltage lines as dangerous to their health. Given other choices most people will take that other option, those with more wealth have more choices.

The point being - the benefit aspects to this project are reduced by the loss of property value along the entire 192 miles.

The project is being subsidized by property owners - this is a transfer of wealth from one group of land owners to Eversource and to a degree to other non effected land owners.

We have attached the following documents:

University of Wisconsin Press: Do High Voltage Electric Transmission Line Affect Property Value?
Authors: Stanley W. Hamilton and Gregory M Schwann
https://headwaterseconomics.org/library/files/Hamilton;Schwann,1995.pdf

Project Sudbury, Research Team News, May 26, 2016:
http://www.protectsudbury.org/research-news-2016-05-26/

SFGate Home Guide: How Much Do Power Lines Lower Real Estate Values?
http://homeguides.sfgate.com/much-power-lines-lower-real-estate-value-2979.html

American Real Estate Society: High Voltage Power Lines: Do They Affect Residential Property Value? Charles Delaney, Douglas Timmons
https://ideas.repec.org/a/jre/issued/v7n31992p3215-330.html

Respectfully submitted

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Do High Voltage Electric Transmission Lines Affect Property Value?
Author(s): Stanley W. Hamilton and Gregory M. Schwann
Reviewed work(s):
Source: *Land Economics*, Vol. 71, No. 4 (Nov., 1995), pp. 436-444
Published by: University of Wisconsin Press
Stable URL: http://www.jstor.org/stable/3146709
Accessed: 08/02/2012 10:53

Do High Voltage Electric Transmission Lines Affect Property Value?

Stanley W. Hamilton and Gregory M. Schwann

ABSTRACT. *This paper empirically analyzes the impact of high voltage (defined as 69,000 volts or greater) electric transmission lines on the prices of nearby single detached houses. The study demonstrates the importance of using the correct function specification and correcting for (commonly found) heteroscedasticity. We find the electric transmission lines do have an effect on property value, but such effects are restricted to a narrow band and are primarily due to the visual externalities of the transmission towers.* (JEL Q24, R14)

I. INTRODUCTION

The purpose of this study is to add to the literature on the impact of high voltage (defined as 69,000 volts or greater) electric transmission lines on nearby property values. Existing research suggests that proximity to such lines has a small negative impact on property values, but this impact is restricted to properties adjacent to or within 200 meters of the line (Kroll and Priestley 1991). This study adds to the existing literature in two important ways. First, we are able to use a much richer database than any previous study. Our sample contains a greater range of neighborhoods, more varied properties, properties in quite different price ranges, and transmission lines of differing sizes. Second, we are more rigorous in our analysis than previous studies.

Research suggests that some people believe proximity to high voltage transmission lines poses potential health and safety hazards (Priestley and Evans 1990), although the evidence of such a health hazard is inconclusive. Additionally, many believe that proximity to high voltage electric transmission lines reduces property values, either because potential buyers are concerned about the health and safety risks or because of the unsightliness of the lines themselves. We focus on the potential impact of transmission lines on property value.

The existing literature on the impact of transmission lines on property values falls into three general categories. First are the appraisal or valuation based studies, generally utilizing small samples of similar property values. Blanton (1980) and Earley and Earley (1988) are examples of this approach. The second type of research are survey or attitudinal studies which focus on the perceived effects of transmission lines on property values. Priestley and Evans (1990) is the most thorough attitudinal study to date. Other similar studies, using single markets, include Kinnard et al. (1984), Rhodeside and Harwell (1988), Market Trends (1988), and Economics Consultants Northwest (1990). These studies are generally not sophisticated and the survey respondents have a tendency to overestimate the negative impacts of the transmission lines (Kroll and Priestley 1991). The third, more rigorous, set of studies use regression models to estimate the impact of the transmission lines on property values. Ignelzi and Priestley (1989, 1991) provide the most comprehensive analysis to date. Earlier studies using regression models include Carriere, Chung, and Lam (1976), Kinnard et al. (1984), Colwell and Foley (1979), and Colwell (1990).

While the details vary, the results are generally consistent: overhead transmission lines can, in some instances, reduce the value of nearby properties (Kroll and Priestley 1991). These impacts, where they exist,

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are generally less than 5 percent of the property value. The effects are confined to the immediate area of the transmission lines and dissipate quickly with distance. Neither the height of the transmission structures nor the voltage of the lines are found to have significant impact on property values. In all studies, other neighborhood factors dominate the explanation of variations in property values.

Most studies involve properties which were sold after the transmission lines were in place, as does this study. In this case, the estimated impact of a transmission line on property values should be interpreted as a long-run equilibrium effect. When a new transmission line is constructed, or an old line extended in an existing subdivision, the measured effect will also have a dynamic component. Studies of transmission line extensions report that the impacts are initially significant, but quickly diminish over time (Kroll and Priestley 1991).

In some studies a (small) positive impact is found. This is generally associated with a right-of-way (R-of-W) which is accessible for recreational use, or which is attractively landscaped, or provides added privacy to adjacent properties (Rhodeside and Harwell 1988). However, the value of greenspace should not be overrated. Peiser and Schwann (1993) report that pure greenspace exerts a very small effect on property values.

II. DATA

The data used for this study includes all arms-length sales of single detached dwellings in four separate neighborhoods in the metropolitan Vancouver area[1] over the period 1985–91. The four neighborhoods are in proximity to existing transmission lines and the time frame corresponds to a relatively stable period in the market place. The rights-of-ways in the four areas include two areas with a 140m corridor with two 500kV and one 230kV lines on steel towers; one area with two transmission lines on steel towers; and one area with a 60kV line on wood poles. Each property in our sample was located on a map and the distance to the center of the transmission line right-of-way was recorded (*DIS*). Properties which were adjacent to the right-of-way were noted with a dummy variable (*ADJACENT*), and if a property was partially within the right-of-way, this was noted as a dummy variable (*WITHIN*). All properties within a 200m band[2] of the transmission line were inspected to determine the number of towers (*TOWERS*) which were visible from the property and to determine if the transmission lines were visible (*VISIBLE*).

Where necessary, the impact of vendor financing was removed from those sales prices involving vendor-supplied financing. Accurate and current property characteristics were then obtained for all properties sold within the time period of our sample. The property characteristics used in the analysis include the types of variables commonly found in the analysis of real property prices. Dummy variables were used for the presence of a *GARAGE*, *POOL*, *SEWER*, *CURB*, and *CORNER* lot. Continuous variables are used for the *AGE* of the dwelling, number of fireplaces (*FIREPL*), basement rooms (*BASRMS*), bedrooms (*BEDRMS*), full baths (*FBATHS*) and partial bathrooms (*PBATHS*), number of other rooms (*OTHRMS*), and the width (*WIDE*) and depth (*DEEP*) of the lot.

The final sample included 12,907 transactions of single detached dwellings in the four study areas (Table 1). Of this sample, 2,364 were within 200m of the transmission line and of these, 426 were adjacent to or partially within the right-of-way.

III. FUNCTIONAL SPECIFICATION

The question we address in this section is whether the simple linear or log-linear func-

[1] British Columbia uses a Torrens system of land registration in which all sales must be recorded in a central registry and the market value or sales price reported. Analysis of the reported sales prices indicates they are accurately reported. The sales data used in this study were supplied by the provincial Assessment Authority. As part of their annual real property tax assessment function, they identified non-arms-length sales (e.g., sales between family members at less than full price).

[2] Previous studies report that 200m is the outer bound for the region affected by the transmission lines.

TABLE 1
SAMPLE SIZE AND SAMPLING AREAS OF PROPERTY TRANSACTIONS

Study Subarea	Total Sample	Within 200m	Adjacent to R-of-W
Cloverdale	2,605	318	58
Newton East-west	4,086	235	40
Newton North-south	3,815	961	166
Walnut Grove	2,401	850	162
All Areas	12,907	2,364	426

TABLE 2
TESTS FOR FUNCTIONAL FORM

	Dependent Variable			
	v_{it}		$\ln v_{it}$	
Test	Statistic	Prob.	Statistic	Prob.
J-test	25.832	0.0000	22.546	0.0000
Quadratic Terms = 0	43.651	0.0001	42.933	0.0001
Cross-product Terms = 0	13.489	0.0001	12.463	0.0001

tional forms used by other authors provide an adequate approximation of the function relating house prices to property characteristics or whether more comprehensive functional specifications are needed. All of our test results are presented in Table 2.

We begin by using MacKinnon's *J*-test to test the null hypothesis that the hedonic form is linear against the alternative hypothesis that the hedonic form is log-linear. This is a two-step test. In the first step, we estimate the log-linear model and calculate the predicted values from the regression. In the second step, the linear model is estimated, with the predicted values from the first regression included as an extra regressor. The *t*-statistic for the predicted values is the test statistic for the *J*-test. Our *t*-statistic for this test is 25.8 (Table 2, column 2); clearly, we can reject the null hypothesis of a linear functional form. The analogous test of a log-linear functional form against a linear functional form yields a *t*-statistic of 22.5 (Table 2, column 3). Again, we can reject the null. Our results for this pair of tests show that neither the linear nor log-linear functional forms are up to the task of approximating the functional form for the hedonic relationship.

We next consider approximating the hedonic function using a flexible functional form. After exploring the data by fitting a number of Box-Cox, Box-Tidwell, and spline regressions (not reported), we chose the translog functional form as our basic estimating equation. Our explorations showed that the general curvature of the hedonic function was best captured by a form which was logarithmic in the independent variables[3] and with price as the dependent variable. We later address the functional form of the dependent variable.

It is well known that all flexible functional forms provide second-order differential approximations to an arbitrary function. However, in our past works, we have found that flexible forms suffer from multicollinearity. That is, the number of regressors might be reduced without severely compromising the fit. To examine whether this is true for our data, we estimate three translog functions of increasing complexity. Each of the three equations use logarithmic independent variables. The first includes only linear terms; the second includes linear and quadratic terms; and the third includes linear, quadratic, and cross-product terms. We test whether each increase in complexity is warranted using a standard Wald test.

We first test whether the coefficients on the quadratic terms added to the linear specification are jointly zero. The value of the *F*-test of this hypothesis is 43.6 when the dependent variable is v_{it}, and 42.9 when the dependent variable is $\ln v_{it}$ (Table 2, columns 2 and 3). Obviously, the null hypothesis is rejected. Next, we add the cross-products to each regression and test whether the coefficients on the cross-product terms are jointly zero. The *F*-test statistics are 13.4 and 12.4, respectively, for the two de-

[3] Flexible functional forms are usually chosen because of desirable global curvature properties in demand or supply systems, or because of the domain of the independent variables. Since theory provides no guidance regarding the functional form for hedonic regressions, no such criteria operate here.

pendent variables. The null is rejected in both cases. Thus, despite our concern about becoming overly complex, the test results indicate that the full translog specification is warranted.

We now examine the appropriate transformation for the dependent variable conditional on a full translog specification of the independent variables. We fit a simple Box-Cox regression and estimate the power transformation by maximum likelihood. The estimated coefficient is .106 with a t-statistic of 8.4. Hence, the dependent variable is close to logarithmic in absolute terms, but not close enough to be statistically indistinguishable from zero.

Unfortunately, residual diagnostics reveal that the regressions have a significant degree of heteroscedasticity. We test the homoscedasticity of the two regressions using the statistic proposed by Harvey (1974). The test values are 14,192.5 and 1,609.8 for the Box-Cox and log dependent variable regressions, respectively, and the values are both χ^2 distributed with 224 degrees of freedom. The null hypothesis of homoscedasticity is rejected.

Based on the preceeding tests, we conclude that the curvature of the function can best be approximated using the following functional form:

$$\nu_{it}^{(\theta)} = \beta_0 + \sum_{i=1}^{n} \beta_t z_{it} + \sum_{i=1}^{n} \sum_{j=1}^{i} \beta_{ij} z_{it} z_{jt} + \sum_{i=1}^{m} \gamma_i d_{it} + \sum_{t=1}^{28} \gamma_t Q_{it} \qquad [1]$$

where $\nu_{it}^{(\theta)} = (\nu_{it}^{\theta} - 1)/\theta$ is the Box-Cox transformed dependent variable, z_{it} are continuously measured dwelling unit characteristics, d_{it} are discretely measured dwelling unit characteristics, and Q_{it} are quarterly dummy variables for the date of sale. We deal with the problem of homoscedasticity by estimating the Box-Cox model with endogenous multiplicative heteroscedasticity. The log of the variance is taken to be linear in the unit characteristics. The estimations are done by maximum likelihood. We then apply equation [1] to the entire sample and examine the residuals.

TABLE 3
CORRECTED TESTS FOR FUNCTIONAL FORM

	Adjacent Properties		Mid-Range Properties		Far Properties	
	χ^2	df	χ^2	df	χ^2	df
Adding Quadratic Terms	30.6	11	120.6	11	530.3	9
Adding Cross Product Terms	154.8	52	207.5	57	663.5	38
All Terms	185.4	68	328.1	68	1,194.3	47

TABLE 4
TESTS FOR FUNCTIONAL HOMOGENEITY

	χ^2	df
Adjacent and Mid-Range	329.5	130
Adjacent, Mid-Range, and Far	766.4	234

The residuals from equation [1] indicate that the hedonic functional form for properties adjacent to the high voltage electric transmission lines may be different from that for properties further removed from the lines. We examine this by dividing the sample into three sets of properties: properties adjacent to a transmission line (Adjacent), properties within 200m of a transmission line, but not adjacent to a line (Mid-Range), and properties more than 200m from a transmission line (Far), and test for the equality of the coefficients of the hedonic regression across the subsamples.

In Table 3, we report the likelihood ratio tests of functional specification for our three distance zones. The χ^2 statistics are all significant at a p-value of 0.001 or less. Thus, a full translog specification is strongly validated, even after the incorporation of a Box-Cox dependent variable and correcting for heteroscedasticity.

In Table 4, we present the tests for a common functional relationship across the three distance zones in our sample. These tests are based on the full Box-Cox/translog functional form. The null hypothesis that the Adjacent and Mid-Range properties

TABLE 5
HEDONIC REGRESSION RESULTS

	Adjacent Properties		Mid-Range Properties		Far Properties			Adjacent Properties		Mid-Range Properties		Far Properties	
Parameter	Coeff.	*t*-stat	Coeff.	*t*-stat	Coeff.	*t*-stat	Parameter	Coeff.	*t*-stat	Coeff.	*t*-stat	Coeff.	*t*-stat
LAGE	−1.057	−0.806	−0.068	−0.153	0.141	1.173	*LBEDLPBA*	1.171	2.254	−0.108	−0.825	0.023	0.492
LFIREPL	−1.270	−0.567	−1.940	−1.752	−0.050	−0.197	*LBEDLWID*	5.107	1.921	−0.427	−1.769	0.120	1.427
LBASRMS	5.238	1.563	1.245	1.978	0.845	4.717	*LBEDLDEE*	−0.227	−0.238	−0.138	−0.403	0.043	0.414
LOTHRMS	8.182	1.958	−2.970	−1.304	−1.344	−2.595	*LBEDLLDI*	−0.076	−0.257	−0.227	−1.707		
LBEDRMS	−11.935	−1.497	3.163	1.770	−0.713	−1.305	*LBEDLTOW*	−0.269	−0.712	−0.154	−1.901		
LFBATHS	−0.173	−0.030	−5.694	−2.304	1.773	2.559	*LFBALPBA*	1.806	1.726	0.537	2.609	0.244	4.036
LPBATHS	0.826	0.326	−1.710	−1.749	0.107	0.369	*LFBALWID*	0.965	0.697	0.560	1.863	−0.042	−0.403
LWIDE	−10.755	−1.799	−0.980	−0.552	−1.072	−2.973	*LFBALDEE*	−1.936	−1.351	0.087	0.221	−0.268	−2.237
LDEEP	5.252	0.745	−0.139	−0.053	−0.742	−1.383	*LFBALLDI*	0.077	0.308	0.641	3.742		
LLDIS	−2.019	−2.139	−0.059	−0.070			*LFBALTOW*	1.335	1.828	0.334	3.155		
LTOWER	2.447	0.940	−1.203	−1.918			*LPBALWID*	0.582	0.960	0.248	2.174	−0.062	−1.370
LAGELAGE	−0.087	−1.627	−0.062	−4.688	−0.051	−15.151	*LPBALDEE*	−0.937	−1.245	0.142	0.812	0.039	0.761
LFIRLFIR	−0.092	0.794	0.018	0.273	0.092	4.878	*LPBALLDI*	−0.019	−0.252	0.101	1.635		
LBASLBAS	0.133	1.989	0.052	1.479	−0.020	−1.907	*LPBALTOW*	0.333	1.665	0.034	0.895		
LOTHLOTH	0.930	1.643	0.288	1.530	0.024	0.536	*LWIDLDEE*	1.052	1.494	0.080	0.282	0.260	3.900
LBEDLBED	−1.864	−2.197	0.024	0.265	0.022	0.797	*LWIDLLDI*	0.029	0.213	0.127	1.069		
LFBALFBA	2.604	1.636	0.669	3.649	0.540	11.489	*LWIDLTOW*	−0.837	−2.099	0.259	3.298		
LPBALPBA	−0.024	−0.115	0.138	1.743	0.129	5.420	*LDEELLDI*	0.318	1.846	−0.119	−0.838		
LWIDLWID	−0.103	−0.507	−0.074	−0.632	−0.072	−2.126	*LDEELTOW*	0.187	0.553	0.053	0.561		
LDEELDEE	−0.756	−0.936	−0.068	−0.288	−0.019	−0.360	*LLDILTOW*	0.063	1.151	0.027	0.874		
LLDILLDI	0.035	1.870	0.072	2.923			*GARAGE*	0.092	2.311	0.062	3.213	0.050	9.056
LTOWLTOW	0.074	1.172	−0.024	−1.428			*SEWER*	−2.064	−1.260	0.221	2.876	−0.028	−4.256
LAGELFIR	−0.041	−0.612	−0.004	−0.142	−0.049	−4.979	*CURB*	0.281	1.582	0.015	0.496	0.047	6.697
LAGELBAS	−0.123	−1.576	−0.011	−0.670	0.033	6.121	*SIDEWALK*	−0.179	−1.205	0.038	1.207	−0.005	−0.662
LAGELOTH	−0.538	−1.805	−0.122	−2.001	−0.079	−4.589	*CORNER*	−0.045	−0.928	−0.018	−0.656	−0.010	−1.095

LAGELBED	0.181	0.830	0.160	2.825	0.024	1.322
LAGELFBA	0.175	0.542	−0.173	−2.399	−0.076	−3.880
LAGELPBA	0.122	1.028	−0.065	−2.300	−0.053	−4.843
LAGELWID	0.283	1.324	−0.037	−0.680	0.021	1.077
LAGELDEE	0.120	0.660	0.138	1.802	0.009	0.443
LAGELLDI	−0.042	−1.631	−0.034	−1.590		
LAGELTOW	0.081	0.924	−0.024	−1.692		
LFIRLBAS	0.048	0.569	−0.005	−0.142	−0.003	−0.245
LFIRLOTH	−0.227	−0.951	0.458	2.913	0.028	0.772
LFIRLBED	−0.904	−2.168	0.145	1.081	−0.069	−1.790
LFIRLFBA	0.657	1.514	−0.027	−0.157	0.088	1.789
LFIRLPBA	−0.010	−0.074	−0.095	−1.241	−0.016	−0.781
LFIRLWID	0.544	1.483	0.246	2.053	0.043	1.030
LFIRLDEE	0.058	0.137	0.121	0.667	0.001	0.027
LFIRLLDI	0.095	1.122	−0.077	−1.246		
LFIRLTOW	−0.052	−0.560	−0.010	−0.260		
LBASLOTH	0.034	0.188	−0.073	−0.833	0.008	0.334
LBASLBED	−0.366	−1.439	−0.057	−0.715	−0.074	−3.163
LBASLFBA	−0.582	−1.557	−0.169	−1.816	−0.111	−4.429
LBASLPBA	−0.359	−2.065	−0.059	−1.490	−0.062	−4.831
LBASLWID	−0.191	−0.879	0.023	0.356	−0.096	−3.609
LBASLDEE	−0.787	−1.297	−0.174	−1.638	−0.062	−2.014
LBASLLDI	0.065	0.852	−0.043	−1.272		
LBASLTOW	0.058	0.706	−0.016	−0.684		
LOTHLBED	−1.405	−1.513	0.142	0.467	0.049	0.670
LOTHLFBA	−2.206	−1.249	−0.670	−2.031	−0.360	−4.017
LOTHLPBA	−1.190	−1.876	−0.313	−2.009	−0.034	−0.800
LOTHLWID	−0.378	−0.699	0.384	1.548	0.355	4.310
LOTHLDEE	−0.738	−1.007	0.642	1.633	0.059	0.671
LOTHLLDI	0.065	0.404	−0.386	−2.978		
LOTHLTOW	0.737	−2.120	−0.113	−1.422		
LBEDLFBA	1.272	0.870	0.005	0.016	−0.052	−0.659

ENCUMB	−0.151	−0.853	−0.026	−0.858		
VISIBLE	0.210	0.888	−0.051	−1.295	−0.026	−2.203
Q2	−0.156	−1.560	−0.062	−1.338	0.019	0.957
Q3	0.021	0.268	−0.045	−0.722	0.014	0.706
Q4	−0.019	−0.465	0.031	0.616	0.036	1.826
Q5	−0.035	−0.713	0.087	1.547	0.077	3.767
Q6	0.233	2.347	0.071	1.546	0.109	5.728
Q7	0.144	1.993	0.123	2.596	0.136	7.224
Q8	0.263	2.162	0.146	2.719	0.138	6.981
Q9	0.523	2.589	0.164	2.980	0.185	9.534
Q10	0.367	2.585	0.249	4.543	0.228	12.379
Q11	0.296	2.312	0.256	4.552	0.263	13.402
Q12	0.307	2.188	0.337	5.201	0.261	12.333
Q13	0.337	2.352	0.299	4.529	0.279	13.343
Q14	0.332	2.317	0.357	5.514	0.358	17.765
Q15	0.553	2.658	0.439	6.219	0.436	20.267
Q16	0.507	1.869	0.606	6.639	0.471	20.475
Q17	0.546	2.609	0.673	7.060	0.622	24.469
Q18	0.905	2.363	0.861	7.352	0.752	26.358
Q19	1.124	2.756	0.954	7.192	0.822	26.952
Q20	1.120	2.591	1.109	7.362	0.974	28.135
Q21	1.865	2.261	0.405	7.276	0.239	28.640
Q22	1.543	2.615	0.699	7.030	0.231	27.812
Q23	1.237	2.155	0.253	7.225	0.111	27.755
Q24	1.156	2.201	0.263	7.342	0.072	27.646
Q25	1.672	2.640	0.322	7.223	0.099	27.886
Q26	1.685	2.426	0.527	7.203	0.229	29.039
Q27	1.610	2.281	0.598	7.181	0.303	28.635
Q28	1.962	2.340	0.628	7.168	0.340	28.531
CONSTANT	13.205	0.969	7.318	0.767	5.923	3.402
THETA	0.329	1.969	0.298	5.297	0.212	15.911

have a common functional form is rejected (p-value < 0.001), as is the test of the null hypothesis that all three subareas have a common functional form (p-value < 0.001).

Because of these results, our assessments of the effects of high voltage electric transmission lines on property value are based on separate regressions for the three distance zones. And, our estimates are based on the heteroscedasticity corrected Box-Cox/translog model. The estimated regression results are presented in Table 5.

IV. THE EFFECT OF HIGH VOLTAGE ELECTRIC TRANSMISSION LINES ON PROPERTY VALUES

We are now in a position to address the central question of this paper: Do high voltage electric transmission lines affect property value? To answer this question, we perform three experiments based on the estimated equations. These experiments determine the increase (decrease) in property value from removing the transmission line effects. The results from these experiments are presented in Table 6.

In the first experiment, we calculate the change in property value for an average dwelling unit from removing the existing visual externality of the high voltage electric transmission line towers. For properties adjacent to the towers, we estimate that removing the unsightliness of the towers increases property value by 5.7 percent ($6,669). The t-statistic for the test of the hypothesis of no change in value is 1.91 and this effect is significant at the 6 percent level. For the Mid-Range properties, we find no significant change in property value from removing the visual externality of the tower in either model.

In our next experiment, we examine the effect of proximity to the high voltage electric towers. For the Adjacent properties, we calculate the effect of increasing the right-of-way so that the average property is 100m or 200m from the towers. Moving the houses to the 100m point increases property value by 5.8 percent ($6,740 for our average property). This increase is highly statistically significant, with t-values of 5.3. Recall that previous studies have shown that 200m is the boundary of the effects of towers on property value.

We next calculate the effect of increasing the distance of Mid-Range properties from the transmission lines to 200m (an average increase of approximately 30m). We assume that this move reduces the visibility of the towers. This increase in distance results in a 2.8 percent increase in property value, which is statistically significant. Note that increasing average distance of a Mid-Range property from a transmission line by 30m increases its property value by $3,438, which is approximately half of the $6,740 increase in property value from moving an Adjacent property to 100m. Thus, our estimates for Adjacent and Mid-Range properties are consistent.

In our final experiment, we remove both the visual effect of the towers and the proximity effect. The result is more than a simple addition of the individual effects be-

TABLE 6
THE EFFECTS OF HIGH VOLTAGE ELECTRIC TRANSMISSION LINES ON PROPERTY VALUE

	Adjacent Properties			Mid-Range Properties		
	%	$	t-stat	%	$	t-stat
Tower Visibility	5.7	6,669	1.91	−0.7	907	−1.48
Distance from Tower (100m)	5.8	6,740	5.32			
Distance from Tower (200m)				2.8	3,438	8.88
Joint Effect (100m)	6.3	7,339	2.75			
Joint Effect (200m)				1.1	1,338	2.07

cause of interaction effects in the translog form and the significance test will be different because the effects are correlated. We find that electric transmission line towers do have a significant impact on the values of properties located adjacent to the towers. After removing both of the effects of the lines, property values increase by 6.3 percent ($7,339) for 100m. We find also that transmission lines affect Mid-Range properties, but the effect is small. The properties increase in value by 1.1 percent, or $1,338, after both of the effects of the electric transmission line are removed. All of these impacts are statistically significant.

Our estimates of the effects of the high voltage electric transmission lines are comparable to those obtained in previous studies; they are not very large. A detailed examination of our regression results shows that there is a strong interactive relationship between the distance from a transmission line and lot width, and number of towers visible and lot width. Inspection of the affected properties reveals that the builders/developers of these properties have, to a significant degree, compensated for the transmission lines by reconfiguring the lots and reorienting the house to mitigate the visual externalities.

V. CONCLUSION

High voltage electric transmission lines do have an effect on property value. We find that properties adjacent to a line lose 6.3 percent of their value due to proximity and the visual impact. This is in the mid-range of results reported by earlier studies. As expected, properties more distant from transmission lines are scarcely affected, losing roughly 1 percent of their value.

Our study also demonstrates the importance of thorough econometric work in determining the effect of transmission lines on property value. We obtain three results in this regard. First, the functional specification is crucial. Cavalier use of linear or log-linear specifications yields faulty results. Second, the error term in hedonic equations is heteroscedastic for all of the functional specifications we tried. This is a common finding. But, our work highlights how important it is to correct for heteroscedasticity when trying to uncover the impact of externalities on property value through statistical testing. Finally, we find that the functional form of the regression for properties close to electric transmission lines is different for that of properties far from the lines.

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Protect Sudbury

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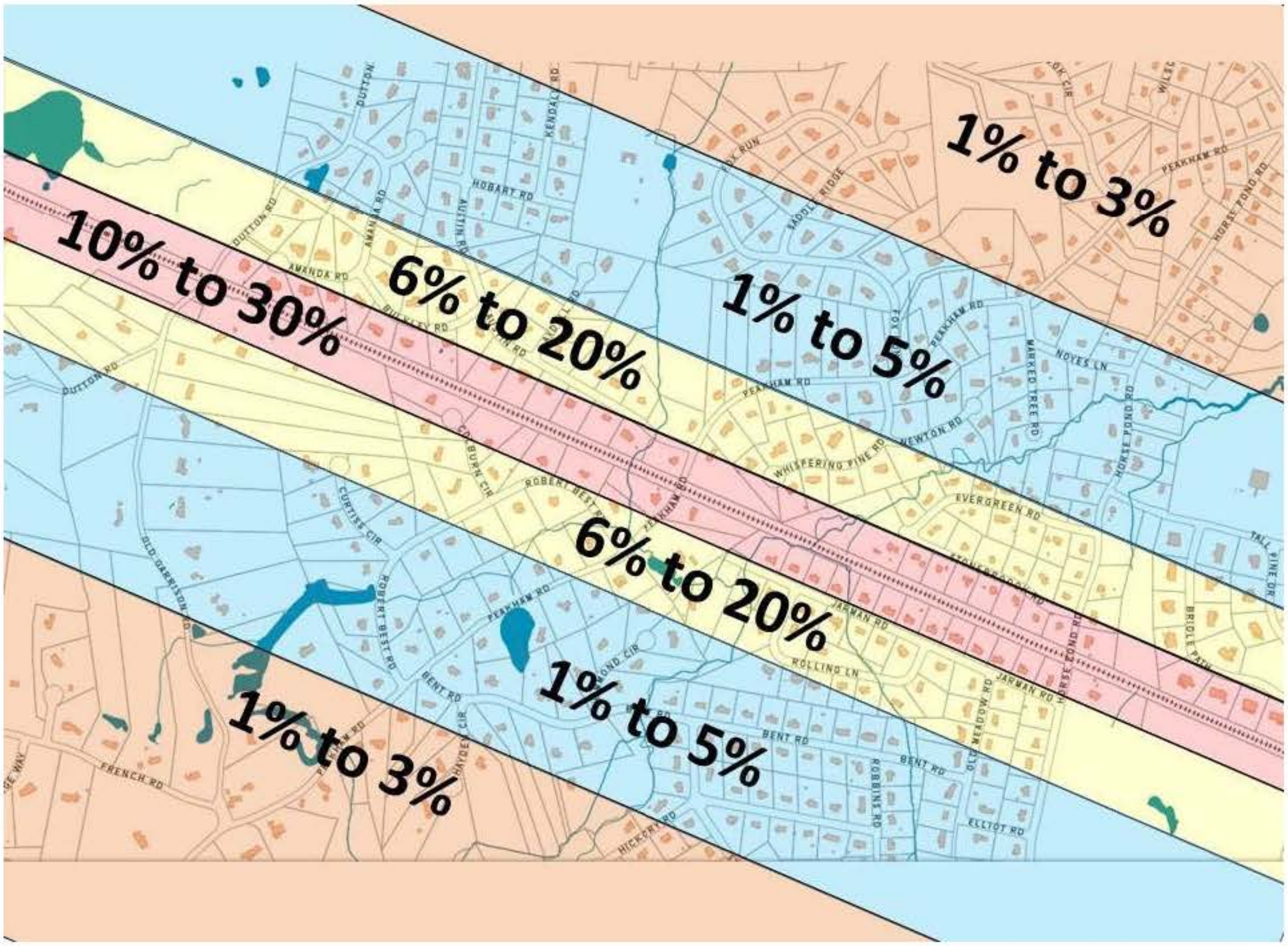
Research Team News, May 26, 2016

The Protect Sudbury Research team, led by Julie Lieberman, has been hard at work developing fact-based data that will be vital in our short and long term legal and political fight. This month, the Research team completed work on an in-depth analysis of the effect of the overhead power lines on property valuation and tax revenues. Loss percentage ranges were determined in accordance with the studies and information from eight national and local research reports. The Protect Sudbury study includes data from Sudbury, Hudson, Marlboro, Stow and Wayland. Through the use of the MassGIS Oliver data base, all properties within proximity of 3,000 feet from the rail ROW were studied. The study determined that the property de-valuation extends into four categories based on proximity to the property lines:

1. Direct Abutters (50 feet)
2. Adjacent Neighborhoods (300 feet)
3. Impacted Neighborhoods (1000 feet)
4. Outlying Neighborhoods (3000 feet)

The potential impact was examined on a 'best and worst' case basis. The illustration below shows a typical neighborhood and the projected impact across these four categories or 'zones'.



The total potential loss in property values for the town of Sudbury alone ranged from ~$20m to $63m dollars. Due to the resulting reduced assessments on these properties, annual tax revenues were projected to decline by about $400,000 to $1,000,000. The table below breaks down the total potential loss in property values for each zone under best and worst case scenarios.

SUDBURY	count	loss min	loss max
Based on 2016 Assessment Data			
Sudbury Total Loss Direct Abutter (50 feet)	187	$7,529,594	$22,588,782
Sudbury Total Loss Adjacent to ROW (300 feet)	131	$3,840,745	$12,802,484
Sudbury Total Loss Impacted Neighborhood (1000 feet)	335	$1,553,754	$7,768,772
Sudbury Total Loss Adjacent Neighborhood (3000 feet)	1,232	$6,776,289	$20,328,866
Sudbury Total Loss to Property Owners w/i 3000 ft	**1,885**	**$19,700,382**	**$63,488,904**

Residential	$18,896,798	$60,928,115
Commercial/Industrial	$281,324	$971,908
Recreational/Conservation Land	$522,261	$1,588,881
Sudbury Total Loss to Property Owners w/I 3000 ft	**$19,700,382**	**$63,488,904**

This data will be made available to residents at both our upcoming neighborhood meetings and through a tool that will be integrated into our web site. Individual property owners will be able to measure the impact on both their neighborhood as well as their own properties.

The Research Team also spent substantial time investigating potentially viable alternative routes for the Sudbury to Hudson power line that may not have been considered by ISO-New England or Eversource. This is a complex task that requires an in-depth understanding of transmission system planning, the existing grid, tariffs and rate assessments, and the existing infrastructure that exists on these potential routes. Despite these challenges, the team is confident that Protect Sudbury will be able to retain experts who can further develop and analyze these ideas.

Loss percentage ranges were determined in accordance with the following studies and information:

Steven C. Bottemiller, MAI, and Marvin L. Wolverton, PhD, MAI, The Price Effect of HVTLS on Abutting Homes, The Appraisal Journal (2013, Winter)

- *Portland Study Area Abutting homes impacted 1.65%*
- *Seattle Study Area Abutting homes impacted 2.429%*
- *Seattle Study Area Higher Priced Abutting homes impacted 11.225%*

Charles J. Delaney and Douglas Timmons, "High Voltage Power Lines: Do They Affect Residential Property Value?" Journal of Real Estate Research 7, no. 3 (Summer 1992): 315–329.

- *Proximity to power lines reduces home value by about 10%*

Dean Chapman, "Transmission Lines and Industrial Property Value," Right of Way (November/December 2005): 20–27.

- *Finds no basis for consequential damages to industrial properties based on proximity to*

HVTLs

James A. Chalmers, "High-Voltage Transmission Lines and Rural, Western Real Estate Values," The Appraisal Journal (Winter 2012): 30–45.

- *Studied large agricultural production land and land with a recreational influence*
- *Concludes that properties oriented toward resiential use are more vulnerable to (negative) HVTL price effect, larger properties are less vulnerable, and when a market provides more purchase alternative (subsitute properties) HVTL-impacted properties are more apt to experience a price effect.*

Stanley W. Hamilton and Gregory M. Schwann, "Do High Voltage Electric Transmission Lines Affect Property Value?" Land Economics 71, no. 4 (November 1995): 436–444.

- *Analyzed 12,907 transactions from four neighborhoods in Vancouver, Canada from 1985-1991*
- *Study found a 6.3% dimunition in value for homes in close proximity to power lines*

Francois Des Rosiers, "Power Lines, Visual Encumbrance and House Values: A Microspatial Approach to Impact Measurement," Journal of Real Estate Research 23, no. 3 (2002): 275–301.

- *Based on a sample of 507 single family houses sold in Montreal from 1991-1996.*
- *Findings suggest that although severe visual ecumbrance due to a direct view on a pylon or conductors does exert a significantly negative impact on property prices with depreciations ranging from 5% to well in excess of 20%. Though, being adjacent to an easement will not necessarily cause a house to depreciate and amy even increase its value in similar proportions where proximity advantages exceed drawbacks.*
- *Primary result was a 9.6% reduction in value for a home adjacent to a power line and facing a pylon.*
- *Two court decisions by New York State's Court of Appeal and the Court of Appeal of Kansas, Texas, have since stated that evidence of fear in the market place and ensuing economic damge to the property shoud be admissible as a ground for compensation, irrespecive of the reasonableness of the fear*
- *Wherever negative impacts are at stake, these vary, by and large, between 1% and 6% of value at a 200 ft distance, 9% in the case of improvements to existing lines and between 6% and 9% of value at a distance of 50 feet. (Colwell and Foley, 1979: and Colwell, 1990).*
- *Immediate proximity to, or direct view on, a pylon does cause house prices to drop, from 5% at a 50 meter, or 160 ft., distance to more than 27% at 10m., or 33 ft. (Callanan and Hargreaves, 1995; and Hamilton and Schwann, 1995)*
- *Owners of luxury houses tend to be more sensitive than other to the potential visual encumbrance*

- *Proximity of 165-500 feet leed to drops of 4.1% to 5.3% in 165-325 feet range, in eastern study 165 feet = 8.4% depreciation and 12% for properties within 325 to 500 feet, Overall, price reduction stands at roughly 10% of mean house value, but averages 15% in study area where setback from powerline is 50 ft. While properties belonging to lower end of the market experience price reductions in the 10% to 15% range, findings also suggest prices drops of around 15% – 20% for upper price properties. In one neighborhood dpreciation reaches 23%. Similarly, a direct view of conuctors will usually reduce property values by 5% – 10%; in some cases though, the market discount exceeds 15%.*
- *Property premiums of 7% to 22% were found when proximity advantages (enlarged visual field, increased intimacy) exceed drawbacks*
  Negative impacts decrease rapidly after 500 ft.

Robert A. Simons and Jesse D. Saginor, A Meta-Analysis of the Effect of Environmental Contamination and Positive Amenities on Residential Real Estate Values, The Journal of Real Estate Research; Jan-March 2006; 28, 1; ProQuest Central p. 71

- *For the 164 observations that utilize regression analysis, the largest loss was $42,480 and the mean loss was $6,443. These values correspond to a percentage loss in value of 29% for the largest loss and a mean loss of 4%*
- *Case studies, while often highlighting worst-case scenarios and often only one hamoe, had losses ranging from 0 to $438,200 (88%) of home value, with a mean of 21%.*
- *Survey methods also had larger losses in terms of percent. The maximum loss was $96,669 (94%) with a mean loss of $17,164 (19%).*

Study Conducted by Libby Hamill, Sales Associate, Stephan Real Estate, 400 Boston Post Road, Sudbury, MA, 01776; L.Hamill@StephanRE.com; 978-443-7300

- *Spoke to the Assessor in town and she said that houses that have a power utility easement have a 15% standard reduction the land value of the property.*
- *The Assessor also stated that their formulas are market driven.*
- *There are approximately 30 homes that are affected by transmission lines from Wayland. The market history is very limited: A consumers adverse perception of price could lower market value by 10% to 30% or more.*
- *35 Stonebrook has been lowered 3 times values has decreased by 14% and not sold yet.*
- *23 Millbrook lost approx 35% – 38% of vaue between 2008 and 2010*

How Much Do Power Lines Lower Real Estate Value?

The presence of high-voltage power lines near a property has long been a bane of real estate agents. Not only are most power lines unsightly and sometimes noisy, but also they can raise a number of safety concerns among buyers related to the risk of electrocution and rumors that exposure to electromagnetic fields can cause a variety of diseases, including cancer. These drawbacks have translated into consistently lower property values for homes near power lines.

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Features

According to an article in the Appraisal Journal, homes suffer a loss in value only when high-voltage power lines are evident. Power lines that are noiseless and well-hidden tend to have little or no impact on property value. However, when power lines are evident, studies show a decline in property value of between 1 percent and 10 percent.

Effects

A 1995 study by Stanley Hamilton and Gregory Schwann examined the effect of a proximity to high-voltage power lines on real estate prices. Using a sample of more than 12,000 homes, Hamilton and Schwann found that properties next to a power line lost an average of 6.3 percent of their value.

Considerations

According to the Appraisal Journal, the decline in value diminishes as the distance between the home and the power line increases. Also, if the lines are partially obscured from view, the decline is also found to be less severe. However, if the view is entirely unobstructed, the price of homes as far away as one-quarter of a mile can be affected.

Expert Insight

Fifty-two of 54 real estate agents surveyed by the "Roanoke Times" in 1998 stated that high-voltage power lines lowered residential property values. However, real estate agents noted that more expensive homes were likely to suffer a disproportionately large decline in value compared with cheaper properties, a discrepancy they attributed to the selectivity of a wealthier clientele. "Cheaper property won't be affected as much, but homes in exclusive areas will lose value," said William Ward, the owner of a Roanoke real estate agency. "People who can afford to pay $200,000 for a house are not going to want to pay that much for a house near a power line. Therefore it drives the price down."

Misconceptions

Although long rumored to be a carcinogen, no credible scientific evidence that power lines cause cancer or any other disease has been developed. A 1995 statement by the Council of the American Physical Society, a group of prominent physicists, stated that no study has yet shown a link between power line fields and cancer. A study by the National Research Council came to a similar conclusion. Wider proliferation of these findings may ease concerns about the lines' possible negative health effects.

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High Voltage Power Lines: Do They Affect Residential Property Value?

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A survey administered in 1990 suggests that proximity to high voltage power lines is being capitalized into lower values for residential properties. Respondents who had appraised such property report that power lines can affect residential property value to varying degrees under certain circumstances and that the market value of these properties is, on average, 10.01% lower than the market value for comparable properties not subject to the influence of high voltage power lines. Further, the results indicate that even appraisers who had not appraised such property believe that power lines contribute negatively to property value.

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