



## **Underground vs. Overhead Transmission Lines**

A common question asked by the public during the siting of transmission lines is:

### **Can the lines be buried?**

While it is common for the lower voltage distribution lines to be buried (lines less than 69,000 volts), it is very rare that we would propose to build a transmission line underground. Placing transmission lines underground is a practice generally used only when there is no viable overhead corridor.

There are several factors that affect the decision to place transmission lines underground:

- Cost
- Outages and operational issues
- Environmental impacts

### **Cost**

The materials and construction methods required for underground transmission lines lead to more costly projects. Generally, burying transmission lines cost 10 times more than the cost to build overhead transmission lines.

Because the costs associated with new and existing transmission lines are passed along to retail electric customers in their monthly electric bill, various state commissions that regulate Xcel Energy's operating companies determine during their review of projects whether it is prudent to place part or all of a transmission lines project underground.

In some instances, transmission lines have been placed underground where there is an entity, such as a city or a developer, willing to pay the additional cost to bury a line.

In either case, specific construction measures are necessary for safe and reliable operation of the line.

### **Outages and operational issues**

Underground lines are less subject to intermittent outages from lightning strikes than overhead lines. However, when an underground transmission line fails or is damaged, the time required to locate and repair the facility can be weeks or months, while overhead transmission lines can be repaired in hours or days.

This is largely due to the fact that underground lines are contained in a cable vault or duct.

When a fault occurs, that energy also is contained and will cause damage to the vault or duct. With overhead lines, the energy is dissipated into open space around the conductor, minimizing the amount of damage.

Locating and accessing underground damage also is an issue. While a broken conductor or damaged insulator should be plainly visible on an overhead line, it will not be apparent on the underground circuit. Special equipment must be used to determine the exact location of the cable fault. Then that section needs to be accessed, possibly requiring excavation of the duct bank or cable vault. Underground repairs also can be more complicated, sometimes requiring splices to be installed, which takes more time than pulling and replacing a failed cable.

From an operational perspective, all electric lines produce heat and therefore have a limit on the amount of power they can carry to prevent overheating. Underground lines cannot dissipate heat as well as overhead lines. So, it would be rare that the company would agree to bury major transmission lines on its system, such as our 345 kV and 500 kV lines, because of this limitation and potential operational issues that could affect the overall reliability of our system.

### **Environmental impacts**

While there is some belief that placing transmission lines underground and out of sight is better for the environment, underground transmission lines can't be simply plowed into the ground. They need to be encased in conduits, which are usually built with concrete.

That requires large trenches and bores along the entire route of the line, which is invasive and disruptive – especially when there are wetlands and streams that need to be crossed.

Access points for the underground line also need to be placed at regular intervals in order to inspect and repair buried cable. And an access road would be required along the length of the route. If oil-filled cable is required, there is the potential for oil leaks and the need to have pressure stations along the route.

Issue	Overhead	Underground
Cost		10 times higher than overhead
Outages	More frequent Shorter duration	Less frequent Longer in duration
Design	Standard designs require less engineering time	More time is required to design underground lines
Environmental		More invasive construction techniques

## **When would Xcel Energy bury a transmission line?**

There are two conditions.

1) If based on our review of the project underground construction is more feasible and cost-effective for our ratepayers we would propose that option. A regulatory commission in the state where the project is proposed makes that decision. However, those circumstances are rare. Since underground construction is so much more costly than overhead construction, Xcel Energy needs to consider what the impact of the project cost will be on all of our ratepayers.

For this reason, placing transmission line underground is an option only when a suitable overhead corridor cannot be identified such as in a city or urban areas, or near airports.

2) Xcel Energy would bury transmission lines when an entity is willing to pay for the additional cost. There are several locations throughout Xcel Energy's service areas where short sections of transmission lines have been buried -- usually due to clearance requirements for airports. For example, when the Minneapolis-St. Paul airport expanded in the 1990s the existing transmission line just south of the airport was buried. The airport paid for that project. In other cases, housing developers have paid to bury the lines.