Wallingford-Ingo, Gail

From: William Johnson <westernyankee24@gmail.com>
Sent: Tuesday, December 10, 2019 5:12 PM
To: Wallingford-Ingo, Gail
Subject: RE: House Bill 1041 Permit No. 1041 2019-003
Attachments: How do High Voltage Overhead Transmission Lines impact the environment and how can this be evaluated.docx; Study reveals the impact of power lines on real estate values.docx; The Electrifying Factor Affecting Your Property's Value.docx; Black Hills Reliability Project #3.docx; Power Lines and Property Values.docx; What is the safe distance for living near high voltage power lines.docx; How Much Do Power Lines Lower Real Estate Value.docx; Lots Near Power Lines Lose Nearly Half Their Value.docx; Mayor of Pueblo Concerning Future of Black Hills.docx; Black Hills Transmission Line Issues.docx; Clean energy technologies threaten to overwhelm the grid.docx; Valuation Guidelines for Properties with Electric Transmission Lines 1.pdf

Gail L. Wallingford-Ingo
Interim Director
Planning and Development Department

In reference to the upcoming January 9, 2020 public hearing (Pueblo Board of County Commissioners) - Permit No 1041 2019-003, we are attaching documents for consideration by the commissioners. These include documents previously sent to the Pueblo Mayor, Pueblo County Planning Commission, Pueblo West Administration, Pueblo West District Manager Assistant, and Jay-Michael Baker (Communication and Engagement Manager). In addition, there are research articles attached that are pertinent to the current issue.

We appreciate your assistance in this matter.

Respectfully submitted,

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How do High Voltage Overhead Transmission Lines impact the environment and how can this be evaluated?

June 10, 2019 05:15

High Voltage Overhead Transmission Lines (HVOHL) impact the environment in six ways: a) Landscape, b) Biodiversity, c) Land use, d) Proximity effect, e) Indirect emissions and f) Resource depletion.

1. **Landscape** – HVOHL cause a visual deterioration of the skyline reducing its aesthetic appeal. In passing through populated areas this results in a loss of property values in the vicinity ; and in less populated areas, with a scenic, cultural or natural importance, this affects the tourism potential.
2. **Biodiversity** – The main impact is avian collisions which is particularly significant in high risk areas such as wooded regions and bird migration corridors. The impact on fauna and other animal species is usually temporary and reduces after the construction phase is over.
3. **Land use** – HVOHL passing through agricultural lands may permanently reduce the area under cultivation and cause physical damage during construction and maintenance.
4. **Proximity effect** – The "proximity effect" on human beings in the vicinity of HVOHL encompasses a fear of the adverse health effects of electromagnetic fields, annoyance and noise. While there is no definitive scientific study which establishes that 50 Hz electromagnetic fields within the recommended range of WHO present a danger for human health, many countries place restrictions on distance to human habitation as a precaution.
5. **Indirect emissions** – Energy losses during transmission cause indirect carbon emissions and air pollution in power generation plants which vary with the type of primary energy source.
6. It is important to integrate these environmental impacts into the cost-benefit evaluation of HVOHL projects in order to avoid decisions that may be biased towards less environment friendly solutions.

Efforts have been made, notably in the reference cited below, to compile methodologies and case studies for the economic quantification of these impacts of HVOHL on the environment, particularly those that remain after avoidance, mitigation and compensation, the so called ''residual effects''. Some methodologies connected with market prices are well developed, such as those for the loss of property values and land use, as well as transmission losses.

The methodologies for evaluating the impact on landscapes, visual effects and biodiversity are somewhat weaker, being more uncertain and time consuming. For biodiversity, there is no consensus on economic valuation methods and further research is needed.

Case studies from some European countries have shown that the evaluated costs of these environmental impacts can even add up to more than a million EUR per km per year in some cases.

Ref : CIGRE Technical Brochure 616 "Externalities of Overhead High Voltage Power Lines'' Working Group C3.08, April 2015. (CIGRE report)

Referenced Website
https://help.leonardo-energy.org/hc/en-us/articles/207186749-How-do-High-Voltage-Overhead-Transmission-Lines-impact-the-environment-and-how-can-this-be-evaluated-

Study reveals the impact of power lines on real estate values

August 27, 2018 by Mike Wheatley

Proximity to power lines can have a hugely detrimental effect on the prices they sell for, according to a new study.

The study, published in the Journal of Real Estate Research, found that lots located next to high-voltage power lines sell for 45 percent less than similar lots located further away. Moreover, those lots that are located within 1,000 feet of power lines also sell at a discount of 18 percent, the study found.

Researchers Mothorpe and Wyman, who are assistant professors at the College of Charleston in Charleston, South Carolina, said they chose to focus on the value of vacant land rather than homes, so that factors such as the style of the home and the square footage, which could also influence the price, are eliminated. The study notes that land typically represents around 20 percent of a home's value, so the 45 percent decrease in the land's value would represent a total property value drop of around 9 percent.

The researchers culled sales data from 5,455 vacant lots sold between 2000 and 2016 in Pickens County, South Carolina, for their study. A network of high-voltage electrical lines are located in Pickens County from the Oconee Nuclear Station.

According to the paper, one of the main factors that drives down the sales price of land located next to high-voltage lines is health concerns. Still, there is no solid scientific evidence that living so close to power lines has a negative impact on human health, the researchers add, even though the belief is fairly widespread.

Another factor is that power lines also make for unattractive views. Residents who live near them may also hear a humming sound produced by the lines.

"My intuition tells me the visual [component] is the largest" factor leading to a decrease in values, Mothorpe told The Wall Street Journal.

Referenced Website
https://realtybiznews.com/study-reveals-the-impact-of-power-lines-on-real-estate-values/98750122/

The Wall Street Journal

The Electrifying Factor Affecting Your Property's Value

Vacant lots adjacent to power lines sell for significantly less than equivalent property further away as homeowners shy away from unattractive views.

By Adam Bonislawski
Aug. 15, 2018 10:31 am ET

Research has shown that property next to power lines comes at a discount. Just how much of a discount, though, is a little shocking.

A recent study in the Journal of Real Estate Research by College of Charleston assistant professors Chris Mothorpe and David Wyman, finds that vacant lots adjacent to high-voltage transmission lines sell for 45% less than equivalent lots not located near transmission lines. Non-adjacent lots still located within 1,000 feet of transmission lines sell at a discount of 18%.
Previous studies have similarly found that proximity to power lines lowers real-estate values, but Prof. Mothorpe says most of these analyses have looked at lots with homes already built, which, he notes, complicates the question.

"You could have similar lots with similar views but different houses, and the pricing impact would be different because the housing structures would be different," he says. "So by just focusing on vacant land, we were able to not have to deal with those kind of issues."

Assuming a market where land represents 20% of a home's overall value, the 45% decrease translates to a drop in total property value of around 9%, the authors note.

For their analysis, the professors used sales data from 5,455 vacant lots sold between 2000 and 2016 in Pickens County, S.C.

The researchers also developed a "Tower Visibility Index" that Prof. Mothorpe says accounts for not only a lot's proximity to a transmission line but also whether features like trees or hills hide the line from view.

"Even if the tower is within 1,000 feet, if it's behind a big hill, I might not even know it's there," he says, which would lessen the tower's impact on a property's value. "There's that idea of, out of sight, out of mind."

For their analysis, the professors used sales data from 5,455 vacant lots sold between 2000 and 2016 in Pickens County, S.C., where a network of high-voltage lines transmits electricity from the Oconee Nuclear Station.

Prof. Mothorpe suggests three main factors driving the discount: health concerns associated with proximity to high-voltage lines (though, as the authors note, researchers have not established solid links between proximity to power lines and health issues); the unattractive views; and, for properties very close to the lines, the humming sound they produce.
"It's hard [based on the study data] to distinguish between the three," he says. "But my intuition tells me the visual [component] is the largest of the three."

At almost 50% off, maybe it’s worth just looking the other way.

Referenced Website
https://www.google.com/amp/s/www.wsj.com/amp/articles/the-electrifying-factor-affecting-your-propertys-value-1534343506

July 10, 2019

Pueblo County Planning Commission
Pueblo West Administration public email
Laura Savage, Assistant to the District Manager
Jay-Michael Baker, Communications and Engagement Manager

Black Hills Reliability Project comments

The area covered by this project is in the flight path for migratory birds. There are four basic paths throughout the US and one of them is down the eastern side of the Rocky Mountains. Unfortunately, these birds frequently do fly into the power lines resulting in their own death and damage to the powerline itself.

If you have been around high-tension lines you may have noticed that they will crackle or pop. This is due to the static discharge from the ionized air around the power line. These discharges give off UV light. To animals, who have visual receptors in the UV range, these will appear as flashes of light. This has resulted in many animals becoming disoriented, avoiding power lines, and ultimately disrupting their natural travel and migration path.

Another issue with high tension lines is the nesting and hunting habits of birds, particularly raptors. These birds love the high places, but it creates two problems. The first is they will build their nest on top of a transmission line insulator or pole and in the process get between the wires, or a wire and the pole which will result in their electrocution as well as damage to the wire. The second issue is creating high perches for the raptors from which to hunt. This might seem like a good idea, but it provides unnatural help for the raptor, which can unbalance or decimate the population of smaller animals such as Prairie dogs, rabbits, ferrets, etc. This is another environmental issue created by man.

There is a diverse population of animals and birds on the Walker ranch and the surrounding properties (which includes my own). These animals include at a minimum: Elk, Cattle, Deer, Coyotes, Black foot ferrets, prairie dogs, raptors, and multiple smaller bird species. Studies have shown that power lines do affect these animals and it is past time we ignore these negative impacts and start preserving the natural diversity that has been given to us.

Below are links to studies with more in-depth information on what has been presented in this letter.

- https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0209968
- https://www.theguardian.com/environment/2014/mar/12/animals-powerlines-sky-wildlife
- https://help.leonardo-energy.org/hc/en-us/articles/207186749-How-do-High-Voltage-Overhead-Transmission-Lines-impact-the-environment-and-how-can-this-be-evaluated-?mobile_site=true
- https://www.tdworld.com/overhead-transmission/power-wild
- https://www.ncbi.nlm.nih.gov/pubmed/17624193

Respectfully submitted,
William Johnson

Power Lines and Property Values

An article in the Wall Street Journal (Aug. 15, 2018) points to a recent study in the Journal of Real Estate Research:

1. Vacant lots adjacent to high-voltage transmission lines sell for 45% less than equivalent lots not located near transmission lines.
2. Non-adjacent lots still located within 1,000 feet of transmission lines sell at a discount of 18%.
3. Assuming a market where land represents 20% of a home's overall value, the 45% decrease translates to a drop in total property value of around 9%.

These results were obtained from a recent study in the Journal of Real Estate Research by College of Charleston assistant professors Chris Mothorpe and David Wyman.

According to Prof. Mothorpe the three main factors that influence the lower price:

1. Health concerns associated with proximity to high-voltage lines (though, as the authors note, researchers have not established solid links between proximity to power lines and health issues)
2. The unattractive views
3. The humming sound they produce (for properties very close to the lines)

Study published in the Journal of Real Estate Research:

The Pricing of Power Lines: A Geospatial Approach to Measuring Residential Property Values

The valuation of power lines is a complex phenomenon. Using a sample of 5,455 vacant lots sold in Pickens County, South Carolina, we uncover substantive pricing discounts of 44.9% for properties adjacent to power lines, and a pricing discount of 17.9% for non-adjacent vacant properties up to 1,000 feet away from the power lines. Applying four different geospatial approaches—buffer zones, straight line distance, viewshed analysis, and tower visibility—we find that high-voltage transmission line (HVTL) pricing models should account for both proximity and visibility to reflect location-specific variations in pricing.

http://aresjournals.org/doi/abs/10.5555/0896-5803.40.1.121?code=ares-site

Referenced Website
https://www.emfsa.co.za/news/power-lines-and-property-values/

Image credit: Jack B https://unsplash.com/

What is the safe distance for living near high voltage power lines? How close is too close?

Normal street power lines are much closer to homes and can cause the same problems are high voltage power lines.

In our line of work we get asked this regularly… It comes mostly from people looking to purchase or rent a house near high voltage power lines. It seems, in my experience, that those who bought a house too close to power lines, made the decision a while back that it was safe and dare not go back on that decision and admit they were wrong.

How is health affected by high voltage power lines?

When electricity flows an electromagnetic field is created that kind of swirls around the source of the radiation like a whirl wind. Its strength depends on a number of factors, but how much and how strong the electricity is that flows through is significant. As you move further away from the source, the strength of the magnetic field would normally reduce. Magnetic fields can be larger than you think.

This electromagnetic radiation (EMR) cannot practically be shielded against. This type of electronic pollution is a very important one to investigate before committing to ANY property regardless if it is positioned near high voltage power lines or the 'everyday' street power lines running up and down most streets. The majority of homes are not affected by these electromagnetic fields by a serious degree, but a home being exposed is certainly not rare either.

The ongoing exposure to EMR can slowly start to ask its toll. Chronic complaint, fertility problems as well as cancers could be caused.

'The government wouldn't allow you to live that close to transmission lines if it were dangerous'

The problem is that maximum exposure standards set or accepted by governments are typically based on outdated research. What is considered 'legally safe exposure' has been showing for years that there are clear links to health issues, fertility problems and cancer.

The strength of low frequency electromagnetic fields is expressed in milligauss (mG) or nanoTesla (nT) or other values. In most countries the maximum 'safe' exposure to electromagnetic fields is 1000mG. Have a look at the table below what peer reviewed research has found over the years:

1000 mG	**Many governments safe maximum**
2 mG to 12 mG	Shown to block the hormone melatonin in its anti-cancer action (abstract)
4 mG	Consistently mentioned by various research to increase likelihood of childhood leukaemia (abstract)
1.6 mG	Double the chances of sperm abnormalities (abstract)
1 to 2 mG	Mortality rate in children with leukaemia shown to be up to 370% higher than children with leukaemia that are not exposed to 1 to 2 mG (abstract)

Therefore, a reading of just 1 milligauss (1 mG) is the value you don't want in your home.

Depending on what instrument you use and the way it measures (a flat measurement or a weighted measurement), the values you don't want to exceed varies depending on who you speak to, but often lays between 0.8 mG and 0.3 mG (80 nT to 30 nT)

An example of one and the same property located near high voltage power lines. It is for sale frequently, gets sold and some time after is back on the market for a long time. High voltage power lines can be problematic at far greater distances, but small street power lines can also produce similar problems.

Governments can't go back on exposure limits to EMR, it would cripple the economy

How close is too close when it comes to high voltage power lines, and how are our children affected?

Think about this: Governments and local building requirements have allowed buildings to be constructed close to power lines for so many years, and condoned the placement of high voltage power lines, as well as street power lines, very near existing homes. If the exposure standards were now to be lowered in light of research showing health effects, it is like admitting fault that everything they supported in the past was a big mistake. The lawsuits from such a move and the amount of homes that would then simply need to be declared uninhabitable would likely cripple an economy.

What is a safe distance for a home near high voltage power lines?

It is difficult to simply attach a 'value' to what a safe distance might be:

1. If you had a figure and it was not conservative enough, you might end up buying or renting a home too close to high voltage power lines and your health or your quality of life (chronic complaints etc.) could be severely affected.
2. If you had a figure and it was too conservative, you might find yourself walking away from a dream home that was perfectly ok to purchase.

Either way, giving you a 'safe distance figure' is not really helping you without realising the implications of it.

Measure EMR yourself before getting professional help, but help you will need to deal with the more common domestic radiation sources

EMF radiation from phone towers, but even more importantly power lines, should be measured before buying any home.

The best solution is to measure EMF exposure on a property near ANY power lines and you can do this yourself initially. **You may be shocked to find out how many homes are affected** by this and that many of those homes are nowhere near those 'big' high voltage power lines.

Once you find a home where the values are under the 0.8mG or 0.3mG depending on the instrument method of measuring, it seems to be giving you the 'green light'. The smart thing to do, is to then get a professional to do a pre-purchase inspection and reconfirm your good findings before buying

or renting a property. Just like you wouldn't think twice about organising a pest inspection or structural building inspection before buying a home.

The consultant can then also investigate for the more common radiation types we find in most homes (electric fields in the bedroom and radio frequency radiation from phone towers etc.), and explain what needs to be 'updated' to the property to create a healthier environment inside.

From my time as a real estate agent, in my opinion, you are better off not putting an offer subject to a home health/EMR pre-purchase inspection, but rather do it before you put the offer in. This way you 'let sleeping dogs lie' (the other potential buyers) and you can, when you are happy with the property, put an offer on the table that is not subject to this 'weird' request that vendors will be unfamiliar with. By doing this you don't make your offer less attractive and reduce your chances it gets accepted. – Every home buying situation is different, so you have to make up your own mind on what the best strategy is for your situation.

Distances within which you should not fail to measure EMF radiation from power supply

Homes built way too close to power lines in Nieuw-Beijerland in the Netherlands.

As long as you are fully aware that these figures could be not conservative enough or may be too conservative, here are some distances within which you should definitely investigate the EMF exposure:

- High voltage power lines (transmission lines, aka the 'walkers') – anywhere within 1200m / ¾ of a mile.
  (Some research shows increased cases of childhood leukaemia within these distances from power lines)
- Transformer box – 150 meter / 165 yards
- Electrical substation – 150 meter / 165 yards (article)
- Street power lines on 'your' side of the street (above or underground)
- Solar panels being present on the home

My health is affected from living near power lines, what can I do?

This a not a great situation to be in. You purchased a home, not knowing about electronic pollution and environmental health burdens, or perhaps you didn't think this was a problem.

The thing to remember is that your sleep is your key regenerative time… the time when your body is supposed to fix itself. For this reason, the exposure during sleep time should be seen as the most important. Sometimes, the field of electromagnetic radiation from power lines wears off over a relatively short distance. It could be that a bedroom close to the source, is affected by unsupportive levels of EMR whilst the distance to another bedroom is just enough to reduce the levels of EMR to a level where you get a better restorative sleep in terms of electromagnetic fields. This is worth investigating and perhaps moving your bedroom.

If excessive EMR exposure from high voltage power lines can't be avoided or removed, as often it can't be, then moving yourself away from the home seems the only logical option. Everyone has to come to that decision themselves.

If moving bedroom or house is just not an option then you should reduce all other sources (the common ones) of radiation, in specifically the bedroom, to attempt to make the burden as little as possible. You will need a proper home assessment for low-level radiation and geopathic stress, and use verifiable solutions. This may still not produce a healthy bedroom, as there is still an elephant in the (bed)room, but it will help the body as much as is possible.

In a distant past Patrick van der Burght gained experience in real estate.

Selling a property near high voltage power lines can bring both a financial and moral dilemma

People are becoming more aware that properties near high voltage power lines, as well as mobile phone towers (article), are getting harder to sell unless the vendor is prepared to reduce the price. The other problem for those realising their health has been affected by something that is 'perfectly legal', is that by selling it, they are passing the problem to another family who are unaware. Brushing off the situation as a 'Buyer Beware' situation doesn't seem entirely justifiable, what do you think? (leave a comment below, please) Legally, I would imagine, you would be safe as the exposure standards legally allow for this exposure to people. It is a tough one… Perhaps offering a bargain price (compared to properties not near high voltage power lines) is a way to have peace with one's conscience… I don't envy you for being in this situation, if this applies to you.

To buy or not to buy near power lines… that was the question

The message I'm trying to get across here is to go and measure. High voltage power lines or tiny street power lines, electromagnetic fields should be taken seriously when considering committing to a property. Homes are plagued by electric fields and radio frequency radiation as well, but this can normally be addressed just nicely through a proper assessment and products that are well designed solutions.

Link to website
https://en.geovital.com/how-close-is-too-close-when-living-near-transmission-power-lines/

How Much Do Power Lines Lower Real Estate Value?

Written by Jane Meggitt; Updated June 23, 2018

Powerlines at Malvern image by David Hutchinson from Fotolia.com

Related Articles

- 1 What Services Nearby Your Home Can Increase the Selling Price?
- 2 What Causes a Home's Value to Depreciate?
- 3 What Does it Mean When Vacant Land Says Utilities Nearby?
- 4 Problems With Two-Stage Air Conditioners

You've found the house of your dreams. It's beautiful, spacious and has wonderful views, at least from some angles. Other windows look out on nearby power lines, which few people find attractive. Aesthetics, however, aren't the problem if you're considering purchasing a house near power lines. Those utility company necessities might allow you to buy the house for less money than a comparable dwelling away from power lines, but they can also affect your resale value. In short, there are a lot of people who won't consider buying a property located close to power lines, even if they can save money on the purchase.

Lower Property Values

Proximity to power lines may lower a property's value by as much as 30 percent, although that's the higher end and usually refers to isolated incidents. A Rhode Island group, the Friends of India Point Park, is trying to have high-voltage power lines moved underground cites the 30 percent number on its website, and the documentation it uses shows that some studies confirm that number. Still, it's reasonable to assume that power line proximity has an overall negative effect on value of at least 10 percent, and possibly more.

A 2013 study published in The Appraisal Journal found when comparing homes sales in Portland and Seattle in similar houses abutting and not abutting power lines, houses near power lines did

sell for less, but not significantly so. With an average sale price of $291,000, researchers found a Portland home abutting a power line sold for approximately $5,000 less than a comparable home not near a power line. In Seattle, the average sale price was $502,000, and houses abutting a power line sold for approximately $12,500 less. The real question is, just how dangerous are power lines and how do they affect human health?

Electromagnetic Fields

Countless studies have been conducted on the effect of electromagnetic fields (EMFs) generated by power lines and their affect on people. The problem is that these studies have not come to a definite conclusion. About half of the studies conclude there is no real risk, while approximately just over one-fifth cite DNA damage from long-term EMF exposure and one-third had mixed results. EMFs are rumored to cause cancer, birth defects or miscarriages, low birth weight and heart abnormalities, but again, evidence is inconclusive. Those studies that found some correlation between power lines and cancer, in particular, don't address what distance is considered safe or how much exposure is needed to cause health problems.

Contact the Utility

If you fall in love with a property near power lines and resale value isn't a concern, you can lay your fears to rest, or perhaps have them confirmed, by contacting the electric utility and requesting an on-site reading, according to real estate company Zillow. If you're handy, you can conduct your own readings using a magnetometer. If you decide to buy, you're making an informed decision based on the EMF levels near the home.

Referenced Website
https://homeguides.sfgate.com/much-power-lines-lower-real-estate-value-2979.html

Study: Lots Near Power Lines Lose Nearly Half Their Value

August 22, 2018

Lots located next to power lines tend to sell for a whopping 45 percent less than similar lots further away from high-voltage transmission lines, according to a new study in the *Journal of Real Estate Research*. Lots that are non-adjacent to power lines but are located within 1,000 feet of them often sell at a discount of 18 percent, researchers Chris Mothorpe and David Wyman, the authors of the study, found.

© Zen Rial - Moment/Getty Images

The study focused on the value of vacant land, eliminating other factors that could also influence price, such as home style and square footage. The researchers say land typically represents 20 percent of a home's overall value. Therefore, the 45 percent decrease in land value would translate to a drop in total property value of around 9 percent, according to the study.

Mothorpe and Wyman, assistant professors at the College of Charleston in Charleston, S.C., culled sales data from 5,455 vacant lots sold between 2000 and 2016 in Pickens County, S.C. A network of high-voltage electrical lines are located in Pickens County from the Oconee Nuclear Station.

Mothorpe says health concerns about being near high-voltage lines are one of the factors likely driving down prices of nearby land. But a solid link between power lines and health issues remains elusive, he adds. Unattractive views of power lines also affects land prices, Mothorpe says, and residents who live near them may hear a humming sound produced by the lines. "My intuition tells me the visual [component] is the largest" factor leading to a decrease in values, Mothorpe told *The Wall Street Journal*.

Source:
"The Electrifying Factor Affecting Your Property's Value," The Wall Street Journal (Aug. 15, 2018) [Log-in required.]

Referenced Website
https://magazine.realtor/daily-news/2018/08/22/study-lots-near-power-lines-lose-nearly-half-their-value?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+DailyRealEstateNews+%28Daily+Real+Estate+News%29

November 14, 2019

William Johnson
11011 Panther Mountain Rd
Maumelle, AR 72113

The honorable Nicholas A. Gradisar, Mayor of Pueblo, Colorado:

A brief introduction. I am a retired electrical engineer who has worked with the Entergy power company to provide electrical power for a major teaching hospital for the last 20 years. The institution has an electrical power budget in excess of $2,000,000 per year. During my tenure there, we put in cogeneration facilities that gave us access to an optional interruptible tariff (OIS). By using this approach, the institution saved about $500,000 per year. They are currently looking at building another cogeneration facility to save about $4 million over the next 10 years.

While the OIS tariff may look like a giveaway to big business, it is actually a collaboration between the energy supplier and the customer which benefits everyone. During extremely cold and extremely hot days (which occur several times a year) Entergy may not have sufficient generating capacity to meet the needs of its customers. The only choice, besides building additional generating facilities, is to purchase necessary power from the grid. The cost for this power is extremely expensive. I have been told it is 10 to 40 times above normal generating prices. To prevent having to purchase this extremely expensive power, Entergy can require us to take our load off the grid and therefore eliminate such a purchase. This results in lower costs to Entergy and lower costs to all end users. A win-win for all of us.

My wife and I purchased land in Pueblo West two years ago with the intention of building our retirement home there in 2020. In preparation for our move, we have maintained an active involvement with Pueblo West Metro events/information, the Pueblo West neighborhood Facebook page, and our neighbors. Based on concern for utilities, the future of environmental issues, and our own planned move, we listened to last night's town hall meeting with great interest and concern.

First, let me address corporate responsibility. Entergy is a multistate provider of power for Arkansas, Louisiana, Mississippi, and Texas. These include some of the poorest parts of the country in this nation - especially Mississippi and Southern Arkansas. Entergy has been a strong partner in providing needed resources, through many programs, to assist the poor. Entergy has also developed new initiatives to bring some work and stability back to these hard-hit areas. Entergy is an investor owned company just like Black Hills, but when I heard of the way that Black Hills treats their customers - especially the economically deprived ones - I could not help but conclude that it is "only the dollar" that Black Hills is chasing, with little concern for their customers.

When I was listening to the rate information, it reminded me that Entergy essentially divided itself up into three companies: generation, transmission, and distribution. Each section has the ability to make decisions on the most effective use of resources. This also allows tariffs for each part of the energy bill. For example: End user providers could use transmission and distribution from one company while getting generation from another. This takes some of the sole source provider issues out of the picture and can result in lower and more reasonable rates for the end user.

My next concern is the Public Service Commission. A comment was made last night that members of the commission are appointed by the Governor and not elected. If this is true, it can easily lead to a major problem of conflict of interest and the commission becoming a rubber stamp for the appointing official. The "PUBLIC SERVICE commission" is supposed to be there for service and protection of the public when dealing with monopolies such as utility companies.

Another concern is integrity. In my personal dealings with Black Hills, it has been difficult to get information. When I asked questions about reliability, and if I needed a standby generator, phone calls were never returned and information was never made available. When I was requesting information on their new power line proposal, promised phones calls were returned, but only after several days. This lack of responsiveness has resulted in concerns with trust and accountability. In addition, comments pointed out last night about failing to include fuel charges in their cost study, sets up a perception of negligence, incompetence, or definite attempts to mislead their customers.

Another concern has to do with Black Hill's proposed new substation and power line. This appears to be a means to increase the value of their assets more than a matter of need. This would make it more difficult for anyone to condemn and purchase these assets from them. I would hope that at a minimum this will be put on hold until the vote for separation is taken, if not permanently stopped.

A major concern about moving away from Black Hills is financial. In the event of a tornado, earthquake, major fire, etc., will the new provider have adequate resources to efficiently repair the infrastructure in a timely manner? And how would this realistically impact the overall rate structures -especially for the basic home owner?

I am writing these concerns in hope that this information can be used to encourage voters to move away from Black Hills. I believe this company does not have the best interest of the citizens of Pueblo, Pueblo West, Pueblo County, or Colorado as their primary focus. They appear to be interested only in how much money they can make for themselves and their stock holders.

Thank you for your time.

Respectfully,
William Johnson

July 14, 2019

Elizabeth and Daniel Mielke
Residences of Pueblo West

About two years ago my wife and I purchased 3 lots at the end of E. Hastings (#'s 46,74, and 102) in Pueblo West. The main purpose for this purchase was to move to the state of Colorado, invest in the community, and build a retirement home. We purchased these lots at a premium price because of the location, incredible views, wildlife, and dark skies at night.

The proposal for the new Black Hills power line will run ¾ mile from our property and will not only destroy primary sight lines, but negatively impact property values. In addition, the area covered by this project is in the flight path for migratory birds. There are four basic paths throughout the US and one of them is down the eastern side of the Rocky Mountains. Unfortunately, these birds frequently do fly into the power lines resulting in their own death and damage to the powerline itself.

If you have been around high-tension lines you may have noticed that nothing grows well and they make crackle or pop noises. These sounds are due to the static from ionized air around the power line. These discharges give off UV light. To animals who have visual receptors in the UV range, these will appear as flashes of light. This has resulted in animal disorientation and disruption in their natural travel and migration path.

Environmental concerns are another issue with high tension lines. They create a nesting and hunting area for birds, particularly raptors. These birds love high places, but it creates two problems: #1) They build their nest on top of a transmission line insulator or pole and in the process get in between the wires, or on a wire and the pole. This results in their electrocution as well as damage to the wire; #2) These high perches might seem like a good idea, but it provides unnatural assistance for the raptor resulting in an imbalance or decimation of smaller animal populations - i.e. prairie dogs, rabbits, ferrets.

There is a diverse population of animals and birds on the Walker ranch and the surrounding properties (which includes our own). These animals include at a minimum: Elk, Cattle, Deer, Coyotes, Black foot ferrets, prairie dogs, raptors, and multiple smaller bird species. Studies have shown that high tension lines do affect these animals. We believe it is important to start preserving the natural diversity that has been given to us. Are these power lines necessary? Or, can we find alternatives to this project- i.e. highway 50, up north by Fort Carson, or the use of a battery powered back up plan in Canon City?

Below are links to studies with more in-depth information on what has been presented in this letter.

- https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0209968
- https://www.theguardian.com/environment/2014/mar/12/animals-powerlines-sky-wildlife
- https://help.leonardo-energy.org/hc/en-us/articles/207186749-How-do-High-Voltage-Overhead-Transmission-Lines-impact-the-environment-and-how-can-this-be-evaluated-?mobile_site=true
- https://www.tdworld.com/overhead-transmission/power-wild
- https://www.ncbi.nlm.nih.gov/pubmed/17624193

Respectfully submitted,

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Clean energy technologies threaten to overwhelm the grid. Here's how it can adapt.

The centralized, top-down power grid is outdated. Time for a bottom-up redesign.

By David Roberts@drvoxdavid@vox.com Updated Nov 11, 2019, 10:46am EST
Graphics: Javier Zarracina

This piece was originally published in November 2018.

The US power grid is, by some estimates, the largest machine in the world, a continent-spanning wonder of the modern age. And despite its occasional well-publicized failures, it is remarkably reliable, delivering energy to almost every American, almost every second of every day.

This is an especially remarkable accomplishment given that, until very recently, almost none of that power could be stored. It all has to be generated, sent over miles of wires, and delivered to end users at the exact second they need it, in a perfectly synchronized dance.

Given the millions of Americans, their billions of electrical devices, and the thousands of miles of electrical wires involved, well, it's downright amazing.

Still, as you may have heard, the grid is stressed out. Blackouts due to extreme weather (hurricanes, floods, wildfires) are on the rise, in part due to climate change, which is only going to get worse. The need for local resilience in the face of climate chaos is growing all the time.

Related

Wildfires and blackouts mean Californians need solar panels and microgrids

What's more, the energy world is changing rapidly. A system designed around big, centralized power plants and one-way power flows is grinding against the rise of smarter, cleaner technologies that offer new ways to generate and manage energy at the local level (think solar panels and batteries).

Unless old systems are reconceived and redesigned, they could end up slowing down, and increasing the cost of, the transition to clean electricity (and hampering the fight against climate change).

Energy professionals are aware that strains are starting to show. Energy sector reform is all the buzz these days, with active discussions and experimentation around rate design, market reforms, subsidies, regulations, and legislative targets.

But according to Lorenzo Kristov, the rise of new energy technologies should occasion a step back and a fresh, holistic perspective — not just a reactive scramble on policy. Now in private

practice as an energy consultant, Kristov saw the challenges facing the grid up close as a longtime principal at the California Independent System Operator (CAISO), which runs California's electricity grid.

"As these devices — generators, storage, and controls — get cheaper and more powerful," he says, "every end-use customer will be able to get a major portion of their energy on-site or in the community. That touches every level of the electric system."

Stepping back and thinking about the grid at the systems level, in terms of its key actors and functions, is the province of a discipline known as "grid architecture."

Now, I grant you, "grid architecture" is not a term designed to set the heart aflame. But it is extremely important, and the stakes are high. The danger is that policymakers will back into the future, reacting to one electricity crisis at a time, until the growing complexity of the grid tips it over into some kind of breakdown. But if they think and act proactively, they can get ahead of the burgeoning changes and design a system that harnesses and accelerates them.

Now is the time to rethink the system from the ground up.

What is grid architecture?

The Pacific Northwest National Laboratory has a grid architecture center that offers some semi-useful definitions. A system architecture is "the conceptual model that defines the structure, behavior, and essential limits of a system." Grid architecture is "the application of system architecture, network theory, and control theory to the electric power grid."

Yes, I realize that's not entirely clear. Think of it this way: Grid architecture offers the conceptual tools needed to reshape the structure of the grid system so that it can better accommodate disruptive ongoing changes, i.e., the shift from centralized power plants and one-way power flows to massive amounts of small-scale resources at the edge of the grid.

The system's structure determines its properties and behaviors — what it is capable of, what types of change it welcomes or resists, what outcomes it can achieve, and what conditions could push it into failure. It is at the structural level that reform is needed.

Tell you what, let's just jump in. Like many concepts in energy, grid architecture makes more sense when you look at the specifics. So I'm going to describe (with illustrations from Vox's inimitable Javier Zarracina) the current architecture of the grid, reasons to think it needs reform, and a proposal for a new architecture.

Actually, there are two opposing proposals, one that doubles down on the current, top-down system and one — more ambitious, but to my mind far superior — that would redesign the grid system around a new bottom-up paradigm.

If nothing else, I hope to convince you that changing the way we architect the grid is a key step — perhaps *the* key step — in unlocking the full potential of the clean energy technologies that

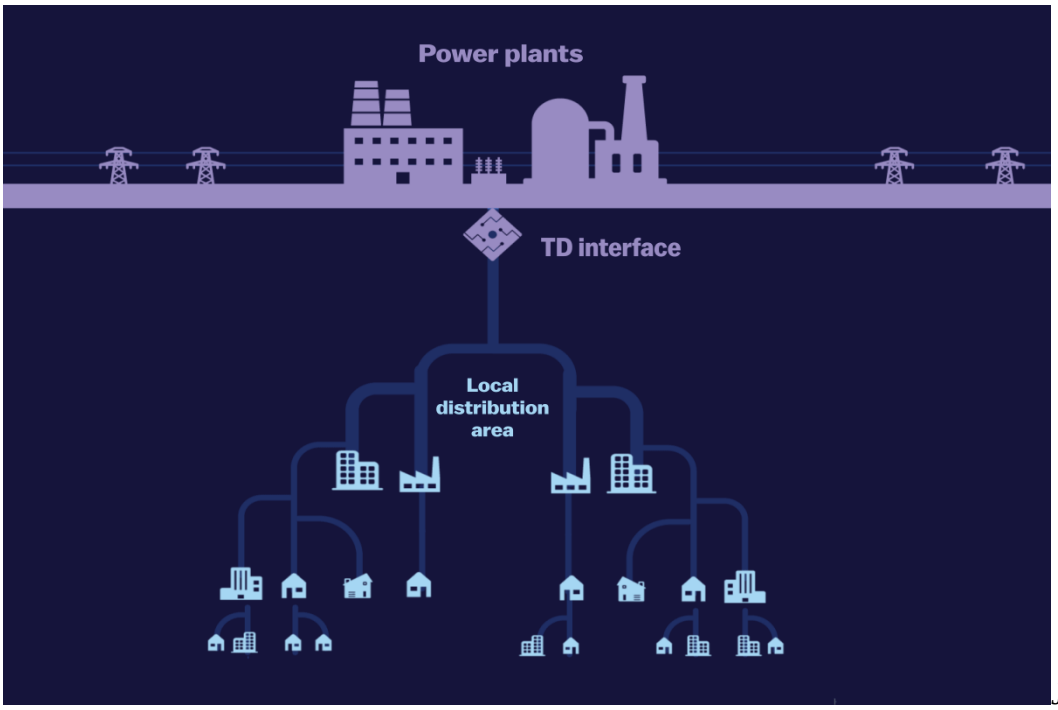
will be needed to decarbonize the electricity sector and meet new demand coming from electrification of other energy-intensive sectors like transportation and buildings.

And as I've written before, decarbonizing the electricity sector is central to addressing climate change. Getting the grid right is vitally important. So let's have a look.

The grid has worked on a top-down model for a century

Since it first started growing in earnest in the early 20th century, the grid has worked according to the same basic model. Power is generated at large power plants and fed into high-voltage transmission lines, which can carry it over long distances. At various points along the way, power is dumped from the transmission system into local distribution areas (LDAs) via substations, where transformers lower the voltage so it won't fry the locals.

Distribution wires carry power from these transmission-distribution (TD) interfaces in various directions to end users. The voltage is lowered again by transformers on power poles, and then the power is fed into buildings through meters that keep track of consumption. Once it is "behind the meter," it is used by computers and dishwashers and iPhone chargers.



Javier Zarracina

One notable feature of this model is that power travels in only one direction, which is why hydrological metaphors are so popular in grid explainers. Transmission lines are like mighty rivers that feed into urban water distribution systems, where the water/power travels to the end of the line and is consumed. At no point does water travel back up the line.

While the US transmission system acts as a true network — it is highly interlinked, so power can travel throughout to where it is needed — the "distribution feeders" that pump power into LDAs do not. Distribution feeders are generally "radial" in design, meaning power travels from the substation out along tendrils to end users, in one direction. (There are also other distribution feeder designs, wherein an LDA is linked up to two or more substations, but those are less common, so we're going to keep it simple.)

It is important to understand how these various parts of the grid are managed in the US. Unfortunately, that means I'm about to hit you with a hail of acronyms. Brace yourself.

The transmission network is managed by, depending on the region, an independent system operator (ISO), a regional transmission organization (RTO), or an electric utility that is not a member of an ISO or RTO. (All of these are versions of transmission system operators — TSOs, the generic term popular in Europe — so for the rest of this post, and in the illustrations, I'll use that term.)

Because transmission crosses state lines, TSOs are under federal jurisdiction. Specifically, they must follow rules established by the Federal Energy Regulatory Commission (FERC). FERC is responsible for the reliability of the transmission grid, with help from the North American Electric Reliability Corporation (NERC), a nonprofit public-benefit corporation that analyzes grid reliability and enforces reliability standards.

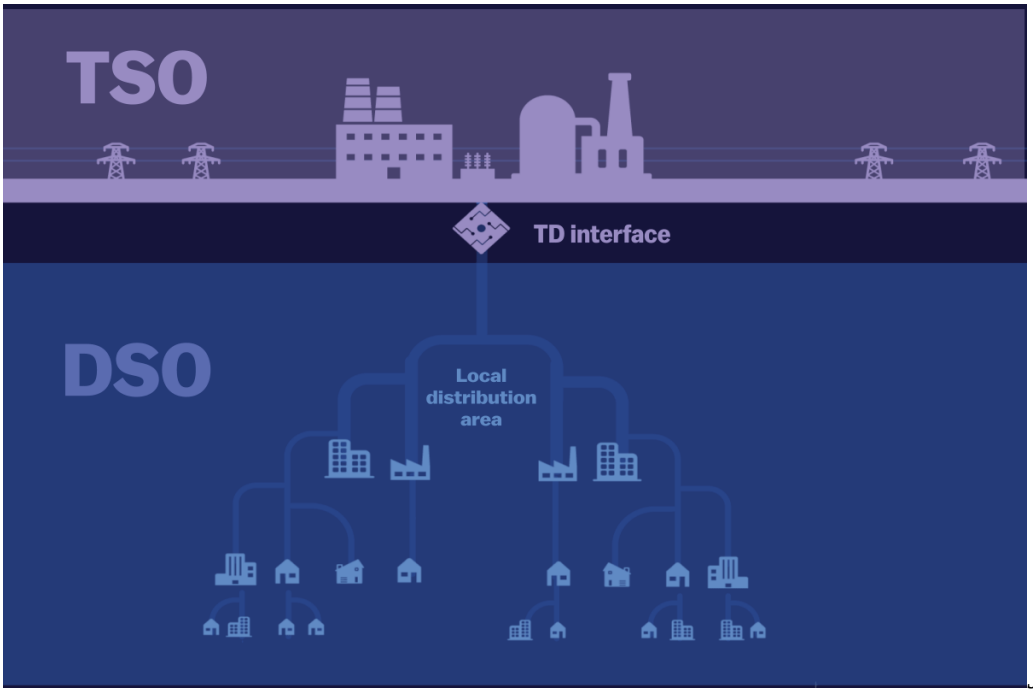
In some regions, utilities are still "vertically integrated," meaning they own power plants and are also "load serving entities" (LSEs), distributing power locally. But in areas serving about two-thirds of US customers, the utility sector has been "restructured," splitting the two apart. (This post mostly focuses on restructured areas, though it applies beyond them as well.)

In restructured regions, distribution utilities do not own any power plants. They buy power for their local customers from wholesale markets, where the owners of power generators ("gencos") compete, selling their power (and other energy services) at auction. Wholesale power markets are administered by TSOs and under FERC jurisdiction.

Distribution systems, because they generally do not cross state lines, are under state jurisdiction. They are the responsibility of power utilities, the state public utility commissions (PUCs) that oversee utilities, and the state legislators who pass laws utilities have to follow. (Municipal utilities and electric cooperatives also operate distribution systems, subject to local governing bodies rather than state commissions.) These utilities are responsible for the reliability of distribution systems. They act as distribution system operators (DSOs).

Still with me? On the transmission side, TSOs watch over wholesale markets, regulated by FERC and guided by NERC. On the distribution side, DSOs provide connections to end-use customers and are regulated by state legislatures and state PUCs or local governing bodies.

So here's that model again:



Javier Zarracina/Vox

That's the basic grid architecture as it has existed since time immemorial.

But in the past few decades, things have started changing.

Three clean-energy trends are shaking things up

Changes in the electricity world are many and varied, but they boil down to three core trends.

The first is the rise of renewables. Wind and solar complicate management of the grid because they are variable — they come and go with the weather. You can't ramp them up and down at will like you can fossil fuel plants. The sun comes up, you get a flood of power from all those solar panels; the sun goes down, you get none.

This vastly increases the complexity of matching supply to demand in real time, and creates an urgent need for flexibility. A grid with lots of renewables badly needs resources that can ramp up and down or otherwise compensate for their natural variations. Integrating high levels of variable renewables is already creating challenges for grids like California's.

The second is the rise of distributed energy resources (DERs): small-scale energy resources often (though not always) found "behind the meter," on the customer side. Some DERs generate energy, like solar panels, small wind turbines, or combined heat-and-power (CHP) units.

Some DERs store energy, like batteries, fuel cells, or thermal storage like water heaters. And some DERs monitor and manage energy, like smart thermostats, smart meters, smart chargers,

and whole-building energy management systems. (The oldest and still most common DER is diesel generators, which are obviously not ideal from a climate standpoint.)

DERs are sometimes known as "grid edge" technologies because they exist at the bottom edge of the grid, near or behind customer meters. They are rapidly growing in variety, sophistication, and cumulative scale, and as they do, they unlock opportunities to stitch together more locally sufficient energy networks — if grids can handle them. (More on that later.)

Javier Zarracina/Vox

The third trend is the increasing sophistication and declining cost of information and communication technology (ICT). As sensors and processors continue to get cheaper, it is increasingly possible to see exactly what is going on in a distribution grid down to the individual device, and to share that knowledge in real-time over the web. More information can be generated, and with artificial intelligence and machine learning, information and energy can both be more intelligently managed.

If the first trend, the rise of renewable energy production, creates the need for grid flexibility, the second two, DERs and ICT, can help provide that flexibility — if they are enabled and encouraged.

But there's reason to believe that current grid architecture is not well-suited to enabling and encouraging them.

DERs are getting all up in wholesale energy markets

The simple fact is that DERs can do a lot of the things that only big conventional power plants used to be able to do, like generate energy and provide grid services like capacity, voltage and frequency regulation, and "synthetic inertia." They can also do things power plants can't, like store energy and economize its use.

That means DERs can increasingly help smooth out the variations in demand and renewable energy production locally, without calling on distant power plants.

With new ICT, it is possible to network DERs together into big operational chunks — "virtual power plants" (VPPs) they are sometimes called, though that's a bit misleading, since they can do things normal power plants can't do. Virtual power plants are assembled by "aggregators." It is a rapidly growing market.

There are also physical aggregations of DERs, known as microgrids, local electricity systems that can operate either connected to the main power system or, at least temporarily, as an "island," disconnected from it.

Microgrids can do many of the same things as virtual power plants, and as a bonus, they also provide their residents with backup power service in case of a blackout. (Fun fact: One of the biggest microgrids in the US is a literal island — it runs Alcatraz, off the coast of San Francisco.)

Now here's where things get tricky for the old grid model. There are all these new DERs, more every day, interoperating in increasingly sophisticated ways. They can produce power and services, not only for the customers whose meters they are behind, but for the grid as a whole.

But the physical grid, DSOs, TSOs, and current regulatory structures were all designed for one-way power flows. How can the value of the power and services DERs provide be fully realized? For instance — who should DERs sell their services to?

Remember, almost all US electricity markets are run at the transmission level, by TSOs. DERs are hanging out down at the bottom edge of the grid, under the aegis of DSOs.

The solution thus far, such as it is, has been to allow DERs some limited access to wholesale power markets. Aggregators bundle up the power and services and bid them into those markets.

So here's the model now, with power flowing down to the edge of the grid and then, from DERs, flowing back up into wholesale markets:

Javier Zarracina/Vox

The question now is whether, given the continued development and profusion of DERs, the existing grid architecture can keep pace.

Two contrasting visions of the future electricity grid

The electricity sector is changing rapidly and the grid is changing with it. That will continue no matter what. The question is whether to reinforce and enhance the current grid architecture or to conceive and build something new.

That choice is laid out in "A Tale of Two Visions: Designing a Decentralized Transactive Electric System," published in 2016 in *IEEE Power and Energy Magazine* by Kristov, Paul De Martini of the California Institute of Technology, and Jeffrey Taft of the Pacific Northwest National Laboratory.

Kristov, De Martini, and Taft sketch two ways that the profusion of DERs can be managed, involving different roles for TSOs and DSOs. They purposefully describe two opposing poles, two contrasting extremes, acknowledging that in the real world many systems will be some mix, or may change incrementally and slowly from one to another.

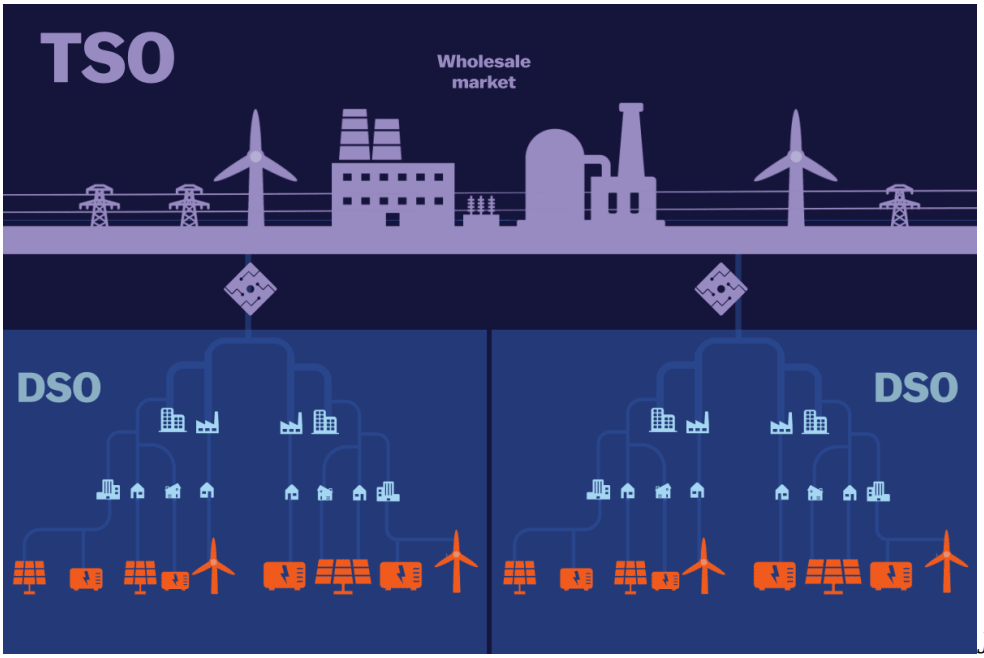
The first vision is the logical extension of the current wholesale market system — just with a lot more DERs involved. The study's authors call this the "Grand Central Optimization" model,

because all optimization, all balancing of supply and demand, would be done in one place, the TSO. It is a “total TSO” model.

Under the Grand Central model, TSOs would continue to manage and dispatch DERs (or aggregations of DERs) for any transactions affecting wholesale markets. Wholesale markets would become much more complex, involving many more diverse participants.

This would be a “minimal DSO” model, in that the DSO, typically a distribution utility, would remain uninvolved in such transactions and continue merely to maintain operations and reliability at the distribution level.

Here’s how Grand Central might look, with lots and lots of DERs feeding energy and services directly into wholesale markets from down at the grid edge:



Javier Zarracina/Vox

This is more or less where the system is heading by default, unless something big changes. But the evolution seems less intentional than a matter of path dependence and lack of holistic planning.

Kristov, De Martini, and Taft worry that Grand Central is not the right model — that it will ultimately increase the cost and complexity of integrating more renewable energy and DERs.

The details get can get technical, but there are two basic problems with Grand Central.

The first is that DERs more and more often serve two masters. They have a relationship with the TSO that bypasses the DSO, in the form of wholesale-market commitments. They also have a relationship with the DSO; it must manage them in the name of distribution-grid stability and reliability.

As DERs and their aggregations grow more numerous and larger, the risk arises that large chunks of the system will receive dueling instructions. The paper's authors call this "tier bypassing, which occurs when two or more system components have multiple structural relationships with conflicting control objectives."

The second problem is simply complexity. DERs are still at a fairly nascent level of development, but they are set to explode in coming years, as rooftop panels, electric vehicles, home batteries, and smart meters become more common. Soon there will be all kinds of combinations and aggregations, at all levels, across every one of hundreds of LDAs.

Wholesale markets could go from having dozens of participants to having hundreds, or thousands, or hundreds of thousands.

That's going to be a lot for a TSO to track — a thicket of new rules, new enforcement mechanisms, and sheer computational bulk. "Under this model," Kristov, De Martini, and Taft write, "the TSO needs detailed information and visibility into all levels of the system, from the balancing authority area [i.e., the TSO level] down through the distribution system to the meters on end-use customers and distribution-connected devices."

TSOs would have to track and manage all this information while working alongside, and attempting to coordinate with, dozens of DSOs maintaining local reliability.

Already some TSOs are complaining to FERC that state energy policies are distorting their wholesale markets. Imagine when those federally run markets involve thousands of DER participants, all of which are also subject to a variety of state energy policies and all of which are also constrained by DSO reliability requirements.

These are the kinds of thoughts that give FERC commissioners migraines. Balancing the interests of TSOs against the interests of dozens of DSOs will be an unending hassle.

Some economists like to think that if each energy source and service were priced properly, based on its real-time, location-specific value, the market would allocate electricity with perfect efficiency. Just get the right pricing algorithms in place and let 'er rip.

But there are reasons to doubt that distribution systems, filled with quirky and unpredictable human behaviors, can be adequately guided by the invisible hand alone. They need a more personal touch.

Kristov, De Martini, and Taft take no stand in the paper on whether the Grand Central model is possible, but when I asked De Martini directly, he was frank. "I don't think the grand centralization model will work at scale," he said, "as there are too many dynamic, random variables [in distribution systems] involving both machines and humans."

"As I think about a TSO trying to have full awareness of what's going on in a distribution system, bringing that together in a simultaneous optimization with the transmission grid, it just

doesn't make sense," Kristov told me. "It seems needlessly complex. But if you don't have that, then you need the DSO to step up to some higher-level responsibilities."

Which brings us to the alternative to Grand Central.

A new, bottom-up architecture for the grid

The alternative grid architecture that the study's authors propose solves these problems in an elegant way. It is called ... hang on to your hats ... a "decentralized, layered-decomposition optimization structure." Whee!

Let's translate that into English. (Side note: Layered or "laminar" structure is a familiar concept in telecoms and software architecture. It is somewhat newer to power systems.)

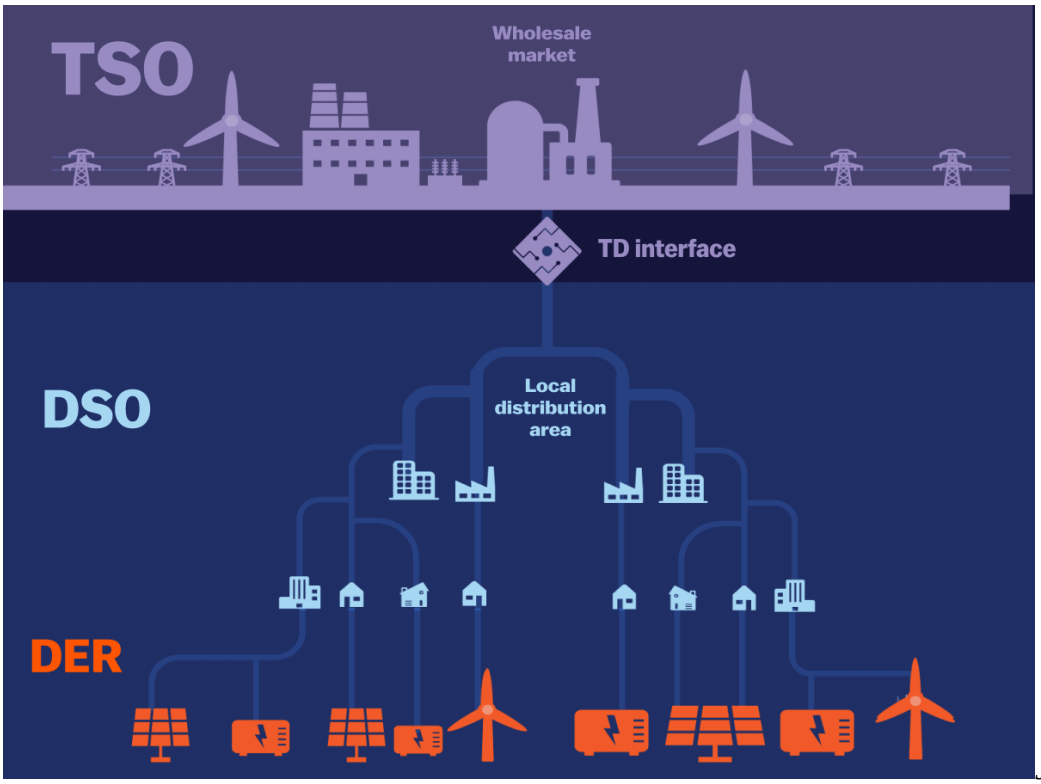
In the Grand Central model, the TSO optimizes everything in one place, not only power plants at the transmission level, but thousands of DERs and aggregations at the distribution level, in service of wholesale markets and transmission system reliability, while having sufficient real-time visibility into the distribution system to avoid conflicts with local reliability needs.

In Kristov, De Martini, and Taft's proposed model — which I'm going to call LDO, for layered decentralized optimization, because I don't want to type all those words again — each layer, the transmission layer and the distribution layer, would be responsible for its own optimization and its own reliability.

Remember tier bypassing? The LDO model would prevent that by effectively sealing the layers off from one another, except at their electrical interface points. The only point of communication and coordination between the transmission layer and the distribution layer beneath it would be at the TD interface (the substations). Everything below the TD interface would be managed and optimized by the DSO.

Responsibility "decomposes" to the layer beneath — that's what "layered-decomposition" refers to.

The DSO would balance supply and demand within a local distribution area (LDA) using, to the extent possible, local DERs. It would then aggregate all remaining supply or demand into a single bid to wholesale markets (either a purchase or a power offer).



Javier Zarracina/Vox

This would radically simplify things for a TSO.

It would not need to keep track of, manage, and dispatch tens of thousands of DERs, DER aggregations, and microgrids across the LDAs in its region. The DSOs would handle all that.

Each DSO would present to the TSO as a single unit at each TD interface. All the TSO would need to do is accept one aggregate wholesale market bid from each TD interface, of which there would be dozens or hundreds (rather than tens of thousands). That would maintain the simplicity and manageability of wholesale markets.

Just as responsibility for optimization would decompose downward, so too would responsibility for reliability.

The TSO would be responsible only for the reliability of the transmission system, up to the point of TD interface. Beyond that, each DSO would be responsible for reliability within its own LDA.

Every grid architecture must have a “coordination framework” that assigns basic roles and responsibilities to various components of the system. The LDO architecture is a “maximum DSO” or “total DSO” model, in that it assigns substantial new roles and responsibilities to DSOs, well beyond those assigned to them by the current system. (We’ll talk more about that in a moment.)

An architecture that scales all the way down

There are many advantages to the LDO architecture, which we'll get into below, but one worth highlighting is scalability. LDO serves as a way of managing complexity up (or down) to any scale.

The electricity system need not have only two layers; it can have many.

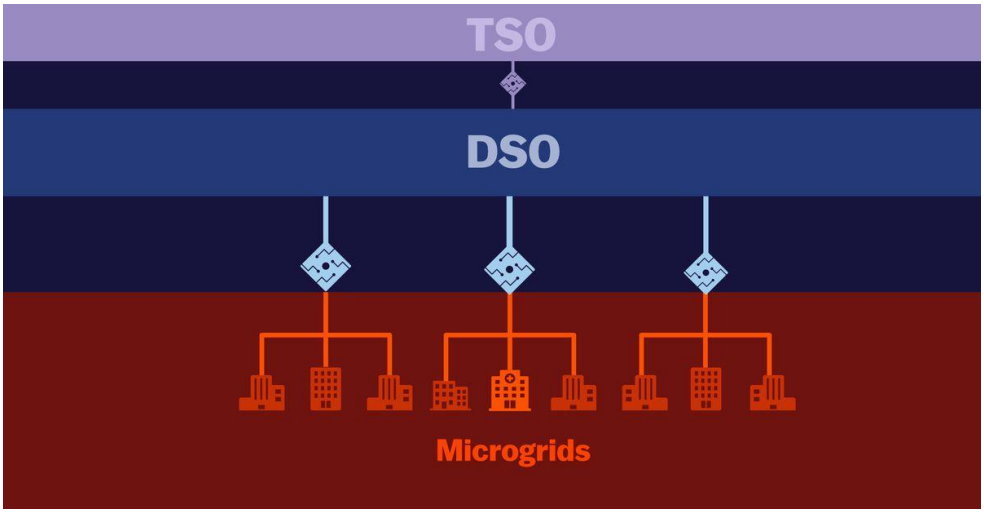
Recall that in the LDO model, the transmission layer interacts with the distribution layer only at a limited number of TD interfaces. The only interaction a distribution system has with the transmission system above it is at that single point.

But there could be another layer beneath that first distribution layer. And it could communicate with that first distribution layer the same way the first distribution layer communicates with the transmission layer, i.e., through a single interface. Responsibilities would decompose downward again — the second layer would be responsible for its own optimization and reliability.

And there could be a third layer below that, and a fourth, ad infinitum.

For instance, imagine a local microgrid that links together dozens of buildings, solar panels, combined heat-and-power (CHP) units, batteries, EV charging stations, and perhaps even a few smaller microgrids into a single network (a university campus, say). That network can island off from the larger grid and run on its own, at least for a limited time, if there is a blackout.

That microgrid is another layer. Rather than managing dozens of DERs, the DSO now manages the microgrid as a single aggregated asset. As for the microgrid, its only interaction with the larger distribution layer above it is through a single interface. It is responsible for its own optimization and reliability and can island if necessary.

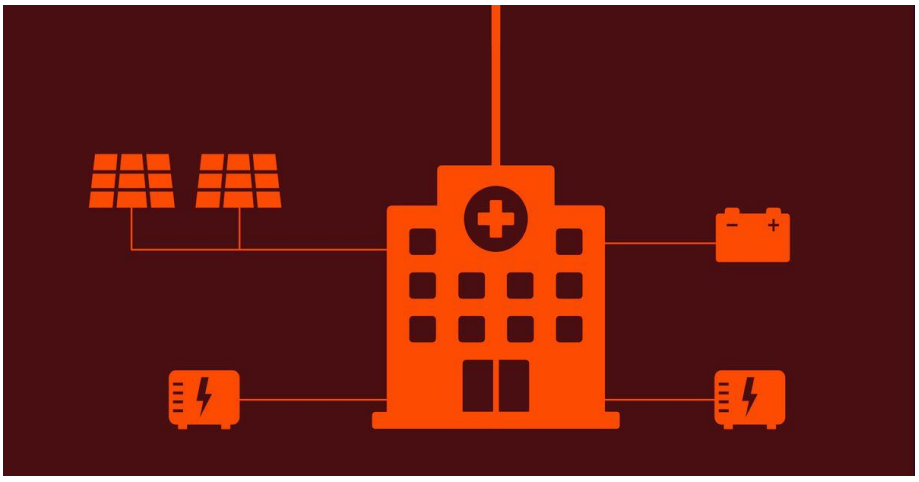


Now, imagine the big microgrid contains several smaller microgrids within it. Each of them connects, say, three buildings, some solar panels, and some batteries.

Same deal: There's a single point of contact between the big microgrid and each small microgrid (thus simplifying things for the big microgrid). Beneath those points, responsibility decomposes again, to the small-microgrid level.

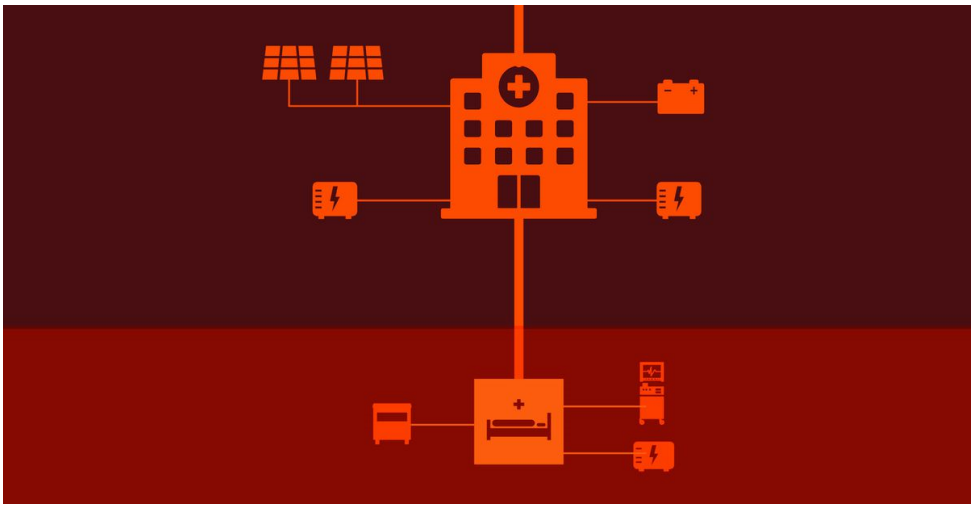
Now imagine one of the small microgrids contains a building (say, a hospital) that is itself a microgrid — it has solar panels on the roof, diesel generators in the basement, some batteries, and a smart inverter that allows it to island off from the small microgrid in emergencies.

Same deal: One point of contact with the microgrid above it; responsibility decomposes down.



Now, imagine the hospital has an emergency wing that is itself a microgrid (nanogrid? teeny-weenygrid?), with a smart inverter and one diesel generator, just enough to power a couple of respirators and monitors.

Same deal: single point of contact; responsibility decomposes.



Because responsibility devolves downward, no single entity gets stuck tracking and dispatching an unwieldy number of DERs. And there is no tier bypassing. Each layer is responsible for itself and interacts with the level above it through a single point of contact.

This helps tame the problem of rapidly increasing complexity in the electricity sector. Whereas in the Grand Central model, the TSO will have to single-handedly keep track of all the blooming and buzzing DERs beneath it — which, let's be serious, will eventually overwhelm it — in the LDO model, each layer is its own, tractable domain.

Layered grid architecture faces substantial real-world obstacles

There are all sorts of reasons why the LDO vision will be slow to come to fruition, if it ever does. It's a major departure from the centralized, top-down architecture that dominated the past 100 years, and as such it requires a whole raft of legal, regulatory, and economic changes, ranging over numerous jurisdictions.

Among other things, local distribution utilities would need to be beefed up considerably to become maximum DSOs. In the LDO architecture, Kristov, De Martini, and Taft write, DSOs "would have to provide an open-access distribution-level market that would aggregate DER offers to the wholesale market, obtain services from qualified DER to support distribution system operations, and enable peer-to-peer transactions within a given LDA and potentially even across LDAs."

That's a lot of new stuff to figure out (though many technical questions are addressed by papers from the Pacific Northwest National Laboratory and others). Even where progress moves in the LDO direction, it will be shaped to local conditions and likely small-c conservative.

Still, these are volatile times in the sector, with utilities and regulators alike wondering nervously how to get ahead of the curve. If a bold utility did a maximum-DSO demonstration, perhaps it could spark a wave of similar reforms.

Rather than trying to predict the possible uptake of the LDO model, let's talk about a few more advantages.

The LDO architecture would put more power in local hands

Aside from scalability, the most notable feature of LDO architecture is that it flips a top-down system. Responsibility for electrical power — and with it, social and political power — decomposes downward, to the local level, rather than concentrating at the top.

Starting at the very lowest level, often behind the customer meter, each level will have a smart controller maximizing its efficiency and self-reliance. Only to the extent that it is unable to provide for itself will it seek power from the next level up.

At that level too, a smart controller will be optimizing all its varied resources, seeking efficiency and self-sufficiency. Only to the extent that it is unable to provide for itself will it seek power from the next level up. And so on.

This architecture puts local DERs, at the bottom edge of the grid, first in the priority stack, ensuring that they are optimized and fully utilized before any LDA requests power from the transmission system. Big, centralized power plants become the last resort, not the first.

Now let's pause here to forestall a couple of possible objections.

First, nothing about the LDO architecture implies that it is bad for a level to request power from the level above it, or bad for LDAs to request power from the transmission grid. Most levels and most LDAs, especially in these early days of DERs, are far from fully self-sufficient and will be for some time. They will need transmission-grid power. Many always will.

And that's fine. The limits of energy self-sufficiency are not moral failings, they are a matter of local climate, population density, and engineering. Different communities will value self-sufficiency differently. Some will seek independence to every extent possible, perhaps even becoming net producers that sell into wholesale power markets. Some will be content to get most of their power from the transmission grid. All will have their choices shaped by local conditions and limitations.

The whole point of big power plants and the continent-spanning (or at least partially continent-spanning) transmission grid is to provide everyone with backup power, so that we are not limited by local conditions. It's a beautiful thing; no one need ever apologize for utilizing it.

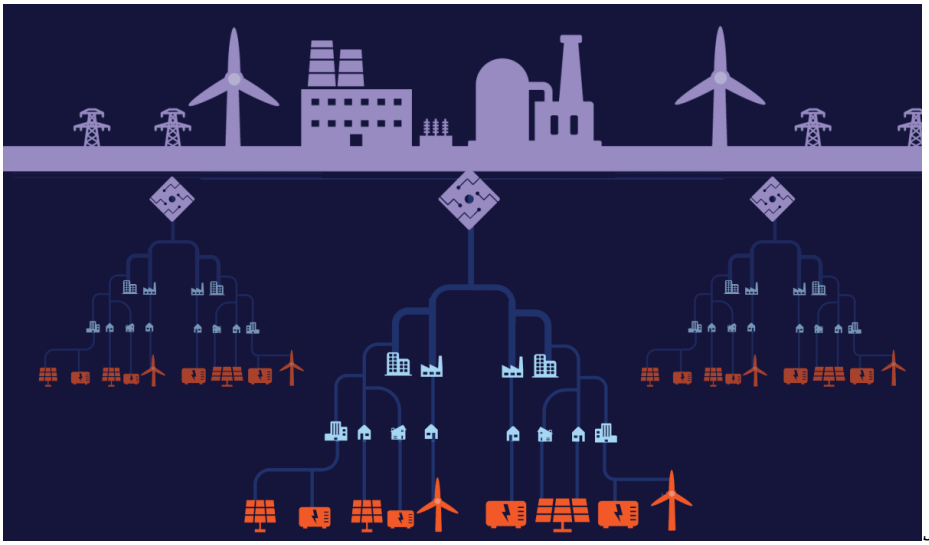
Second and relatedly, there is often a false dichotomy drawn in the energy world, with advocates for big power plants and the big grid (the "hard path" in energy development) on one side and advocates for self-sufficient local grids run on DERs (the "soft path") on the other.

The LDO architecture neatly moots that debate. Each layer optimizes, then draws on the layer above, all the way up to the transmission layer. Local DERs are systematically maximized, even as everyone enjoys the benefits of the power plant/transmission grid backup.

What flips is the priority, and with it, the power. Foregrounding local resources would at long last make cities and regions (their vehicle fleets, their building and zoning codes, their infrastructure, their vulnerabilities) full partners in optimizing and decarbonizing energy.

“A lot of things we consider electrification and decarbonization are going to play out through local planning,” Kristov says, “whether it’s rethinking mobility in urban areas or retrofitting buildings, these are local initiatives that will create local jobs. So you start having local economic development as a consequence of this decentralization.”

The LDO architecture would structure local needs, local aspirations, and local resilience directly into the decarbonization effort.



Javier Zarracina/Vox

Unleashing DERs would spark enormous innovation

It would also spark a surge of energy innovation. Right now, thanks to outdated regulatory models, utilities are often hostile toward DERs, which are increasingly able to substitute for grid infrastructure. Anything that reduces utilities’ need to invest in more infrastructure threatens their financial returns. Consequently, they often show exactly as much support for DERs as is mandated by legislators, and no more.

In the LDO model, DSOs wouldn’t make money off infrastructure investments and they wouldn’t own DERs. They would make money by providing services. Each DSO would run what is effectively a distribution-level market within its own LDA. DERs would bid their energy and services in, local supply and demand would be matched to the extent possible, and the DSO would submit the remainder as a single wholesale-market purchase (if there’s residual demand) or bid (if there’s residual supply) at the TD interface.

The upshot is that each DER or aggregation, each layer, would have financial incentive to optimize its own resources and maximize its own self-sufficiency — to produce as much power

as possible and consume as little as possible. That would create enormous demand-side pull for DER innovation.

And remember, DER innovation isn't like power-sector innovation of old. Fossil fuel and nuclear power plants only come in one increment: big. It takes a long time to build, iterate, and improve them, and the capital barriers to entry in that market are high.

DERs tend to be smaller and more connected to information and communication technology (ICT), things like electric cars, smart car chargers, new kinds of batteries, or just software to run all that stuff. The capital barriers are lower; the time it takes to iterate is much shorter; learning and improvements spread much faster.

The mammals are coming for the dinosaurs.

(If you'd like to hear Kristov talk more about these topics, I highly recommend this in-depth interview on the Energy Transition Show podcast — it is delightfully nerdy.)

With a new grid architecture, DERs can turn the focus to local resilience and rapid decarbonization

In 2015, Kristov published a speculative piece in Public Utilities Fortnightly called "The Future History of Tomorrow's Energy Network." It is written as a look back from 2050 at the energy system that developed since 2015, describing its evolution into the LDO model.

What came between 2020 and 2030, he writes, was "the realization that DERs would dominate the future rather than simply lurk at the margin."

That is the key question facing the electricity sector: whether DERs are at the front end of a massive and sustained expansion. If they are — and all signs point to go — then it's worth thinking ahead about the kind of electricity system that can manage and maximize them.

That's what the LDO architecture is meant to do: manage complexity, speed decarbonization, and enhance local resilience. It moves responsibility for DERs into the hands of those closest to them and builds the grid from the bottom up, making every community a partner in the great fight against climate change.

https://www.vox.com/energy-and-environment/2018/11/30/17868620/renewable-energy-power-grid-architecture

Valuation Guidelines for Properties with Electric Transmission Lines

By: Kurt C. Kielisch, ASA, IFAS, SR/WA, R/W-AC

Before a discussion can be entered about the perception of electric transmission lines and their effect on property value, it is important to understand what a transmission line is and how it differs from a distribution line.

An electric *transmission* line is an electric line that transports electrical power from one substation to another. These lines are typically 100kV (kilovolts) or larger exceeding one mile in length[1], have large wood or steel support towers over 45ft in height, and often have more than one set of wires (3 wires per circuit plus the static wire). Electric transmission lines do not directly serve electric utility customers: their power is distributed from distribution point to distribution point. Transmission line wires are not insulated and are "bare". Typically, they constructed to have at least 20ft of clearance between the ground elevation and wire at low sag.

An electric *distribution* line is a power line that transports electricity from the substation to the electric utility customers. These lines are of less voltage, typically under 65kV, carried on wood poles of 45ft in height or less and hold one pair of wires. The voltages of these lines are downgraded before the electricity is brought to the customer's residence or commercial building. The focus of this report is on "transmission" lines, not "distribution" lines

Perception = Value

The valuation of properties that have an electric transmission line requires an understanding of the basic principles of Market Value. Market Value is defined, in layman's terms, as the value a property would sell for at a given date considering an open market. (A complete definition of this term is included in the body of the appraisal report.) An open market assumes that the property is available for purchase by the public, being properly marketed for maximum exposure, and that the buyer is well informed, fully knowledgeable and acting in their best interest. Included in this definition is that the buyer has full knowledge of the pros and cons of the property, and then acts with that knowledge in a way that will benefit them. In other words, the value of the property is based on the perception of the buyer. Understanding that perception drives value is the foundation in analyzing the effect that electric transmission lines have on property value.

The key point of the Market Value definition, which gives guidance to answer the "impact" question, is the "willing buyer" part of the equation. In appraising a property the appraiser attempts to reflect the potential buyer of the subject property and estimate their action as to the subject property with all its advantages and disadvantages (knowledgeable buyer). To accurately reflect this buyer, the appraiser must determine the typical profile of such a buyer of the property in question. An example of this

1 Wis. Stat. 196.491(1)(f)

would be a one bedroom condominium along a lake may indicate a typical buyer to be a retired couple who is looking for a recreational retreat for themselves and their guests. Another example would be a parcel with the best use being a dairy farm; the typical buyer would be a person either currently engaged in dairy farming looking to expand or relocate, or one who desires to enter into this field -- in either case a "dairy farmer." Such an analysis should be obvious, yet often overlooked when appraising properties.

For rural properties that are utilized for agricultural purposes, the most likely buyer would be one who: (1) prefers the rural lifestyle over the urban lifestyle; (2) typically generates their income from working in the agricultural field; (3) would be sensitive to environmental issues that affect the uses of the land and the view shed of the land; and (4) would be sensitive to health and safety issues relating to the land and its use.

It is most likely that such a person, when confronted with an electric transmission line traversing the property, would view such an improvement as aesthetically "ugly," potentially hazardous to their health, disruptive to rural lifestyle and potentially harmful to the use of the land for agricultural purposes.

Research Format

Our research into the impact of electric transmission lines followed several stages. The first was a "literature" study. This study involved investigating, collecting, indexing and reading many of the published articles, news stories and published transcripts relating to the topics of EMFs and stray voltage. Stray voltage was included in this research due to the concern dairy farmers have relating to its presence from high voltage power lines. This research resulted in over 2,500 pages of information collected and analyzed. The purpose of this study was to discover "what is the public's perception of high voltage transmission lines." Overall, the majority of the articles indicated a "fear" of these power lines, citing health concerns as the primary factor. Other concerns included stray voltage issues (mainly with rural publications) and aesthetics. It was clear that most of the information the public receives about these matters is negative. The literature study will follow these "guidelines."

The second part of our study involved researching studies completed on the effects on property value due to the presence of electric transmission lines. This included collecting many of the published research studies on this topic found in the public domain. Additionally, the study reviewed trade journals not available to the public, but available only to real estate professionals. Again, to be fair, some of the studies indicated that there was no measurable effect. However, there were a number of studies (mostly recent) that indicated there was a measurable effect and that effect ranged from a loss of 10% to over 30% of the overall property value. These studies included both improved and vacant land.

Empirical Studies

Below is a sampling of some studies we have reviewed regarding the impact that electric transmission lines have on land value and were utilized to formulate our opinion of value when a property is impacted by a high voltage transmission line.

- *Study of the Impact of a 345kV Electric Transmission Line in Clark County, Town of Hendren.*

(Appraisal Group One, Kurt C. Kielisch, 2006, revised 2009) This study was limited to Hendren Township, Clark County, and covered a five year time period from January 1st, 2002 to June 1st, 2006. This study included 22 land sales of agricultural and recreation land, of which 4 were encumbered with a 345kV electric transmission line having wood H-pole design, 60ft height and 150ft wide easement. The other 18 land sales were considered comparable to the power line encumbered sales. The conclusion of this study was that: (a) the land sales with an electric transmission line sold for 23% less than comparable land sales without a transmission line; and, (b) the more severe the location of the power line the greater was the loss of value.

- *An Impact Study of a 345kV Electric Transmission Line on Rural Property Value in Marathon County - Wisconsin*. (Appraisal Group One, Kurt C. Kielisch, 2006) This study focused on the impact a 345kV line, known as the Arrowhead-Weston line, had on property value. This power line was a 345kV electric transmission line, having steel single poles ranging in height from 110ft to 150ft, single and double circuit lines, having a 120ft wide easement. The study compared sales within a 2 year time period (January 1st, 2004 to December 31st, 2005) in Marathon County, Wisconsin, focusing the area to the Townships of Cassel and Mosinee. This study used 14 land sales, of which 5 were encumbered with the power line and 9 were not. A simple regression technique and matched pair analysis was used to extract the value impact. The study concluded with a finding that when the power line traversed the property along the edge, such as a back fence line, the loss was as low as -15%, and when it bisected a large parcel the loss was as high as -34%. The properties were all raw land sales with either agricultural or residential land use.

- *Transmission Lines and Property Values State of the Science* (Electric Power Research Institute [EPRI}, 2003). This study completed by EPRI for the benefit of its electric utility clients reviewed the issue of property values being impacted by electric transmission lines by summarizing research they had on the subject. Essentially they concluded that the results are mixed, some cases showing a loss in value ranging from 7-15% with appraisers who had experience with valuing such properties, to having no effect. Interestingly, it appeared in their survey that appraisers who did not have experience valuing such properties tended to overrate the negative effects.

- *American Transmission Company, Zone 4, Northeast Wisconsin - High Voltage Transmission Line Sales Study* (Rolling & Company, 2005). This study researched the impact that high voltage electrical transmission lines have on property value in the northeast Wisconsin area. They collected information on 682 land sales of which 78 involved lots near a transmission line corridor, but not directly encumbered by the transmission line. Their conclusions were: (a) easement lots sold at about 12% less than lots located over 200ft from the transmission lines; and (b) no clear impact on “proximity” lots those that lie within 200ft from the easement area but are not directly subject to the easement.

- *Properties Near Power Lines and Valuation Issues: Condemnation or Inverse Condemnation* (David Bolton, MAI. Southwestern Legal Foundation. 1993). This study cites a number of studies that prove a loss of property value due to proximity to an electric transmission line and then cites his own study. His own study found that in the Houston area assessed values of properties that adjoined a power line easement had a 12.8% to 30.7% lower assessment than the average homes not on the line, but in the same area. He also found that: (1) many buyers refused to even look at such properties; (2) such properties took at least twice as long to sell; (3) some brokers said such properties can take three times longer and finally sell at a 25% loss of value; and (4) overall homes adjoining transmission line easements took six times longer to sell and experienced a 10% to 30% loss in value.

- *Power Line Perceptions: Their Impact on Value and Market Time* (Cheryl Mitteness and Dr Steve Mooney. ARES Annual Meeting paper. 1998) The authors interviewed homeowners on or near electric transmission lines and found: (1) that in relation to the average impact of overall property value, 33% said 2-3% loss and 50% said a 5% loss or greater; (2) nearly 66% said the power line negatively affected their property value; (3) 83% of real estate appraisers surveyed said the presence of the power lines negatively affected the property values, most saying the loss was 5% or greater.

- *Analysis of Severance Damages (James Sanders, SRA, 2007)* This study completed an analysis of the impact of a transmission line through the middle of the Continental Ranch subdivision outside of the Tucson, Arizona area. This subdivision had a wood H-pole high voltage electric transmission line running through a portion of the subdivision. The author compared the residential lots abutting the easement to ones that were not. All lots abutting the easement were much bigger than the non-easement abutting lots. The author used improved properties for his study and by the use of regression analysis isolated many variables of value for an improved property to remove them from the analysis. In conclusion, through extensive use of the regression technique, the author finds an overall loss to the improved properties abutting the power line easement at -12%. This loss is attributed to both the land and improvements. However, the author notes that the lots are typically twice the size of the non-easement lots. When the size of lots was factored the overall loss to the land only was factored at -40%. It should be noted that the residences were at a distance from the power line.

- *The Peggy Tierney property: A Comparative Study of the Impact of a 69kV Transmission Line v. 345kV/69kV Transmission Line (Kurt C. Kielisch)*. This was a brief study on the impact difference, if any, between an existing 69kV transmission line and a new proposed 345kV and 69kV transmission line on the same property. The property was a 3.70 acre residential lake front improved property that had an existing 69kV transmission line crossing the west half of the parcel along the road and required the property owner to cross under the power line to enter the parcel. The 69kV line had an easement width of approximately 100ft, wood H-poles at 50-60ft in height. The new 345kV line was to be placed within the existing easement, more or less, would have 140ft monopoles and carries both a 345kV and 69kV line. The seller attempted to sell the property at its full list price after an experienced lake front home Realtor established the list price from a comparative sales analysis. The home eventually sold for 27% less than the list price and took longer to sell in a relatively strong lake front home market. The buyer cited the pending 345kV line as the principle reason for their low offer.

- A comparative sales analysis to isolate the percentage of loss a residential and/or agricultural

land use property suffers due to the presence of a high voltage electric transmission line (HVTL). This study was found in an appraisal completed by Aari K. Roberts for American Transmission Corporation (ATC) on the Herbert Bolz property located in the Town of Rubicon, Dodge County, Wisconsin. Mr. Roberts compared the sale of a rural agricultural 24 acre land parcel that had an HVTL crossing the property, to three comparable agricultural land sales of comparability that did not have a HVTL. His sales comparison study concluded that the property with a HVTL suffered a 29% loss of value due to the presence of the HVTL. This study was completed in September 2007.

- A sales analysis of the property located at: N8602 CTH D, Town of Deer Creek, Outagamie County, Wisconsin. This is a single family home located on 3.19 acres in the rural area of Outagamie County. The home was a ranch style residence with 1,500sf GLA, attached 2-car garage, 8/3/2 room count, full basement and was in average condition overall. The property also had a 104ft x 52ft pole barn and two other outbuildings. There were two appraisals completed on this property, one by the condemnor (ATC) and one by the property owner. The average Before taking value of the two appraisals was $221,000. The property was then improved with a 345kV & 138kV electric transmission line having 126ft pole height and was placed along the roadside reaching 68ft into the property. The edge of the easement was in less than 20ft to the residence, however the placement of the pole was as close to the roadway right-of-way as possible. The condemnor American Transmission Company (ATC) purchased the property and installed the transmission line. Then they upgraded the property with new paint, doors, sinks, dishwasher and flooring, plus cleaned the premises and outbuildings. ATC put the property on the market asking $179,900 a number established by the appraiser for ATC as the After value. It was sold for $128,500 10 months after ATC purchased it.

  The Before taking average value was $221,000. The property was then improved and upgraded at an expense estimated to be $8,000-$10,000, then resold 10 months later with the transmission lines in place for $92,500 less or 42% less. The only differences between the Before taking market value and After taking sale price were the transmission line and time. A review of the Outagamie County market between November 2008 and September 2009 shows only a small downward trend in rural residential property value, therefore the biggest part of the loss is attributed to the presence and near proximity of the transmission line that being 38%-40%.

- *The Gene Laajala property: A Comparative Study of the Impact of a 161kV Transmission Line v. 345kV/161kV Transmission Line (Kurt C. Kielisch)*. This was a brief sales study on the impact difference, between an existing 161kV transmission line and a new 345kV/161kV transmission line on the same property. The property was a 20 acre rural agricultural and residential property that had an existing 161kV transmission line bisecting the parcel along the east side. The 161kV line had an easement width of approximately 120ft, wood H-poles at 50ft± in height. This line was replaced with an upgraded easement comprised of 345kV/161kV line which was to be placed within the existing easement, more or less, and had (2) 110ft and (3) 120ft steel H-poles. The property was appraised in January 2007 with a Before condition value of $204,500 using the Cost approach and $185,500 using the Comparable Sale approach, by Ted Morgan, MAI. (The whole property appraised was 40 acres and the 20 acre parcel was portion out of this whole). The ATC appraiser did not appraise the home in the Before condition, but did conclude the Before taking land value was $44,000 for 20 acres (using his $2,200/acre conclusion for 40 acres) and the assessed value of the improvements were $107,600, indicating a $151,600 Before

value. The property sold and closed in October 2007 for $120,000. The seller attributes the loss to the new power line, it being larger and more lines. The loss indicated was $65,500 (using Morgan's Comparable Sales value) or $31,600 (using ATC's land plus assessed improvement value), indicating a loss range of 35% to 21%.

- *An Impact Study of the Effect of High Voltage Power Lines on Rural Property Value in Southwestern Indiana (Kurt C. Kielisch, Appraisal Group One, 2010).* This study was based in southwest Indiana in Gibson County. It was focused on large agricultural land and the impact of a high voltage transmission lines (HVTL) varying in size from monopole to large steel lattice towers. The study included 32 land sales of which10 were HVTL sales. The time period was January 1st, 2006 to December 31st, 2009. Adjustments were made for time, location and other utility easements (if any) and the results were graphed to compare the non-HVTL land sales to the HVTL land sales. The study concluded that the power lines negatively impacted the property with an impact range from -5% to -36% with the average impact being -20%.

Other Value Issues

Another issue relating to the presence of the transmission line is potential for the creation of an "utility" corridor. Such a corridor is a where several utility transmission lines are placed, such as gas transmission pipelines and communication lines. Indeed, the State of Wisconsin made it a legislative rule that future placement of such utilities are to be given preference to "existing utility corridors."[2] An electric transmission line meets the definition in this statute as an existing corridor. This "corridor" concept continues to grow in the perception of the public as such rules become more commonly known. The reality of such an event happening is the placement of the Arrowhead-Weston Power line, which was often placed within an existing utility corridor such as an oil transmission pipeline, smaller electrical transmission lines or abandoned electric transmission line easements. The very power line that is the focus of this analysis is further proof of the corridor effect for it has been expanded, enlarged and added circuits within the existing easement.

Other factors to consider regarding the valuation of HVTL impacted rural properties are agricultural equipment concerns operating under and near the line, health issues of workers in close proximity of the lines, health concerns of farm animals in close proximity of the lines, stray voltage, the concerns of public in relation to electro-magnetic fields, safety issues regarding bare wires of the transmission line and other concerns addressed in the literature study to follow.

In conclusion, it can be stated with a high degree of certainty that there is a significant negative effect ranging from -10% to -30% of property value due to the presence of the high voltage electric transmission line. The actual loss depends on factors of land use, location of the power line and its size.

2 Wis. Stats 1.12(6)(a).

Literature Study

HVTL Impacts on Rural and Agricultural Properties

Throughout the nation's rural communities, literature research suggests that the presence of an HVTL easement can have a noticeable impact on both the use and appeal of rural properties and farms. Common concerns include stray voltage, health risks to livestock and cattle, diminished livelihoods and heritage, limited land use, and lessened aesthetic appeal. As the following literature survey will show, many different issues play a role in shaping one's perception of the impact of HVTLs on rural property values.

Stray Voltage

To understand the potential impact of HVTLs on rural land, it's important to discuss a key component in many farmers' apprehension about HVTLs: stray voltage.

Stray voltage is the rural equivalent of the high-profile residential Electromagnetic Field (EMF) factor, but instead of fearing leukemia or brain cancer, farmers fear their animals will become unproductive, ill, and even die.

Whenever energy is transferred, some is lost along the way. If metal buildings are near leaking energy, they can act as a conduit for voltage to find its way to feeding systems, milking systems and stalls.

In their 1995 presentation, "Stray Voltage: The Wisconsin Experience," a team of researchers led by Mark Cook and Daniel Dascho stated that farmers most worry that stray voltage will increase somatic cell count in their animals, make cows nervous, reduce milk production, and increase clinical mastitis.[3]

"Few issues are more upsetting to dairymen than fighting case after case of clinical mastitis with more and more cows in the sick pen," writes Dr. Winston Ingalls. "It represents extra time to properly handle such cows, lost production, vet calls, treatment products, concern about contaminated milk and an occasional dead or culled cow."[4]

In Cook & Dascho's presentation, they discuss their findings from a non-random sampling study of farms with stray voltage complaints stemming from a nearby substation. Their research team found no significant relationship between cow contact current and distance from the substation or contact currents. However, they also noted that cow contact current depends on many physical factors from on-farm and off-farm electrical power systems. They say, "There are many confounding factors that may outweigh the impacts of stray voltage which makes it difficult to draw conclusions from field studies about its effects on production and animal health."[5]

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3 **Stray Voltage: The Wisconsin Experience.** Written for presentation at the 1995 International Meeting by Mark A Cook, Daniel M Dascho, Richard Reines and Dr. Douglas J Reinemann.

4 **Clinical Mastitis.** Winston Ingalls, Ph.D. GoatConnection.com. August 2, 2003. http://goatconnection.com/articles/publish/article_173.shtml

5 **Stray Voltage: The Wisconsin Experience.** Written for presentation at the 1995 International Meeting by Mark A Cook, Daniel M Dascho, Richard Reines and Dr. Douglas J Reinemann.

In a 2003 study prepared for the NRAES Stray Voltage and Dairy Farms Conference, a research team conducted by the University of Wisconsin-Madison and led by Dr. Douglas J Reinemann studied the effects of stray voltage on cows at four dairy farms over a two-week time period. He and his team found that after the first few days of exposure, cows quickly acclimated to the presence of stray voltage. They also found that stray voltage of 1mA had little effect on the immune system of a cow.[6]

Concerning EMF levels, they noted that "even though man-made signals were larger than the naturally occurring currents, levels are significantly lower than what is considered sufficient earth current strength to develop step potential anywhere near the Public Service Commission 'level of concern.'"[7]

Stray voltage is usually undetectable by humans, and some researchers believe it occurs when electricity escapes a power line or wiring system and emits a secondary current. The problem intensifies with older barns that add automated electrical equipment, "raising ambient levels of current. Soon the cumulative effect of these secondary currents becomes harmful to cows." Though stray voltage can be measured, experts don't know how and why it happens or what conclusive effect (if any) it has on animals.[8]

Despite little concrete evidence, courts have compensated farmers for their losses due to stray voltage when all other factors are eliminated. In 1999 a jury awarded Peterson Bros. Dairy $700,000 after deciding that stray voltage from an automated feeding system from Maddalena's Dairy Equipment of Petaluma, California slashed the herd's milk output and increased the cow's death rate.[9]

The company's defense attorney called stray voltage "junk science," the Petersons' claim of stray voltage in the milk barn a "harebrained theory" unsupported by electrical engineers, and blamed the herd's health problems on the Petersons' own mismanagement.[10]

In a similar case in Wisconsin in 2004, a dairy operation owned by George and Kathy Muth successfully sued Wisconsin Electric Power Co. (now We Energies) for negligence in the maintenance and operation of a distribution system on their farm. They claimed that the system led to stray voltage that injured and killed several of their dairy cows and damaged their milk production. The utility said that the levels of stray voltage were "extremely low" and were levels you could find anywhere.[11]

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6 **Dairy Cow Response to the Electrical Environment: A Summary of Research conducted at the University of Wisconsin-Madison.** Paper presented at the NRAES Stray Voltage and Dairy Farms Conference. Dr. Douglas J. Reinemann. April 2003.

7 **Results of the University of Wisconsin Stray Voltage Earth-Current Measurement Experiment.** A revised version of a report submitted to the State of Wisconsin Legislature on June 25, 2003. Written by David L Alumbaugh and Dr. Louise Pellerin.

8 **Jury gives $700,000 to dairy farmers for losses blamed on "stray voltage."** Author Unknown. The Associated Press. April 21, 1999.

9 **Ibid**.

10 **Ibid**.

11 **Power company negligent in dairy suit; Jury awards $850,000 to couple over effect of stray voltage on cows.** Lauria Lynch-German. Milwaukee Journal Sentinel. February 27, 2004.

The farmers said that shortly after moving to their new location, they faced low milk production, excessive illnesses, and deaths of cows. [12] The cows didn't walk right or act normal. They didn't want to go into the barn, inside, or into the stalls. The Muths examined everything from the animals' food to their bedding until consultants told them it could be stray voltage. In one year, they lost 15-18 cows and calves. Autopsies were inconclusive.[13]

After reviewing herd management and nutrition, they hired a consultant who detected stray voltage. Later that year the utility found no stray voltage problems. The farmers further consulted with veterinarians and tested and ruled out all the other factors except for stray voltage.[14]

The farmers hired an electrician to upgrade the farm's wiring, but it didn't decrease the stray voltage. After being asked, the utility made some other changes, but this also had no effect. Further consultants still found stray voltage from a conductor on the utility's distribution lines. A couple years later the utility removed a piece of underground electrical equipment and the herd immediately recovered…though the level of stray voltage remained the same.[15]

The utility's attorney stated that being able to measure something doesn't make it harmful. He cited several federal and state studies that say the current must be 2 milliamps or higher to adversely affect cattle and said no reading on their farm reached that level.[16]

The jury awarded the dairy farm $850,000 in damages.[17]

Stray voltage fears aren't limited to dairy or cattle operations. Max Hempt, a horse farm owner in Pennsylvania, tried to oppose a proposed 9-mile 138kV HVTL because he feared that the line's EMFs caused by stray voltage could cause sterility and death among his horses.[18]

Though it's difficult to prove a significant presence of stray voltage, and even more difficult to prove a direct correlation between stray voltage and poor health, courts have awarded farmers sizable judgments to compensate them for damaging stray voltage from nearby power lines.

In 2002, one such case in Iowa made it to the state supreme court where the court upheld a $700,000 judgment to a dairy farmer who argued that stray voltage from nearby power lines injured his herd. A substation sits less than a quarter mile from his farm. He said he often got electric shocks from the metal buildings on the farm. Also, he said his herd acted oddly, appearing frightened and refusing to enter barns. Milk production also suffered.[19]

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12 **Jury must decide in voltage complaint; Farm family says stray power harmed dairy herd.** Lauria Lynch-German. Milwaukee Journal Sentinel. February 5, 2004.
13 **Dairy farm owner testifies that stray voltage killed cows in his herd.** Lauria Lynch-German. Milwaukee Journal Sentinel. February 10, 2004.
14 **Jury must decide in voltage complaint; Farm family says stray power harmed dairy herd.** Lauria Lynch-German. Milwaukee Journal Sentinel. February 5, 2004.
15 **Ibid**.
16 **Ibid**.
17 **Power company negligent in dairy suit; Jury awards $850,000 to couple over effect of stray voltage on cows.** Lauria Lynch-German. Milwaukee Journal Sentinel. February 27, 2004.
18 **Farmer Fears Stray Voltage From PP&L 138 kV Line Could Harm His Horses.** Author Unknown. Northeast Power Report. June 24, 1994.
19 **Court upholds stray voltage judgment.** Mike Glover. The Associated Press. October 10, 2002.

The defendant, Interstate Power Co., said that "there's an inherent risk to transmitting electricity" and it shouldn't be vulnerable to such lawsuits unless they were negligent. The court ruled in favor of the dairy farmer, citing the lack of a statute exempting electric utilities from nuisance claims.[20]

One year later the Wisconsin Supreme Court similarly found "that a utility can be held responsible for harming the health of a dairy herd with stray voltage even though state-recommended voltage tests did not find potentially damaging levels where the animals congregated."[21]

As the preceding case studies show, courts have acknowledged stray voltage and its possible effects. However, to fully understand the apprehension surrounding power lines, one must examine the EMF debate and its fear factor.

EMFs and Fear

In 1990, the EMF debate was so prevalent that members of Congress passed a bill that would limit the public's exposure to EMFs.[22] A couple years later, in response to public concern about EMFs, Congress established the EMF-RAPID program in 1992. Its purpose was to coordinate and execute a limited research program to fill information gaps concerning the potential health effects of exposure to EMFs, to achieve credibility with the public that previous research has not earned, and to coordinate and unify federal agencies' public messages about possible EMF effects.[23] The program originally was to receive $65 million in funding, but total funding is expected to be $46 million.[24]

Several years later in 1999, the National Institute of Environmental Health Sciences studied the health effects of EMF exposure and found conflicting results. Though they concluded that the evidence is weak linking EMFs to health risks, they also found that the most common health risk was leukemia (mostly appearing in children). They also found a fairly consistent pattern of a small, increased risk of childhood leukemia with increasing exposure. The majority of the panel's voting members voted to acknowledge EMFs as a possible human carcinogen. They concluded that ELF-EMF exposure cannot be recognized as entirely safe because of weak scientific evidence.[25]

In 2005, UK scientists conducted a case-control study on childhood cancer in relation to distance from high voltage power lines in England and Wales. They found an association between childhood leukemia and proximity of home address at birth to HVTLs. "The apparent risk extends to a greater distance than

20 **Ibid**.
21 **Utility liable for stray voltage, high court says.** Don Behm. Milwaukee Journal-Sentinel. June 26, 2003.
22 **Electric Powerlines: Health and Public Policy Implications** – Oversight Hearing before the Subcommittee on General Oversight and Investigations of the Committee on Interior and Insular Affairs House of Representatives, 101st Congress, second session on electric powerlines: health and public policy implications. March 8, 1990.
23 **Electric and Magnetic Fields Research Program** by Mr. Mukowski from the Committee on Energy and Natural Resources. 105th Congress, first session. June 12, 1997.
24 **Ibid**.
25 **NIEHS Report on Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields.** Released by the National Institute of Environmental Health Sciences on May 4, 1999.

would have been expected from previous studies" although they have yet to discover an "accepted biological mechanism" to explain their results.[26]

Though an accepted biological mechanism remains elusive, an early nineties case made it possible to link loss of property value to a fear of EMFs. In the 1993 case, *Criscuola v. Power Authority of the State of New York*, the court found that, "there should be no requirement that the claimant must establish the reasonableness of a fear or perception of danger or of health risks from exposure to high voltage power lines" and "Whether the danger is a scientifically genuine or verifiable fact should be irrelevant to the central issue of its market value impact."[27]

Utilities say that landowners should not be able to recover damages or injunctive relief "based on myth, superstition or fear about an alleged health risk that is not supported by substantial scientific or medical evidence."[28]

With the EMF debate unresolved, and evidence for both sides of the argument, some communities are reluctant to approve new HVTLs…and may even legally oppose them.

In an effort to preempt public opposition, Public Service Enterprise Group offered hundreds of thousands of dollars to New Jersey towns opposing its proposed HVTL project if the towns dropped all opposition and didn't comment on the payments. Opponents called them "bribes." The utility called them "settlements" to help minimize impacts of the project on towns and residents.[29]

Some towns accepted payment, but the majority did not. Either they said they didn't have enough time to respond to the offer, or they rejected them as payoffs. One of the opposing mayors, Mayor James Sandham of Montville, said it's not about the money; "It's about safety and property values."[30]

HVTLs and Property Values

Fear can impact the public's buying habits. Residential homeowners' resistance to abutting HVTLs is well documented. Though homeowners may fear negative effects on their community and environment,[31] their first point of opposition is usually safety, especially if there are many children in the neighborhood. Though the 1979 Wertheimer study linking EMFs to childhood leukemia has long been contested, supported, and contested again, the very existence of a debate about the safety of EMFs sows enough doubt in residents' minds to justify the fear.[32] And that fear can influence the values of nearby homes.[33] [34] [35] [36]

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26 **Childhood cancer in relation to distance from high voltage power lines in England and Wales: a case-control study.** Gerald Draper, Tim Vincent, Mary E Kroll, John Swanson. British Medical Journal (bmj.com). June 3, 2005.
27 **'Criscuola' – The Sparks Are Still Flying.** Michael Rikon. New York Law Journal. April 24, 1996.
28 **High Court Hears Arguments Today on EMF Claims.** Todd Woody. The Recorder. June 6, 1996.
29 **Opponents of $750M N.J. power line project argue towns were paid to drop opposition.** Lawrence Ragonese. The Star-Ledger. January 31, 2010.
30 **Ibid**.
31 **NY Power Line Opponents Win Court Fight.** Associated Press. New York Post. February 20, 2009.
32 **Lines in Sand and Sky.** B.Z. Khasru. Fairfield County Business Journal. September 3, 2001. Vol. 40 Issue 36, p3, 2p.
33 **Power line plan concerns metro residents.** Melissa Maynarich. News 9 (Oklahoma). July 22, 2008.

When given the choice to purchase two identical homes, one with such health concerns and the other without, most buyers will choose the home without the concern,[37] forcing the homeowner to lower their price. Aesthetic impact can also influence a property's value. Many residents don't want to look at HVTLs,[38] something they consider to be an "eyesore."[39]

One of the hardest properties to sell can be one encumbered by an HVTL. Unlike roadway proximity, its effect isn't readily noticeable or measurable. Though homes near HVTLs typically have larger lots (and that can be a benefit), the biggest disadvantage is the fear factor surrounding EMFs.[40]

In the early nineties, when EMFs were just entering the public consciousness, it was difficult to find a measurable price difference between homes close to an HVTL and those that were not.[41] However, two researchers (Hsiang-te Kung & Charles F Seagle) conducted a case study on the impact of power transmission lines on property values and found that such negligible results depended almost entirely on the public's ignorance of EMFs and their related issues. They also found that the amount of potential property loss increased dramatically the more homeowners were aware of the potential health impacts of EMFs.[42]

The effect of HVTLs on property values has long been a matter of contention with many studies either proving a diminutive effect or none at all. Methodologies differ and different areas of the country register different results. Some markets (ex. high-end homes) are very sensitive to HVTLs whereas others (ex. low-end homes) hardly notice them. The size of the line and the pylons are also a factor. A 69kV power line will have less effect than will a 1,200kV power line. Distance from the easement also matters. Some studies combine homes thousands of feet from HVTLs with those directly encumbered. Research sponsors also may play a factor with many being funded by the utilities themselves.

For example, in a 2007 study funded by a utility, researchers Jennifer Pitts and Thomas Jackson conducted market interviews, literature research and empirical research and reported little (if any) impact of power lines on property values. However, they did note that there is an increasing recent opinion that proximity to power lines has a slight negative effect on property values.[43]

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34 **Power Line Worries Landowners**. Ben Fischer. The Wisconsin State Journal. June 3, 2006.
35 **Lines in Sand and Sky.** B.Z. Khasru. Fairfield County Business Journal. September 3, 2001. Vol. 40 Issue 36, p3, 2p.
36 **Commissioners voice opposition to transmission lines.** David Rupkalvis. The Graham Leader. February 9, 2010.
37 **Real Estate Agents on Property Value Declines.** 4 Realtor opinion letters submitted to residents in the Sunfish, MN area whose properties are being affected by an HVTL.
38 **Ibid**.
39 **Power line plan concerns metro residents.** Melissa Maynarich. News 9 (Oklahoma). July 22, 2008.
40 **High Voltage Transmission Lines, Electric and Magnetic Fields (EMF's) And How They Affect Real Estate Prices.** David Blockhus. January 3rd, 2008. http://siliconvalleyrealestateinfo.com/electric-and-magnetic-fields-emfs-and-how-they-effect-real-estate-prices.html
41 **Impact of power transmission lines on property values: A case study.** Hsiang-te Kung & Charles F Seagle. Appraisal Journal. Vol. 60, Issue 3, p.413, 6p. July 1992.
42 **Ibid**.
43 **Power lines and property values revisited.** Jennifer M. Pitts & Thomas O. Jackson. Appraisal Journal. Fall, 2007.

Two California appraisers, David Harding and Arthur Gimmy, published a rebuttal to the Pitts-Jackson study that disagreed with their methodology, took issue with their sponsor, addressed omitted information, and failure to conduct before-and-after cost comparisons.[44]

Pitts and Jackson responded to the rebuttal and defended their methodology, saying they purposely limited their literature research to only include empirical, peer-reviewed articles from The Appraisal Journal and the American Real Estate Society journals. They acknowledged they conducted the research for "a litigation matter" but did not elaborate on their sponsor.[45]

In a similar case, researchers James A Chalmers and Frank A Voorvaart published a large study spanning nearly 10 years and over 1,200 properties in which they found that an encumbering HVTL had only a small negative effect on the sale price of a residential home. In half of their samples they found consistent negative property values mostly limited to less than 10%, with most between 3%-6%.[46]

They summarized their findings as showing "no evidence of systematic effects of either proximity or visibility of 345-kV (kilovolt) transmission lines on residential real estate values."[47]

They did, however, say that "An opinion supporting HVTLs effects would have to be based on market data particular to the situation in question and could not be presumed or based on casual, anecdotal observation. It is fair to presume that the direction of the effect would in most circumstances be negative, but the existence of a measureable effect and the magnitude of such an effect can only be determined by empirical analysis of actual market transactions."[48]

Appraiser Kerry M. Jorgensen disagreed with the authors' views that paired data analysis and retroactive appraisal were "too unrefined and too subjective to be of much value," and that only through objective statistics could the effect of HVTLs on property value be truly understood. He argued that relying too much on statistics can be dangerous as there could be problems with how the data is compiled and interpreted. For example, he points out that out of their set of 1,286 qualifying sales, only 78 (6%) are directly encumbered by a power line easement, and only 33 (2.6%) more are within 246 feet of a power line easement.[49]

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44 **Comments on "Property Lines and Property Values Revisited."(Letter to the editor)** David M. Harding & Arthur E. Gimmy & Thomas O. Jackson & Jennifer M. Pitts. Appraisal Journal. Winter, 2008. http://www.entrepreneur.com/tradejournals/article/176131510.html

45 **Ibid.**

46 **High-Voltage Transmission Lines: Proximity, Visibility, and Encumbrance Effects.** James A Chalmers and Frank A Voorvaart. The Appraisal Journal via the Appraisal Institute website. Volume 77, Issue 3; Summer, 2009; pages 227-246. Reposted by CostBenefit of the Environmental Valuation and Cost-Benefit News blog - http://www.envirovaluation.org/index.php/2009/11/09/high-voltage-transmission-lines-proximity-visibility-and-encumbrance-effects

47 **Power Lines Don't Affect Property Values. The Appraisal Journal**. July 30, 2009. http://www.appraisalinstitute.org/about/news/2009/073009_TAJ.aspx

48 **High-Voltage Transmission Lines: Proximity, Visibility, and Encumbrance Effects.** James A. Chalmers, PhD and Frank A. Voorvaart, PhD. The Appraisal Journal. Summer 2009. Pgs. 227-245.

49 **Letters to the Editor**. Kerry M. Jorgensen. Appraisal Journal. January 1, 2010. http://www.thefreelibrary.com/Comments+on+"high-voltage+transmission+lines:+proximity,+visibility,...-a0220765052

The Chalmers-Voorvaart study also attracted the interest of Washington Post Real Estate writer Elizabeth Razzi who wrote that the study was paid for by Northeast Utilities and completed before they proposed a high-voltage transmission grid in New England. She also wrote that both Chalmers and Voorvaart are appraisers and expert witnesses for the power industry.[50]

Several studies have found that, over time, property value damages from nearby HVTLs diminish though properties near the pylons stay permanently damaged no matter the elapsed time.[51] In the first case, though the property owner may grow accustomed to HVTLs and thus think less of them, new potential buyers aren't as sensitized and the diminutive impact is fresh to them.

Realtors usually oppose HVTLs. Nearly all surveyed realtors and appraisers in the Roanoke and New River valleys of Virginia said that close proximity to HVTLs would diminish property values by as much as $25,000, but mostly for high-end homes. Lower-end homes see little impact.[52]

Diminished property values can also impact communities. In one case, Delaware residents were worried that a proposed 1,200 megawatt HVTL would depress local property values, thus weakening the local tax base and leading to higher taxes to offset the losses. Kent Sick, author of a 1999 paper on power lines and property values, projects losses from a few percentage points to 53%.[53]

In Atlanta, a local realty group named Bankston Realty ranked power lines as the number one item that damages resale value, followed closely by busy roads and inferior lot topography. They advise buyers to pay 15% less of the asking price if power lines are present, and they advise sellers to accept it as a logical perception of value.[54]

Evidence suggests that HVTLs affect the health of residents in close proximity to lines 345kV and higher. Evidence also suggests that the power lines have little to no impact on property values because encumbered lots are often larger and more private than unencumbered lots, resulting in no diminution of purchase price. However, most studies did observe longer time on the market for encumbered properties.[55]

Rural Impact

Now that the reader is aware of stray voltage, EMFs, and property values, the reader will have a deeper understanding of the potential effects of HVTLs on rural land throughout the United States.

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50 **Do High-Voltage Lines Zap Property Values?** Elizabeth Rassi. Local Address. August 4, 2009. http://voices.washingtonpost.com/local-address/2009/08/do_high-voltage_lines_zap_prop.html

51 **The Effect of Public Perception on Residential Property Values in Close Proximity to Electricity Distribution Equipment.** Sally Sims, B.Sc. Paper presented to the Ph.D. Forum at the Pacific Rim Real Estate Society Conference. January 2002. This is the first part to the study.

52 A Question of Power: Part III – Realtors: High voltage lines lower property values. Leslie Brown. Roanoke Times. 1998. http://www.vapropertyrights.org/articles/98lineslowervalues.html

53 **Expert: Power lines hurt property value, market research shows sellers lose up to 53 percent.** Elizabeth Cooper. Gannett News Service. May 20th, 2006.

54 **Atlanta Homes and Resale Value… Power lines are a definite NO.** The Bankston Group. July 17, 2008. http://atlantaintheknow.com/2008/07/17/atlanta-homes-and-resale-value-power-lines-are-a-definite-no/

55 **High Voltage Power Lines Impact On Nearby Property Values.** Ben Beasley. Right of Way Magazine. February 1991.

In Goodhue County, Minnesota, an area locally known for protecting agriculture, CapX2020 (a utility consortium) is proposing to build a 345kV HVTL through the county that may be doubled to 690kV. Local landowner Linda Grovender voiced her concern in a 2010 letter to the editor of the Cannon Falls Beacon. She worries that the line, proposed to traverse residential and agricultural lands instead of following existing utility right-of-way, will have an adverse effect on her family's health (due to EMFs), jeopardize agricultural interests, result in lost agricultural productivity, and damage property values.[56] She wrote that if the proposed 345kV HVTL is doubled to 690kV (as it legally could be) it could have an adverse effect on her family's health, jeopardize agricultural interests, result in lost agricultural productivity, and damage property values.[57]

Elsewhere n Minnesota, Dairyland Power Cooperative (one of the chief members of CapX2020) surveyed rural landowners for their opinion regarding the proposed HVTL in their area. Whether they were crop or dairy farmers, each had several reasons why the proposed line would impact their business. The unnamed respondents shared Grovender's views and said they prefer to use highway corridors and woodlands to avoid impacts to productive agricultural land; protect livestock; avoid interference with large farm equipment, GPS, and navigation systems used in farm machinery; preserve open channels for crop-dusting; protect farm buildings; protect pasture land, tree farms, and timber production.[58]

The Dairyland survey also found that livestock operations are concerned that the HVTL will generate stray voltage, impacting livestock and feedlots. Cattle, horses, and other livestock will not go near transmission lines due to stray voltage. And stray voltage can impact the health of beef cattle and hogs. Farmers also fear potential impacts on dairy operations, poultry, livestock mortality, horse boarding facilities, and herd reproduction. [59]

HVTLs also pose potential technological obstacles. For example, The GPS equipment used in the farm equipment may not be able to steer around transmission poles, potentially making farming around the towers extremely difficult. [60]

One major concern was the routing the HVTLs through the middle of properties or fields. The surveyed farmers quoted many repercussions for bisecting a property. They include: Interrupted irrigation and tile drainage equipment and practices; decreased food production; fragmented existing cropland and dairy operations; diminished lease value: the addition of transmission lines would make it difficult to lease farm land for the top rental price; compacted soil from construction of the HVTLs and access roads: it would take 3–5 years to restore.[61]

Across the border in Wisconsin, the state's Department of Agriculture validated many of the Minnesota respondents' concerns when it found that HVTL construction could compact soil, making it difficult to

56 **No CAPX2020.** Letter to the Editor by Linda Grovender. The Cannon Falls Beacon. March 23, 2010.
57 **Ibid**.
58 **SE Twin Cities-Rochester-La Crosse Transmission System Improvement Project Macro-Corridor Study, Appendix A: Summary of Public Comments regarding a proposed HVTL.** Dairyland Farm Cooperative. September 2007.
59 **SE Twin Cities-Rochester-La Crosse Transmission System Improvement Project Macro-Corridor Study, Appendix A: Summary of Public Comments regarding a proposed HVTL.** Dairyland Farm Cooperative. September 2007.
60 **Ibid.**
61 **Ibid**.

plow and plant those areas, naturally resulting in reduced crop yields. The HVTLs force farmers to change planting patterns to avoid support structures. Since farm land is only as valuable as its ability to yield good crops, rural property values suffer from the limitations and effects of HVTLs on their land.[62]

Potential compaction, forced building changes, and lower property values equally threaten dairy operations as much as agricultural farmers. Susan and Robert Herckendorf, dairy farmers in the path of the proposed A-W HVTL, are worried that the line could put local dairies out of business.[63]

In researching the possible negative factors of the then-proposed Arrowhead-Weston HVTL in Wisconsin in 2000, the state's Public Service Commission found that rural property values may decrease from "concern or fear of possible health effects from electric or magnetic fields; The potential noise and visual unattractiveness of the transmission line; Potential interference with farming operations or foreclosure of present or future land uses."[64] They also found that the value of agricultural property will likely decrease if the pylons inhibit farm operations."[65] However, they also found that adverse effects appear to diminish over time.[66]

The impact report further states that, on farmland, HVTL installation can remove land from production, interfere with operation of equipment, create safety hazards, and deprive landowners the opportunity to consolidate farmlands or develop the land for another use. The greatest impact on farm property values is likely to occur on intensively managed agricultural lands.[67]

Nearly a decade later in 2009, the Wisconsin Public Service Commission conducted another study on the environmental impacts of transmission lines and found that "in agricultural areas, the number of poles crossing a field may be the most significant measure of impact," and "agricultural values are likely to decrease if the transmission line poles are in a location that inhibits farm operations."[68] Beyond the impact of pole placement, the PSC found that "the overall aesthetic effect of a transmission line is likely to be negative to most people, especially where proposed lines would cross natural landscapes. The tall steel or wide 'H-frame' structures may seem out of proportion and not compatible with agricultural landscapes or wetlands."[69] They further explained that "Transmission lines can affect farm operations and increase costs for the farm operator. Potential impacts depend on the transmission line design and the type of farming. Transmission lines can affect field operations, irrigation, aerial spraying, wind breaks, and future land development."[70]

The study further examines how rural HVTL pole placements can affect agricultural land values: They can create problems for turning field machinery and maintaining efficient fieldwork patterns; expose

62 **Line could affect farms, property values.** Author Unknown. Oshkosh Northwestern. June 26, 2000.
63 **Ibid**.
64 **Property Values (pages 212-215) from Final Environmental Impact Statement, Arrowhead-Weston Electric Transmission Line Project, Volume 1.** Public Service Commission of Wisconsin. Docket 05-CE-113. Date issued, October 2000.
65 **Ibid**..
66 **Ibid**.
67 **Property Values (pages 212-215) from Final Environmental Impact Statement, Arrowhead-Weston Electric Transmission Line Project, Volume 1.** Public Service Commission of Wisconsin. Docket 05-CE-113. Date issued, October 2000.
68 **Environmental Impacts of Transmission Lines.** Public Service Commission of Wisconsin. March 2009.
69 **Ibid**.
70 **Ibid**.

properties to weed encroachment; compact soils and damage drain tiles; result in safety hazards due to pole and guy wire placement; hinder or prevent aerial activities by planes or helicopters; interfere with moving irrigation equipment; hinder future consolidation of farm fields or subdividing land for residential development.[71]

To oppose these potentially diminutive effects on their land, landowners sometimes organize against them. In Ohio, a group of concerned citizens formed the group, Citizens Advocating Responsible Energy (CARE), to oppose FirstEnergy's proposed Geauga County power line. On their website they state the reasons for their opposition. They fear the HVTL will devalue the properties it crosses, force affected property owners to continue paying taxes on damaged property, damage natural beauty and local ecology, lessen agricultural productivity of impacted land, thus reducing farm income and local purchasing power, and create a thorough-fare for snowmobiles and off-road vehicles.[72]

Other times, concerned landowners are united in voice, but not in form. In 2010, Idaho property owners in Bonneville County are nervously following the progress of Idaho Falls Power's proposed 161kV HVTL that would pass close to their homes.[73]

Lynn Pack, a Bonneville County dairy farmer, has educated himself on HVTLs and said he's most concerned with stray voltage. "It causes so many problems with cow's production. They won't feed, they won't drink water, they dry up and when they dry up they just don't give any milk." [74] Another property owner, Sharon Nixon, fears the HVTL could harm her husband's health after his recent victory over bone cancer. She also fears the value of her home will fall. "It is not something we want in our backyard. We worked all our lives. This is our dream home." [75]

Idaho Falls Power General Manager Jackie Flowers said the HVTL is a necessary step to meet new federal energy reliability standards and that the utility is open to the public's input. [76]

A year earlier in Idaho, a coalition of Rockland County farmers tried to convince Idaho Power Company to avoid routing a new HVTL through their land, citing environmental and development concerns.[77] Doug Dokter, Idaho Power project leader, said the new lines are required because the existing lines are at their capacity.[78] Because of their concerns, utility representatives say they're looking at other options and hope for a compromise to avoid invoking eminent domain to take the land. [79]

Sometimes opposition to a proposed HVTL route can alter its course. In 1994, Public Service Company of New Mexico abandoned plans to take new right-of-way through the Jemez Mountains for a 50-mile long HVTL extension that Indian groups and environmentalists argued would cut through several miles

71 **Ibid**.
72 **We oppose FirstEnergy's proposed Geauga County power line.** Website posting by Citizens Advocating Responsible Energy (CARE). Date unknown but website copyright suggests sometime from 2008-2009.
73 **Transmission Lines Worry Property Owners.** Brett Crandall. Local News 8. March 5, 2010.
74 **Ibid**.
75 **Ibid**.
76 **Ibid**.
77 **Headway being made on proposed route for power transmission line.** Author Unknown. The Power County Press and Aberdeen Times. April 8, 2009.
78 **Ibid**.
79 **Ibid**.

of pristine vistas and Native American ruins.[80] The utility instead re-routed the extension to follow an existing utility corridor, bringing the decade-long dispute to a close.[81]

In 2008, California farmers and ranchers found themselves in a similar situation. San Diego Gas & Electric proposed a 150-mile long, 500kV HVTL (in conjunction with several 230kV HVTLs) across San Diego and surrounding counties to meet increasing energy needs and transport required renewable energy.[82]

Affected landowners are worried the line will have "huge" impacts on their properties. Katie Moretti, an affected cattle rancher, and other farmers worry that building construction access roads across untouched land will limit their land's future use. She also worries that the utility won't compensate her for the loss of use.[83]

Another rancher, Glen Drown, also worries about the impact the line will have on land-use and property values since the proposed route bisects several of his parcels subdivided for future development.[84]

Local dairy producer, Richard Van Leeuwen, is worried that stray voltage from the line would damage the health of his calves and milking cows. To protect his herd's health he said he would have to relocate the calf farm to another part of his property, costing millions.[85]

San Diego County Farm Bureau Executive Director Eric Larson acknowledges that the farming community won't be able to stop the project, but he's trying to make it compatible with the area's farming interests by recommending burying the line underground in some areas, going around some areas, and utilizing existing right-of-way.[86]

Elsewhere in the state, the City of Brentwood researched the potential impact of HVTLs on agricultural land values by interviewing several of their local and experienced Real Estate brokers. All the brokers said that "Agricultural land with power lines above ground is worth less than properties with below-ground utilities."[87]

However, in a 2007 report, the California Department of Conservation's Farmland Mapping and Monitoring Program reported that HVTLs installed on agricultural land for a wind farm will result in a temporary disturbance of 10 acres of farmland and permanently affect 1 acre. Since the affected areas are mainly grazing land, the report concluded that the HVTL would not significantly impair productivity. Though the impact to agricultural productivity during construction would be negative, they claimed it would be mostly insignificant.[88]

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80 **PNM Scraps Jemez Power Line Plan.** Keith Easthouse. Sante Fe New Mexican. December 16, 1994.
81 **Ibid**.
82 **Proposed power line would impact farms.** Christine Souza. California Farm Bureau Federation. May 28, 2008.
83 **Proposed power line would impact farms.** Christine Souza. California Farm Bureau Federation. May 28, 2008.
84 **Ibid**.
85 **Ibid**.
86 **Ibid.**
87 **City of Brentwood, California.** Website page explaining their approaches to valuing agricultural land. Date and author unknown.
88 **3.3 Agricultural Resources.** Part of the public draft by The California Department of Conservation's Farmland Mapping and Monitoring Program. July 2007.

Across the country in Leesburg, Virginia, 26 landowners opposed Dominion Energy's proposed 230kV HVTL, saying it will damage their property values, thus decreasing their tax base and thus affect the county as a whole. They also fear its impact on Blue Ridge tourism.[89]

Bill Hatch, owner of a 400-acre farm was upset to learn the line would run through his farm. He said the proposed line would so affect his farm that he could only afford to keep it by direct marketing or agro-tourism, but he admitted that few people would want to visit a farm with power lines.[90]

Landowners want the utility to bury the lines, but the utility says it will cost 10 times more than traditional overhead lines. However, Harry Orton, an underground power line expert, testified that while the initial costs of burying the lines are higher, the lower cost of maintenance over the years evens the cost along the lines' lifecycle.[91]

A year later in 2006, Dominion proposed an additional 500kV HVTL to meet growing demand and routed it through northern Virginia because it was the most efficient route. However, the area is also one of the state's most pristine, and the proposal met with fierce resistance from landowners, environmentalists, Congressman Frank Wolf, and actor Robert Duvall.[92]

In the path of the HVTL are landowners of some of the most valuable land in Virginia, and they were bothered that the utility plans to erect the 40-mile, 15-story HVTL in their back yards.[93]

One landowner, Cameron Eaton, fears the line will bring financial ruin and "sink" her investment into her 100-acre Fauquier County property and horse business. "No one will buy that land if some ugly power line could run right over their house. I'm broken off at the knees."[94]

Real estate agents consider the area's picturesque countryside to be its most valuable quality. Matt Sheedy, a land developer and president of Virginians for Sensible Energy Policy, said that the very proposal that the line will soon dominate the countryside has already "sent land values plummeting." Brokers confirmed that the market froze. People backed out of real estate contracts, unwilling to live anywhere under the line. Sheedy's groups estimated that land immediately affected could lose as much as 75% of its value.[95]

"When you're out in the country and you're selling property, what you're selling is the open space and the bucolic views and the history," Sheedy said. "Running power lines through an area like this is just devastating." To landowners Gene and Deborah Bedell, who were trying to sell their 223-acre farm to pay for their retirement, it was a hard blow. Their agent old them no one would buy their property if they knew "that it could have a power line looming over it."[96]

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89 **Committee Hears Debate Over Underground, Overhead Power Lines.** Megan Kuhn. Leesburg Today. May 20, 2005.
90 **Ibid.**
91 **Committee Hears Debate Over Underground, Overhead Power Lines.** Megan Kuhn. Leesburg Today. May 20, 2005.
92 **Landowners Fear Ruin from Power Line Route.** Sandhya Somashekhar. Washington Post Staff Writer. December 11, 2006.
93 **Ibid.**
94 **Ibid.**
95 **Ibid.**
96 **Ibid.**

Further north in New York, over 50 landowners and local officials spoke before the state's Public Service Commission in opposition to Upstate NY Power Corp's proposed construction of a 230kV HVTL in their community.[97]

Sharon B. Rossiter, co-owner of Doubledale Farms in Ellisburg, said the HVTL will damage their crop cycle, remove 100 acres from use, and make planting difficult by having to navigate around the poles. Also worried is Roberta F. French, owner of Farnham Farms in Sandy Creek. The proposed line will bisect her blueberry farm, eliminating two-thirds of it.[98]

Jay M. Matteson, Jefferson County agricultural coordinator, advocated routing the HVTL through public land to avoid damaging productive, private land. "The burden should be on New York state and the developer to prove to local landowners why their land is less valuable than public land," he said.[99]

The Town of Henderson opposed it because the town's foundation is tourism and agriculture, and the community is "very concerned about the visual impacts of this project."[100]

Robert E. Ashodian, chairman of the Henderson Harbor Area Chamber of Commerce's Economic Development Committee, agreed. "The scenic resources of the community and the natural resources are at the heart of the value of the community."[101]

In an effort to appease worried or angry landowners, agricultural property owners in Montana with HVTLs encumbering their land will be exempt from paying taxes on land within 600 feet on either side of the HVTL Right-of-Way.[102]

In the 2002 study, "The Impact of Transmission Lines on Property Values: Coming to Terms with Stigma," authors Peter Elliott and David Wadley cite a 1978 Canadian study that, according to one commentary, found "the per acre values from more than 1,000 agricultural property sales in Eastern Canada were 16-29% lower for properties with easements for transmission lines than for similar properties without easements." The impact was greater on smaller properties. The 1978 study found little difference in impact from 230kV or 500kV HVTLs. The study also found that the impacts didn't seem influenced by time.[103]

Three more Canadian studies on the impact of HVTLs on agricultural land values found different results.[104] Brown 1976 studied the effect of low-voltage power lines on agricultural land in Saskatchewan and found no measurable impact on property values. The Woods Gordon 1981 study focused on the effects of 230kV to 500kV HVTLs on Ontario farmland and found some areas had an average of a 16.9% negative impact, two areas had a positive effect, and others showed no statistically

97 **Transmission line gets no support.** Nancy Madsen. Watertown Daily Times. November 17, 2009.
98 **Transmission line gets no support.** Nancy Madsen. Watertown Daily Times. November 17, 2009.
99 **Ibid.**
100 **Ibid.**
101 **Ibid.**
102 **Tax facts on proposed power line.** The Montana Standard Staff. The Montana Standard. July 11, 2009.
103 **The Impact of Transmission Lines on Property Values: Coming to Terms with Stigma.** Peter Elliott & David Wadley. Property Management, pgs.137-152. 2002.
104 **The Effects of Overhead Transmission Lines On Property Values: A Review And Analysis Of The Literature.** Edison Electric Institute Siting & Environmental Planning Task Force. 1992.

significant effect. The third study, a master's thesis referred to as Thompson 1982 found sales prices lower for properties crossed by HVTLs but only where the land has potential for irrigation.(pgs. 56-57)[105]

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105 **Ibid.**