

## **Underground vs. Overhead**

### **Executive Summary**

The primary source of data is an EEI publication in July 2006, “Out of Sight, Out of Mind?” It studies the costs and benefits of undergrounding and overhead power lines. Information from other industry sources is also incorporated into the following Drawbacks/Benefits table.

In general, the costs of undergrounding far outweigh its benefits. In a research conducted by the Virginia commission, the benefits can only justify 38 percent of total costs. A more comprehensive analysis completed by Australia estimates that the benefits will offset only about 11 percent of the costs. Consequently, a comprehensive effort to underground electric distribution systems is concluded as “unreasonable”.

Undergrounding is extremely costly to utilities, especially when saving potentials are uncertain. Although some utilities initiate or participate in special programs to help customers on the funding of the construction cost, many utilities maintain overhead is still a better solution. For example, of Dominion’s 6,100 miles of transmission lines, less than 50 miles are underground. The following table compares the pros and cons of placing power lines underground in three major areas – monetary, reliability, and environmental.

Drawbacks	Benefits
<p><b>Monetary Concerns</b></p> <p>Underground power lines reduce utilities' operating cost to some extent. But they impose a much more significant cost to build and maintain. Although residential customers are willing to pay an incremental cost to have their power lines placed underground, there is a large gap between the public's perception of what undergrounding should cost and what it actually costs. When faced with the real costs of undergrounding, it appears many individuals would rather keep their overhead services.</p>	
<ul style="list-style-type: none"> <li>▪ Much more expensive to construct               <ul style="list-style-type: none"> <li>- \$1 million per mile on average, more than 10 times the cost of a new overhead pipeline</li> <li>- Require rate increases ranging from 80-125 percent</li> <li>- A statewide undergrounding initiative demands \$10,000-27,000 per customer</li> </ul> </li> </ul>	
<ul style="list-style-type: none"> <li>▪ Much more expensive to maintain               <ul style="list-style-type: none"> <li>- In urban areas, underground lines are 4 times more costly to maintain than overhead ones</li> </ul> </li> </ul>	
<ul style="list-style-type: none"> <li>▪ There is a big gap between the public's perception of what undergrounding should cost and what it actually costs.               <ul style="list-style-type: none"> <li>- A Virginia survey finds out that survey participants were only willing to pay on average about \$258 per year for statewide undergrounding, while the actual cost is estimated to be \$3,600 annually. The participants were also prepared to pay another \$400 in total to connect their homes to the underground system. But Virginia Power estimated the actual cost is approximately \$4,270</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▪ More individual customers are willing to pay more for underground lines</li> </ul>

Drawbacks	Benefits
	<ul style="list-style-type: none"> <li>▪ Alternative ways to pay for undergrounding               <ul style="list-style-type: none"> <li>- Cost shared between customers and utilities (FPL)</li> <li>- Cost shared between municipality and utilities (Progress Energy)</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>▪ Mixed results of reduction on O&amp;M cost per mile</li> </ul>	<ul style="list-style-type: none"> <li>▪ Reduce storm damages               <ul style="list-style-type: none"> <li>- A Virginia study shows \$54 million potential savings per year</li> </ul> </li> <li>▪ Reduce tree trimming cost               <ul style="list-style-type: none"> <li>- \$50 million savings annually for Virginia</li> </ul> </li> </ul>
<p><b>Reliability Concerns</b></p> <p>According Duke Power, “underground distribution lines will improve the potential for reduced outage interruption during normal weather and limit the extent of damage to the electrical distribution system from severe weather-related storms. However, once an interruption has occurred, underground outages normally take significantly longer to repair than a similar overhead outage.” Other problems include the limited service life for the expensive underground power lines and difficulty in inspection and maintenance.</p>	
<ul style="list-style-type: none"> <li>▪ Underground lines are not immune to storm-related outages. When they happen, the duration of outages tends to be much longer               <ul style="list-style-type: none"> <li>- Repairs to overhead lines usually can be completed within 24 hours while underground lines require 1.6-2.5 times of time</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▪ Frequency of outages for underground systems is substantially less than that for overhead systems, or approximately 20-50 percent of that for overhead</li> </ul>
<ul style="list-style-type: none"> <li>▪ Shorter service life of underground lines               <ul style="list-style-type: none"> <li>- Pepco found 40-year-old overhead lines are more reliable than 20-year-old underground lines</li> <li>- Failure rates of underground cables increase significantly after 15 to 20 years and reaching end of life after 25-35 years</li> <li>- Transformers placed underground can have their services lives cut in half because the need to circulate air around them also makes them more</li> </ul> </li> </ul>	

Drawbacks	Benefits
<ul style="list-style-type: none"> <li>- vulnerable to rusting</li> <li>- Water and moisture infiltration can cause significant failures in underground systems when they flooded, as often happens in hurricanes</li> </ul>	
<ul style="list-style-type: none"> <li>▪ Difficult to inspect and repair malfunctions               <ul style="list-style-type: none"> <li>- Visual inspection is impossible</li> <li>- Hard to locate and repair fault</li> <li>- Require specialized equipment and crews</li> <li>- In the event of a failure, significant evacuation is usually required for cable repair</li> </ul> </li> </ul>	
<p><b>Environmental Concerns</b></p> <p>Aesthetic benefit is one of the most commonly cited benefits of undergrounding. Removal of unsightly poles and wires may also drive up value of the adjacent properties. However, such benefits are virtually impossible to quantify and accompanied with other environmental disturbances.</p>	
<ul style="list-style-type: none"> <li>▪ Community and government decision makers struggle to determine who should pay for the benefits of the improved aesthetics, which is virtually impossible to quantify based on standard economic criteria</li> </ul>	<ul style="list-style-type: none"> <li>▪ Improved aesthetics               <ul style="list-style-type: none"> <li>- Residential customer put a real and substantial value to underground power lines</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>▪ Environmental disturbance               <ul style="list-style-type: none"> <li>- Placing a line underground result in soil disruption and changes in thermal temperature, two factors that may negatively affect threatened and endangered or sensitive species</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▪ Safety to citizens and workers               <ul style="list-style-type: none"> <li>- In France zero death involves underground facilities as contrast to 19 deaths for overhead facilities in 2000</li> </ul> </li> </ul>