Wallingford-Ingo, Gail

From: Melvin Manrose <ml4570rose@yahoo.com>
Sent: Saturday, January 4, 2020 12:37 PM
To: Wallingford-Ingo, Gail
Subject: Black Hills Energy 1041 2019-003 #6535174 Further Rebuttal
Attachments: 202001032030.pdf

Dear Gail and Commissioners,

In response to Black Hills Energy's claim in their study of property values we would like to submit the following opposite view. It shows values can be affected as much as 59%. It was not biased by an energy company.

Thank you,
Melvin Manrose
228 E. Parkridge Dr.
Pueblo West, CO.81007

High-Voltage Transmission Lines and Residential Property Values in New England: What Has Been Learned

by James A. Chalmers, PhD

Abstract

This article summarizes work over ten years on the effects of high-voltage transmission lines (HVTLs) on residential property values in New England. It identifies what is often presumed—there are some properties for which HVTLs are sufficiently intrusive that their market value is affected. Since the class of affected properties is small, little insight into their defining characteristics has been possible in statistical studies. In the research presented in this article, however, a more traditional case study approach is employed, and a remarkably consistent pattern emerges that gives guidance to situations where there is a significant likelihood of an HVTL effect on value. The research results offer important support for the valuation of properties along existing HVTL corridors and for anticipating effects of proposed projects both in new and existing corridors.

Introduction

The generation and transmission of electrical energy is in a period of rapid change in the United States. The decommissioning of aging coal-fired and nuclear power plants combined with new, and in many cases, more decentralized generating sources is creating the need for significant upgrade and expansion of the electric grid. These projects are frequently controversial, and the possible effect on property values remains a high-profile and poorly understood issue.

The value effect issue is complex because it has two very distinct but interrelated parts. The first issue is the effect of one or more existing high-voltage transmission lines (HVTLs) on residential property values. The second, and increasingly prominent, issue is the incremental effect of system upgrades when existing corridors are reengineered to carry increased loads. The purpose of this article is to address both the issues and examine the implications for the evaluation of proposed projects.

The research has been carried out in the context of three large projects.

- **Project 1: 2008 Massachusetts and Connecticut Study.** The first research project involved the 2008 statistical analysis of over 1,200 home sales during 1998–2007 in four Massachusetts and Connecticut study areas. The results of that research were published in *The Appraisal Journal* in 2009.[1] For purposes of discussion, this study will be referred to as the "2008 Massachusetts/Connecticut Study."
- **Project 2: New Hampshire Research Study.** The second research project involved a case study of residential sales in New Hampshire; this research was carried out in 2013 to 2018. Due to the low density of housing develop-

1. James A. Chalmers and Frank A. Voormann, "High-Voltage Transmission Lines: Proximity, Visibility, and Encumbrance Effects," *The Appraisal Journal* (Summer 2009): 227–245. This research was undertaken on behalf of Northeast Utilities (NU), now Eversource Energy (Eversource).

Exhibit 1 HVTL Research Locations

ment in much of New Hampshire, a statistical study was not possible. Therefore, the focus of the New Hampshire research was on 78 case study sales of residential properties that were either encumbered by, or adjacent to, an HVTL right-of-way (ROW). The case study research is described, and the results presented, in what will be referred to as the "New Hampshire Research Report."[2]

- **Project 3: 2018 Massachusetts and Connecticut Research Study.** The third research project was carried out over the period 2016 to 2017 and consisted of two components: a statistical study of over 1,800 residential property sales in eight Massachusetts and Connecticut study areas and a case study analysis of 42 residential property sales in the same eight study areas. The results of this third project are presented in what will be referred to as the "2018 Massachusetts/Connecticut Research Report."[3]

Exhibit 1 shows the locations of the statistical study areas and the 120 case study transactions in the research projects. The purpose of this article is to synthesize the findings from these research initiatives, with an emphasis on their implications for the evaluation of value impacts of proposed high-voltage transmission line projects.

Research Background

Literature Review

The prior research on the effects of HVTLs on property value has been exhaustively reviewed in the professional literature and will not be repeated here.[4] There are two recent articles, however, that deserve mention. The first article reports on research by Tatos, Glick, and Lunt, and appeared in the Summer 2016 issue of *The Appraisal Journal*.[5] The approach there was unique in that data were collected for approximately 125,000 sales in Salt Lake County, Utah, over a period of fourteen years. Sale price was related to approximately 450 property characteristics (for example, it included eighteen floor variables—cherry, oak, maple, carpet, tile, laminate, slate, etc.).

While this approach is remarkable in the number of observations studied and the large number

2. Chalmers & Associates, "High Voltage Transmission Lines and Real Estate Markets in New Hampshire: A Research Report," June 30, 2015, Revised July 15, 2018. This research was undertaken on behalf of Northern Pass Transmission, LLC, Public Service Company of New Hampshire, and National Grid. A copy of the report is available on request from the author.
3. Chalmers & Associates, "High Voltage Transmission Lines and Real Estate Markets in Massachusetts and Connecticut: A Research Report," July 15, 2018. This research was commissioned by Eversource. A copy of the report is available on request from the author.
4. The relevant literature through 2010 is addressed in James A. Chalmers and Frank A. Voorvaart, "High-Voltage Transmission Lines: Proximity, Visibility, and Encumbrance Effects"; Thomas D. Jackson and Jennifer Pitts, "The Effects of Electric Transmission Lines on Property Values: A Literature Review," *Journal of Real Estate Literature* 18, no. 2 (2010): 239–259; and Julia Haggerty, "Transmission Lines and Property Value Impacts: A Summary of Published Research on Property Value Impacts from High Voltage Transmission Lines" (report prepared by Headwaters Economics for the Mountain States Transmission Intertie Review Project), May 2012). The literature since 2010 is summarized in Orell C. Anderson, Jack Williamson, and Alexander Vorst, "The Effect of High-Voltage Overhead Transmission Lines on Property Values: A Review of the Literature since 2010," *The Appraisal Journal* (Summer 2017): 175–192. It should be noted that there is also an extensive literature review in the New Hampshire Research Report.
5. Ted Tatos, Mark Glick, and Troy A. Lunt, "Property Value Impacts from Transmission Lines, Substransmission Lines, and Substations," *The Appraisal Journal* (Summer 2016): 205–229.

of control variables, its application to the HVTL issue is limited because of the lack of site-specific measurements (which is understandable given the number of observations) of the key HVTL-related variables. The three critical drivers of HVTL effect on residential property values are generally assumed to be proximity, visibility, and encumbrance, and there are shortcomings with each of these measures in the Tatos, Glick, and Lunz study. Specifically, in that study there are no visibility measures; there is an easement variable, but as the authors note, it is not clear whether it refers to all easements on the property or to some subset of the easements; and finally, there is no distance measure from the home to the ROW—rather there is a separate distance measure to every line. As a result, there is no distinction between proximity to two 115 kV lines in the same corridor or to two 115 kV lines in separate corridors. The authors acknowledge that additional refinements of the data could address the easement issue and the proximity issue, but the critical visibility question is very difficult to resolve without a site visit.

A second study of note, by Wyman and Mothorpe, shares some similarities with the Salt Lake County study in that it uses public domain property records and GIS databases to look at a large number of transactions. The subject of this study is over 5,000 vacant lot sales that took place over the period 2000 to 2016 in Pickens County, South Carolina.[6] Unlike the Salt Lake County study, which is cautious in drawing conclusions with respect to HVTL price effects, the Pickens County study finds a 44.9% pricing discount for properties adjacent to transmission lines and a 17.9% discount for non-adjacent properties up to 1,000 feet from the HVTL.

It should be noted that development in Pickens County is extremely diverse. Its western boundary is Lake Keowee, which has been successfully developed into several ultra-high amenity golf course/lakefront communities where lots sell from low- to mid-six figures. Clemson University is located in the southwest corner of the county. The southeastern portion of the county is oriented to the Greenville metropolitan area and its strong manufacturing base. Moving north to the central and eastern portions of the county, development patterns are more scattered and very rural, and property values are low. In this broad and very heterogeneous context, all vacant lot sales of properties with fewer than 20 acres were studied over a seventeen-year period.[7] However, there are no controls for zoning, highest and best use, or for the extent to which certain residential lots benefit from extensive infrastructure and amenity improvements. The lots presumably range from commercial, industrial, agricultural, and residential highest and best uses. Further, those lots with a residential highest and best use have a range of current uses, from unimproved rural acreage to improved residential lots in amenity-rich subdivisions. The study includes some controls, but these do not adequately account for the lack of uniformity in the study properties. Also, as with the Salt Lake County study, there are issues with the three critical HVTL variables of distance, visibility, and encumbrance. Distance is measured from the centroid of the parcel, which on large parcels may be a poor proxy for the likely home site. Visibility is calculated from viewshed analysis that relies on topographic and land cover data sets that lack the granularity to support reliable inferences with respect to individual properties. Finally, there is no encumbrance measure. This research advances interesting ideas for using increasingly rich geocoded databases, but such databases require refinement before they can make a significant contribution to understanding of HVTL effects on residential property values.[8]

The central message from the literature continues to be that about half of the statistical studies find some measure of adverse property value effects and half do not. Where negative effects are found, they are small (usually in the 1% to 6% range), and the effects diminish rapidly with

6. David Wyman and Chris Mothorpe, "The Pricing of Power Lines: A Geospatial Approach to Measuring Residential Property Values," *Journal of Real Estate Research* 40, no. 1 (2018): 121–151.

7. Multi-parcel sales and parcels that resold within six months were excluded, but there was no additional screening to eliminate sales that do not meet the usual criteria of a fair market sale, e.g., related parties, refinking to trusts, short sales, REO sales, etc.

8. The case study research indicates that detailed property-specific and transaction-specific data play a critical role in reaching conclusions about HVTL impact. Given the impracticality of developing information with that specificity for very large data sets, the methods being developed in these studies may have more useful application in other types of investigations.

distance.[9] Most troublesome is that there is no explanation for the variability in the research findings.[10] It follows, therefore, that residential property value effects on nearby properties cannot be presumed. It is also the case that the absence of effects cannot be presumed. The research has not produced results that are sufficiently robust or consistent to allow generalization to unstudied situations.

Study Methodology

Statistical Analysis. Ever since William Kinnard's pioneering work in this area, the dominant research methodology related to HVTL effects has been multiple regression analysis applied to large numbers of property sales located in the vicinity of an HVTL.[11] While this was a major step forward from what historically amounted to anecdotal accounts, the research frequently suffered from a lack of precision in measuring the key variables that determine the extent to which an HVTL intrudes on a property—namely, proximity of the house to the ROW, visibility of structures and conductors, and the extent to which the property is encumbered by the ROW easement. Since these variables are correlated with one another, each must be clearly defined if its independent effect is to be ascertained. It is also the case that the results have to be interpreted as a kind of average. If statistical analysis identifies property value effects, that does not rule out the fact that some properties are likely unaffected. Unfortunately, the statistical analysis does not help identify the conditions that may be responsible for these exceptions.

Notwithstanding these concerns, regression analysis is the most reliable way to answer the question of whether there are systematic, measurable effects of HVTL proximity, visibility, or ROW encumbrance on residential property values. It was in that context that the statistical analysis was undertaken in the 2008 Massachusetts/Connecticut Study.[12]

Case Study Approach. After the publication of the results of the 2008 Massachusetts/Connecticut case study in *The Appraisal Journal*, Northwestern Energy commissioned a similar study for Montana.[13] The study area for that research covered several hundred miles of sparsely populated rural area across the center of Montana, from the Colstrip generating stations in southeastern Montana to Thompson Falls near the Montana-Idaho border. Given the small number of observations and the heterogeneous mix of property types in that study area, it was impossible to conduct the statistical analysis used in other HVTL studies. That led to the development of the case study approach discussed in this article.

The case study approach relies on a combination of tools to come to a conclusion with respect to whether an HVTL has influenced the sale price or the marketing time in a particular transaction. The four basic components of the case study are the facts of the sale, the physical relationship of the property to the HVTL, interviews with transaction participants,[14] and appraisal evidence of the market value of the property independent of HVTL influence.[15] Upon consideration of all four components, an opinion is rendered as to whether or not the transaction was influenced by the HVTL or whether the evidence does not support a conclusion one way or the other.

Where it is concluded that the sale price was adversely affected by the HVTL, the best evidence of the magnitude of the effect is the difference between the appraised value independent of HVTL influence and the sale price. However, that difference must be interpreted cautiously,

9. See Chalmers and Voorvaart, "High-Voltage Transmission Lines: Proximity, Visibility, and Encumbrance Effects."

10. It is possible that the variability in findings is more related to how the variables are defined and measured than to any underlying difference in the key behavioral relationships.

11. See for example, William N. Kinnard Jr., "Power Lines and Residential Property Values," *The Appraisal Journal* (April 1967): 269–284.

12. Chalmers and Voorvaart, "High-Voltage Transmission Lines: Proximity, Visibility, and Encumbrance Effects."

13. The findings of that research are reported in James A. Chalmers, "High-Voltage Transmission Lines and Rural, Western Real Estate Values," *The Appraisal Journal* (Winter 2012): 30–45.

14. The interviews were not scripted but involved an open-ended discussion that centered on whether the listing price, time on market, or ultimate negotiation over sale price were, in the opinion of the respondent, influenced by the HVTL.

15. The appraisal evidence requires a retrospective appraisal at the date of sale of the transaction in question using comparable sales that have no HVTL influence.

because sale price can diverge from an opinion of market value for many reasons, including scarcity of comparable sales in some of the study areas for some of the time periods, no interior inspection possible at the date of valuation, varying negotiating skills and motivational factors of the participants, and the influence of other property or locational factors that are particularly difficult to determine in a retrospective appraisal.

There is a tendency to mischaracterize the case study approach as anecdotal, but it is much more than that. It is based on an empirical foundation regarding the facts of the sale and the physical relationship of the property to the HVTL, the opinions of the market participants, and the market data as presented in the retrospective appraisal. The challenge with the case study approach lies in the level of generalization that can be attached to the findings. The number of observations is likely to be small relative to statistical studies; so, the conclusions that usefully can be drawn from the approach depend on the care with which the studies are carried out and the consistency of the conclusions. As a practical matter, however, it is the only feasible approach in the context of an environment like rural Montana.

In 2013, Northern Pass Transmission, LLC; the Public Service Company of New Hampshire (Eversource Energy); and National Grid USA commissioned development of a research base that would address the effects of HVTLs on residential property values in New Hampshire with particular attention to the incremental effect of additions to an existing corridor.[16] The study areas in New Hampshire presented many of the same issues of low-density residential development and heterogeneous housing stock that had been encountered in the Montana research. Statistical analysis could have been carried out in southern New Hampshire around Concord, but that would have addressed only a very small subset of the potentially affected areas. Based on these facts, a case study approach was indicated and analysis of 78 transactions provides the base on which conclusions were reached, as reported in the New Hampshire Research Report.[17]

In 2016, Eversource Energy commissioned similar research to provide additional information with respect to its Massachusetts and Connecticut service territories, particularly in eastern Massachusetts and south-central Connecticut. Development densities in both areas were capable of supporting the statistical analysis, but the insights gained in the New Hampshire case studies were sufficiently valuable that a case study approach was pursued as well.

The purpose of this article is, therefore, to convey what has been learned from the statistical studies in Massachusetts and Connecticut combined with the case studies carried out in New Hampshire and in Massachusetts and Connecticut.

Study Summaries

The methodology and findings of the previously referenced studies are thoroughly documented in the 2009 *Appraisal Journal* article and the New Hampshire and Massachusetts/Connecticut Research Reports. The objective here is to provide a summary of those findings with particular emphasis on the way in which the research can be applied to the evaluation of proposed projects.

2008 Massachusetts/Connecticut Statistical Study

The 2008 Massachusetts/Connecticut statistical study looked at over 1,200 sales in four study areas: Hartford, Connecticut; Springfield, Massachusetts suburbs; western Connecticut; and two southwestern Boston suburbs. The sales all occurred over the period 1998–2007. The HVTL variables included continuous distance from the street curb opposite the front door to the ROW centerline, distance zones (0–75 meters, 76–150 meters, and greater than 150 meters), number of structures visible, weighted

16. It should be noted that although understanding the effects of existing HVTLs on property values is a necessary first step, this important policy question is often the incremental effect of system upgrades in existing corridors, sometimes referred to as "corridor upgrades" or "corridor intensification."

17. The New Hampshire Research Report addresses two additional research initiatives; the Subdivision Studies and the Market Activity Analysis. The Subdivision Studies look at the timing and prices at which lots sell in subdivisions where some lots are encumbered or adjacent to an HVTL and other lots are not. The Market Activity Analysis looks at days on the market and sale-price-to-list-price ratios for properties in different distance zones from an existing HVTL ROW. These studies provide additional information but do not figure directly in the conclusions on HVTL effects on property values and therefore are not discussed further here.

number of structures visible, and square footage of lot encumbered by the ROW easement.

The results of the 2008 Massachusetts/Connecticut statistical analysis showed no systematic pattern of statistical significance with respect to either the proximity or the visibility variables. The only variable that appeared to have a systematic effect was the encumbrance variable, which always entered with a negative sign and was statistically significant in two of the four study areas.

2018 Massachusetts/Connecticut Statistical Study

In the 2018 Massachusetts/Connecticut statistical study, eight study areas were selected for statistical analysis: one on Cape Cod; three in Boston; one in Springfield, Massachusetts; and three in southern Connecticut. A total of over 1,800 sale properties were inspected, and HVTL-specific data were collected and public record data assembled from the multiple listing service and property record cards. The three key HVTL-related variables—proximity, visibility, and encumbrance—were investigated using both a distance zone model and a continuous distance model.[18]

The data set for each of the study areas represented the universe of market sales of properties located within 1,200 feet of the ROW segment in question for the period 2009–2015. The results revealed no consistent, measurable effect of HVTL proximity, visibility, or encumbrance on the sale price of residential properties in the study areas over the time period studied. Without getting into the detailed results, of the more than 80 estimated coefficients on the HVTL variables, only four variables were significant at the 5% level and one of those had an unanticipated sign.

Case Studies: New Hampshire and Massachusetts/Connecticut

There are 78 case study transactions reported in the New Hampshire Research Report and 42 transactions reported in the 2018 Massachusetts/Connecticut Research Report. In New Hampshire, the transactions represent all the sales of encumbered or adjacent properties in the designated study areas and time period. In Massachusetts and Connecticut, because the number of candidate transactions was large, the case study sales were randomly selected from the total number of encumbered and adjacent properties in each of the eight study areas in the designated time period.

Exhibit 2 summarizes the New Hampshire case study results. Each cell represents the total number of case study transactions that fell into the indicated visibility and distance category as well as the distribution of the cases showing whether an adverse sale price effect of the HVTL was indicated, was not indicated, or was indeterminate.[19] The cell in the lower right shows the total of 78 transactions and the overall result that an adverse sale price effect was concluded for 12 sales, with an absence of effect concluded in 54 sales, and an indeterminant effect in 12 sales.[20]

Most striking is the consistency associated with the cases in which a sale price effect was concluded. Eleven of the 12 affected properties had homes located within 100 feet of the ROW boundary; the exception was a home located 106 feet from the ROW. The results were similar for visibility, where 10 of the 12 affected properties had clear visibility of a structure from the perimeter of the house and the two exceptions had partial structure visibility. Further, all of the

18. The study was carried out in 2016–2017. The analysis is described in detail in the Massachusetts/Connecticut Research Report released in 2018.

19. Proximity was measured as the shortest distance from the house to the ROW boundary. The visibility measure was defined as follows:
- Clearly Visible: unobstructed view from the outside perimeter of the house of all portions of a structure to which conductors are attached.
- Not Visible: no portion of a structure visible from the outside perimeter of the house.
- Partially Visible: all other conditions, i.e., obstructed view of a structure or unobstructed view but not of all portions of the structure to which conductors are attached.

20. In cases where there was well-supported but conflicting evidence, the result was reported as indeterminate. The conflict was typically between the interview evidence and the appraisal evidence although the physical relationship of the property to the HVTL was also often a consideration. There was no tendency for the evidence type to be aligned with any particular conclusion. Sometimes the interview evidence suggested a price effect, but the appraisal evidence did not support that conclusion. In other cases, the appraisal evidence indicated a sale price effect, but that was contradicted by the interview evidence. In the case of conflicting evidence, consideration was given to trying to determine which of the conflicting evidence should be given greater weight but that immediately became very subjective, so where the evidence was conflicting the cases were set aside as indeterminate. In most cases (100 of 120), the evidences all pointed in the same direction, supporting an opinion of "effect" or "no effect" and those concurring cases are the cases on which the discussion is focused.

Exhibit 2 Case Study Results for New Hampshire by HVTL Visibility and Distance of Home from ROW

Visibility	Sale Price Effect*	Distance from ROW						Totals
		0 to 100 Ft		101 to 200 Ft		201 Ft or more		
Not Visible	No:	1		1		15		17
	Indeterminate:	0		2		0		2
	Yes:	0	Total 1	0	Total 3	0	Total 15	0 Total 19
Partially Visible	No:	5		4		10		19
	Indeterminate:	3		3		3		9
	Yes:	2	Total 10	0	Total 7	0	Total 13	2 Total 30
Clearly Visible	No:	8		8		2		18
	Indeterminate:	0		1		0		1
	Yes:	9	Total 17	1	Total 10	0	Total 2	10 Total 29
Totals	No:	14		13		27		54
	Indeterminate:	3		6		3		12
	Yes:	11	Total 28	1	Total 20	0	Total 30	12 Total 78

* "No" means study concluded there was no sale price effect.
"Indeterminate" means a sale price effect could not be concluded one way or the other.
"Yes" means the study concluded there was an adverse sale price effect.

properties are encumbered by the ROW easement. Note that proximity of 100 feet or less, combined with clear visibility and encumbrance, did not uniformly result in a sale price effect. However, the fact that 9 of the 17 properties with clear visibility and encumbrance show a price effect strongly suggests that the combination of these property attributes significantly increases the probability of an HVTL effect on sale price.

Exhibit 3 summarizes the proximity, visibility, and encumbrance attributes of the 12 New Hampshire case study properties for which it was concluded that the HVTL influenced the sale price in the transaction. For affected properties, the average distance of homes from the ROW boundary was 42 feet, with predominantly clear visibility of structures, and encumbered area averaging 40% of the property.

The results for the 42 Massachusetts/Connecticut case study properties are presented in the same format in Exhibit 4 and Exhibit 5. As shown in Exhibit 4, 21 of the 42 properties were concluded to have no adverse sale price effect, 8 of the properties had indeterminate effects, and for 13 properties it was concluded that there was an adverse effect of the HVTL on the sale price. All of the 13 properties concluded to have an adverse price effect had homes within 100 feet of the ROW with the exception of Sale 24, which was 110 feet from the ROW. Further, HVTL structures were clearly visible for 8 of these properties and partially visible for 5 others.

Exhibit 5 summarizes the HVTL variables as they affect the 13 properties where sale price effects were found. As in the New Hampshire study, the affected Massachusetts/Connecticut properties had homes sited very close to the edge of the ROW with structures that are partially or clearly visible; all but 3 affected properties were encumbered by the ROW easement. The homes affected by price impacts averaged 47 feet from the ROW, had clear or partial view of structures, and on average had 36% of their lot encumbered by the ROW. Again, it appears that close proximity of the house to the ROW combined with structure visibility and encumbrance significantly increases the likelihood of sale price effect due to the HVTL.

Exhibit 3 HVTL-Related Variables for New Hampshire Case Study Properties with Sale Price Effects

Property No.	Address	Town/City	Distance of Home to ROW Boundary (ft)	% of Property Encumbered by ROW	No. of Structures on Property	Visibility of Structures
12	Long Street	Webster	19	71.2	15	Clear
14	Horizon Drive	Goffstown	24	46.3	2	Clear
15	Bixby Farm Lane	Bedford	60	76.9	1	Clear
A1	Autumn Street	Windham	93	48.6	1	Partial
31	NH Rte 175	Thornton	28	3.2	0	Clear
32	Sunrise Hill Road	Thornton	106	6.9	0	Clear
41	Lark Street	Franklin	0	75.2	1	Clear
44	Holt Drive	Concord	7	61.9	2	Clear
A4	Ridgecrest Drive	Greenland	0	23.6	3	Clear
A7	New Road	Newmarket	11	19.0	1	Clear
B5	Back Road	Dover	91	20.4	0	Partial
B15	Gorton Drive	Danville	66	29.3	2	Clear
Mean	—	—	42.1	40.2	—	—

Exhibit 4 Results for Massachusetts/Connecticut Case Studies by HVTL Visibility and Distance of Home from ROW

Visibility	Sale Price Effect*	Distance from ROW: 0 to 100 ft		101 to 200 ft		201 ft or more		Totals	
Not Visible	No:	1		1		2		4	
	Indeterminate:	0		0		0		0	
	Yes:	0	total 1	0	total 1	0	total 2	0	total 4
Partially Visible	No:	2		6		2		10	
	Indeterminate:	1		1		0		2	
	Yes:	4	total 7	0	total 7	0	total 2	4	total 16
Clearly Visible	No:	4		3		0		7	
	Indeterminate:	4		2		0		6	
	Yes:	8	total 16	1	total 6	0	total 0	9	total 22
Totals	No:	7		10		4		21	
	Indeterminate:	5		3		0		8	
	Yes:	12	total 24	1	total 14	0	total 4	13	total 42

* "No" means study concluded there was no sale price effect.
"Indeterminate" means a sale price effect could not be concluded one way or the other.
"Yes" means the study concluded there was an adverse sale price effect.

Exhibit 5 HVTL-Related Variables for Massachusetts/Connecticut Case Study Properties with Sale Price Effects

Property No.	Address	Town/City	Distance of Home to ROW Boundary (ft)	% of Property Encumbered by ROW	No. of Structures on Property	Visibility of Structures
6	Oakmont Rd	Barnstable, MA	98	30	1	Partial
12	Cleveland St	Norfolk, MA	76	0	0	Partial
14	Fuller Pl	Franklin, MA	39	0	0	Clear
15	West St	Walpole, MA	75	47	0	Clear
17	Brigati Ter	Framingham, MA	38	0	0	Clear
19	Stonebridge Cir	Natick, MA	67	19	0	Partial
20	Brownlea (A) Rd	Framingham, MA	1	54	0	Clear
21	Brownlea (B) Rd	Framingham, MA	1	58	0	Clear
24	Stephanie St	Burlington, MA	110	31	0	Clear
25	Fox Hill Rd	Burlington, MA	47	72	0	Clear
26	Mill St	Burlington, MA	24	82	0	Clear
30	Wooddruck Ct	Norwalk, CT	21	39	0	Partial
31	Eleanor Ln	Norwalk, CT	10	38	0	Partial
Mean	—	—	46.7	36.2	—	—

Exhibit 6 shows the combined results of the case studies in New Hampshire and Massachusetts/Connecticut and gives additional insight into the likelihood of sale price effects as proximity and visibility increase. In the table, the proximity and visibility attributes of the 23 total cases in which sale price effects were found are compared to the total number of cases in each attribute cell. Cases where no conclusion was reached (indeterminate cases) are set aside in this table since the object is to show the percentage of cases in which a sale price effect was found relative to the total number of cases in which a conclusion was reached.[21] Given the relatively small number of observations, the probabilities cannot be generalized, but it appears that properties with homes beyond 100 feet from the ROW have a very small chance of sale price effect. However, that changes significantly for encumbered properties with homes less than 100 feet from the ROW that also have clear or partial structure viability; for properties with both attributes the incidence of adverse price effect ranged from 46% to 59%.

As suggested in the initial discussion of the case study approach, the only evidence of the magnitude of the sale price effect is the difference between the retrospective appraised value and the sale price. This difference needs to be interpreted cautiously given the variety of influences on a transaction that can cause a sale price to diverge from a market value opinion. In the cases where it was concluded that an adverse sale price effect had occurred due to the HVTL, the difference ranged from 1.6% to 17.9% and averaged 9.3% for the New Hampshire cases; in the Massachusetts/Connecticut cases the difference ranged from 2.8% to 10.9% and averaged 5.9%.

21. Up to this point, the discussion and tables have made reference to all 120 case study properties where a total of 25 cases concluded that the HVTL were responsible for an adverse effect on the sale price, 75 concluded that the sale price was not affected by the HVTs, and for 20 cases the evidence was mixed and a conclusion could not be drawn one way or the other. In the tables and discussion that follow, the 20 indeterminate cases are set aside, and the analysis focuses only on the 100 cases in which it was possible to come to a conclusion with respect to the HVTL effect.

Exhibit 6 Case Study Properties with Sale Price Effects as Percentage of Total Properties, Net of Indeterminate Cases, in Each Distance/Visibility Category*

		Distance from ROW							
Visibility	Sale Price Effect	0 to 100 ft		101 to 200 ft		201 ft or more		Totals	
Not Visible	Yes:	0		0		0		0	
	Total Cases:	2	0%	2	0%	17	0%	21	0%
Partially Visible	Yes:	6		0		0		6	
	Total Cases:	13	46%	10	0%	12	0%	35	17%
Clearly Visible	Yes:	17		2		0		19	
	Total Cases:	29	59%	13	15%	2	0%	44	43%
Totals	Yes:	23		2		0		25	
	Total Cases:	44	52%	25	8%	31	0%	100	25%

* The percentage in each cell is the percent of properties for which an adverse price effect was concluded for total properties in that category, setting aside the 20 indeterminate cases.

Results Implications for Evaluation of HVTL Effects on Residential Property Values

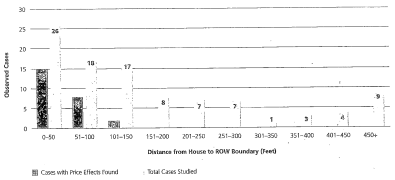
What has been learned from the New England statistical and case study research related to HVTLs and residential property values? The following five key points can be drawn from the research results.

1. Based on the multiple regression analysis, there is no statistically significant evidence in the 12 urban and suburban neighborhoods studied in Massachusetts and Connecticut of consistent, measurable adverse effects of HVTLs on the market value of nearby residential properties. When careful onsite observations of distance of the home from the ROW boundary, structure visibility, and extent to which the property is encumbered by the HVTL ROW are combined with data for location, property-specific characteristics, and conditions of sale data in multiple regression analyses, there is no suggestion of consistent, measurable effects of HVTL-related variables on the market value of nearby properties.

Appropriate interpretation of this result is subject to two important points. First, this does not mean that the direction of the effect of HVTLs on the desirability and value of residential property is not negative. It just means that the weight given this factor relative to all other variables that go into the decision to purchase a home is apparently too small to materially affect market value. Second, this result is not inconsistent with the sometimes spirited reaction of existing property owners in the face of a proposed change in the external environment of their homes. Their personal reaction to the change from the "before condition" to the "after condition" on the subjective value of the property to them is quite different from the reaction of the market to the "after condition" as measured by objective market data. There are apparently enough participants in the market for whom HVTLs are not a material consideration, or for whom the benefits of access to the ROW outweigh negative aspects of the HVTL, that no consistent, measurable effect of the HVTL on market value is found.

2. The case study research suggests there is a unique combination of HVTL proximity, visibility, and encumbrance that significantly increases the probability of an adverse sale price effect. The statistical studies are best able to answer the question of whether HVTLs result in consistent, measurable effects on the market value of nearby residential properties, but the absence of statistically significant adverse effects does not suggest

Exhibit 7 Distance from House to ROW Boundary, Price Effects Summary



that there are no affected properties. Because the number of potentially vulnerable properties is usually small in the statistically analyzed data sets, there may be insufficient data to isolate those affected properties. This possibility is buttressed by conversations with brokers and appraisers who are confident that an HVTL can be sufficiently intrusive on some properties to cause market value effects. Unfortunately, the statistical analyses do not give any insight into the characteristics of these outlier properties.

As explained above, the case study approach was originally designed as a pragmatic response to the sparse and heterogeneous development patterns in Montana and northern New Hampshire. It was designed to focus on the sale of properties most likely to have experienced HVTL effects, namely properties either encumbered by the ROW or adjacent to the ROW. The expectation was that the study area could then be expanded if warranted by the results from these most proximate properties. The Montana cases involved a variety of property types allowing only limited generalizations, but the 78 New Hampshire cases all involved residential properties and were remarkably consistent in their findings. It was the combination of close proximity, clear visibility of structures, and significant levels of encumbrance that significantly increased the likelihood of a market value effect.

The findings in New Hampshire led to the replication of the case study approach in the Massachusetts and Connecticut research, which reinforced confidence in the generalizations drawn from the New Hampshire research. As shown in Exhibit 6, which combines all the case study data, 23 of 44 properties (52%) in which the home was located within 100 feet of the ROW boundary and structures were either clearly or partially visible were judged to have experienced adverse sale price effects. In contrast, of the 41 cases with homes farther than 100 feet from the ROW boundary and either no or partial structure visibility, not a single case was judged to have experienced a sale price effect. The results are even more striking when looking at all 25 cases (which include 2 cases with homes at 106 and 110 feet from the ROW boundary, respectively) for which adverse sale price effects were concluded. These properties had homes that were very close to the ROW—44 feet on average—and had unobstructed views of structures in 18 of the cases and partial views in the other 7 cases.

The graph in Exhibit 7 illustrates the high correlation of home proximity to the ROW boundary, with a case study conclusion that there was an adverse effect of the HVTL on sale price.

Proximity, visibility of structures, and encumbrance are highly correlated, so it is difficult to know the independent influence of each. The

literature shows that visual intrusion, health effects concerns, and precluded development rights or other significant impacts to a property's utility or use associated with a ROW easement are all prominently mentioned concerns. It is also the case that despite structure visibility and/or encumbrance, in the absence of proximity, there is not a single case where an adverse price effect was concluded. Only when all three attributes were present (with the exception of three properties that met the proximity and visibility criteria but were not encumbered by the ROW easement) was an adverse price effect found. It must also be emphasized that when these attributes were present, there were still many cases (about half for properties with homes within 100 feet of the ROW) for which it was concluded that there was no adverse effect of the HVTL on the sale price.

3. For encumbered properties with homes within 100 feet of an existing HVTL ROW boundary and clear or partial structure visibility, the probability of a sale price effect, should they be sold, is indicated by the research to be in the range of 46% to 59%, depending on structure visibility. It is not possible to predict an adverse price effect for the sale of any particular property. The results of an individual sale will depend on the specific motivational factors influencing the parties, negotiating skills, and market conditions as they affect the range of product available in the market at the time. The research just indicates that the likelihood of effect goes up significantly if the noted conditions are present.

The implications of the findings are directly relevant to the construction of a new, overhead HVTL corridor in an area with established residential development. These cases are increasingly rare, but if such a project were being analyzed, the issue would be the number of properties with homes within 100 feet of the ROW boundary with anticipated partial or clear visibility of structures once the line was constructed.[22] For such a project, aggressive mitigation measures could be considered for potentially affected properties; routing, structure type, location, and landscape screening are the principal mitigation measures.

4. **In the future, the most common HVTL proposals will involve changes to existing HVTL corridors. In those cases, there is the possibility of incremental property value effects to the extent that there is an increase in the number of properties with homes within 100 feet of the ROW boundary combined with partial or clear structure visibility.** If there are no changes in the ROW boundaries associated with a project, then there will be no change in the location of homes relative to the boundary, and the number of homes within 100 feet of the boundary and the extent to which they are encumbered will not change. But the visibility of structures could change. If, for example, the number, location, or height of structures changes, it is possible that some properties will have increased visibility of the structures. The result of the project then would be to increase the probability of a sale price effect in the event that the properties affected were sold.

5. System upgrade projects may create changes in the opinion of existing property owners, but for the case studies described here, the number of lines, line voltage, or height and type of structure appears not to affect market value once proximity of the home to the ROW and visibility of structures are accounted for. For an existing property owner living very close to the ROW with an unobstructed view of one or more structures, adding a line to the ROW with perhaps taller structures could be a significant change in the visual environment, and owners may represent that the value of their property (subjectively to them) has been seriously diminished; whether the market value of their property actually has been affected is a different matter.

22. It should also be noted that the 100 feet and structure visibility criteria are not absolute, bright-line criteria. They simply reflect the empirical reality as understood today. Future research might indicate a broader or narrower range for these variables. Proximity of the home to the ROW boundary should also be recognized as a proxy for the complicated set of positive and negative effects of any given HVTL corridor that involve corridor utility (trails, open space, view corridors, etc.) and corridor intrusion (aesthetic, noise, health effects concerns, etc.). These effects may be influenced by both the location of the corridor and its characteristics including its width, number of lines, line voltages, types of structures, location of structures, and visibility of structures. Given sample size constraints, it may not be possible to identify the independent effects of these highly intercorrelated variables.

Given the prevalence of changes to existing corridors as opposed to the development of new corridors, this is a very important question. Evidence on this point to date comes from the case study research where there does not appear to be an association of sale price effects with the intensity of corridor development. The case studies cover a wide range of corridor types. The best controlled situation is in the New Hampshire studies where there are 24 properties along what was called Corridor 1. This corridor is typically 350 feet wide and contains a 450 kV DC line and two 230 kV lines, all on steel lattice structures ranging from 65–95 feet high. There also are 28 case study properties along what was called Corridor 2. That corridor runs roughly parallel to Corridor 1 but is typically only 150 feet wide and contains one 115 kV line on either 55-foot wood H-frames or 75-foot steel poles. Despite the substantial difference in the intensity of development in these two corridors, there was no discernible difference in the occurrence of sale price effects. There were four cases along each corridor where adverse sale price effects due to the HVTL were concluded. Because of its importance, this is a topic that merits additional research. Given that many upgrade projects have been carried out recently, it may be possible to find same-property sale and resale cases that span the time period of an upgrade project.

If the case study findings in this regard continue to be supported by additional research, the implication would be that the size and motivation of the subset of potential buyers willing to consider a property close to an HVTL corridor is not sensitive to structure size or intensity of development of the ROW corridor.

Conclusion

There has been a continuing effort by appraisers and real estate economists to use statistical techniques to answer the question of whether HVTLs affect residential property values. Depending on the geographic area of interest, there may be useful research that can help answer that question. In the case of Massachusetts and Connecticut, there are now 12 study areas that have been investigated with the uniform result of no statistically significant proximity, visibility, or encumbrance effects. But this leaves two important questions unanswered:

1. Does the absence of consistent, measurable effects ensure that no properties are adversely affected?
2. Can the incremental value effects of system upgrades in existing HVTL corridors be anticipated for nearby residential properties?

The research reviewed in this article provides guidance in answering both questions.

First, despite the generalization appropriately based on the statistical analyses, there is a small set of properties—defined by close proximity of the home to the ROW, visibility of structures, and encumbrance—for which there is a significant probability of an adverse sale price effect should they be sold. The research summarized in this article provides guidelines in identifying the properties that fall into this group. The answer to the second question then depends on whether the system upgrade changes the number of properties that fall into the set of vulnerable properties and on the extent to which the effects of the project can be mitigated.

It has always been difficult for appraisers to develop market evidence to adjust for external obsolescence. The prevalence in the literature of statistical studies is of interest but beyond the scope of nearly all appraisal assignments. An appropriate response, which aligns with traditional practice, would be to extract appropriate adjustments from something akin to the case study approach. The benefit of the research summarized here is that it suggests that the critical variables to control for are encumbrance, distance of the home from the ROW boundary, and the visibility of structures. For example, in appraising a property with a home 75 feet from a ROW with an unobstructed view of structures, the research suggests looking for two or three comparable properties that had recently sold that are similarly located with respect to an existing HVTL. The next step would be to conduct a simple analysis of each based on interviews with the participants and analysis of similar sales unaffected by an HVTL that occurred in the same period. The results of that exercise could then be evaluated in comparison to the results as reported here, with attention to the similarity of the study areas in question. A final conclusion could then be reached as to whether an adjustment is warranted, and if so, its magnitude.

SEE NEXT PAGE FOR ADDITIONAL RESOURCES >

About the Author

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Additional Resources

Suggested by the Y. T. and Louise Lee Lum Library

Appraisal Institute
Lum Library, Knowledge Base [Login required]
Information Files—Real estate damages/proximity impacts

Electric Power Research Institute—Research
https://www.epri.com/#/research/landing

Federal Energy Regulatory Commission—Electric Smart Grid
https://www.ferc.gov/industries/electric/indus-act/smart-grid.asp

National Association of Regulatory Utility Commissioners—CPI Library
https://www.naruc.org/cpi/cpi-library/

US Department of Energy—Electric Power
https://www.energy.gov/science-innovation/electric-power

US Energy Information Administration—Electricity
http://www.eia.gov/electricity