FACT SHEET 001

Comparing overhead and underground transmission infrastructure

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What is 'transmission infrastructure'?

Transmission infrastructure is the high-voltage network of physical parts that transports electricity from the point of generation to transmission substations. It includes the cables, towers and transformers that link electricity producers to lower voltage distribution infrastructure, and ultimately users.

High-voltage cables connect generators that produce electricity, through the rest of electricity network, with customers like homes, businesses, schools, hospitals and more. Along the way, transformers increase and decrease voltage (the force that 'pushes' electricity from one point to the next) so that it can be safely and effectively transmitted. Before electricity is supplied to customers, it is converted to a lower voltage by transformers so that it can travel along distribution lines (the smaller poles and wires usually found in residential neighbourhoods).

Transmission lines are located on easements – areas of land with property rights allowing access to employees and contractors of the electricity provider. This is required to allow the company to access infrastructure to perform maintenance and other work. For safety reasons, easement areas often have restrictions about what can be co-located on the land or activities that can be undertaken nearby. Easement size depends on the size of the infrastructure, with towers requiring larger easement areas than underground trenches[1].

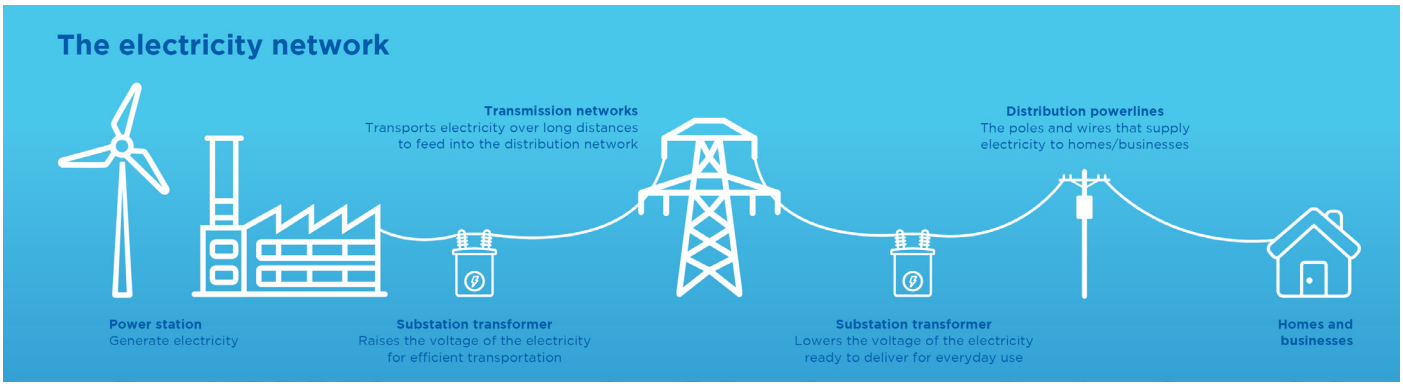

Image: The electricity network. Energex (n.d.) https://www.energex.com.au/about-us/about-our-network/understanding-the-network

Why do we need high-voltage transmission lines?

High-voltage transmission lines are essential for electricity to travel long distances with lower loss along the way. However, transmission lines are becoming even more critical as Australia replaces fossil fuel-generated power with renewables[2].

Generators use a range of energy sources, like coal, gas, wind or solar, to produce electricity and are usually located in regional rather than urban areas. More transmission infrastructure is needed when connecting dispersed generators, like wind and solar farms, than large, centralised generators, like coal-fired power stations, as more distance must be covered[3].

Renewable energy generators can also introduce an influx of electricity into the grid, meaning that transmission infrastructure must be upgraded and/or expanded to handle this abundance of energy[2].

What's the difference between overhead and underground transmission infrastructure?

As the names suggest, the major difference between the two types of infrastructure is how they are installed. Overhead transmission lines are supported above ground by large towers, whereas underground transmission lines are installed in trenches and buried underground. However, each of these methods of delivering electricity has its own benefits and drawbacks. There are a number of trade-offs that must be considered when choosing between underground and overhead transmission infrastructure[4].

While underground cables are often preferred for aesthetic reasons, they are significantly more expensive to install and harder to connect to future infrastructure. While overhead cables are cheaper to build and,

on average, have a longer service life, they are at greater risk of damage by extreme weather events like lightning, and under extremely rare circumstances, may cause bushfires. Typically, overhead infrastructure will also have a larger easement footprint, requiring larger amounts of land clearing, although installing underground lines also requires disruption of vegetation and animal habitats[5].

There is no one-size-fits-all option for transmission infrastructure. Decisions about types and locations of transmission infrastructure must be made based on an area's specific needs, concerns and considerations[4].

Image: High-voltage powerlines often run through rural areas, including farmland. Adobe Stock (n.d.).

Overhead vs underground

For more detailed information, please refer to the joint Curtin University and University of Queensland report *Comparing High Voltage Overhead and Underground Transmission Infrastructure (up to 500kV)* commissioned by Powerlink Queensland.

	Overhead infrastructure	Underground infrastructure
Technical	High performance, with service life between 60-80 years Shorter repair and construction times	Limited to shorter distances (eg 50km for 500 kV) with shorter service life – around 40–50 years Lower risk of outages
Economic	Greater economic and flexible capability for future line connection	Between three and twenty times more expensive than overhead infrastructure (depending on specific context)
Environmental	Vehicle access is required for construction and ongoing maintenance Damage to animal habitats and migration pathways, land clearing, and restriction of vegetation growth In very rare circumstances can spark bushfires	Vehicle access is required for construction and ongoing maintenance Trenches (1-2m deep) must be dug or drilled to lay cables Possible soil degradation and negative effects on water systems
Social and cultural	Visual impact on the landscape is often a concern for host communities Negative perceptions of the impact of overhead lines on property values	Underground infrastructure is preferred for aesthetic reasons or to avoid excessive concentration of overhead cables in a location

References

[1] Western Power. “Transmission Line Easement: Landowner Obligations.” n.d. https://www.westernpower.com.au/safety/safety-at-home/our-infrastructure-around-homes/transmission-line-easement-landowner-obligations/.

[2] Wood, Tony. “What Is the Electricity Transmission System, and Why Does It Need Fixing?” Grattan Institute, October 16, 2020. https://grattan.edu.au/news/what-is-the-electricity-transmission-system-and-why-does-it-need-fixing/.

[3] The State of Victoria Department of Energy, Environment and Climate Action. “Summary of Transmission Infrastructure.” ***Energy Victoria***, 2023. https://www.energy.vic.gov.au/__data/assets/pdf_file/0026/683522/summary-of-transmission-infrastructure-technical-report.pdf.

[4] Curtin University, University of Queensland, and Powerlink Queensland. “Independent Analysis Overview: Comparing High Voltage Overhead and Underground Transmission Infrastructure.” Powerlink Queensland, November 2024. https://www.powerlink.com.au/sites/default/files/2024-11/Comparing%20high%20voltage%20overhead%20and%20underground%20transmission%20infrastructure%20-%20independent%20analysis%20overview.pdf.

[5] Madigan, Gary, Colin Lee, Audrey Cetois, Anupam Dixit, Xin Zhong, Andrew Knight, Sarah Rohl, et al. “Comparing High Voltage Overhead and Underground Transmission Infrastructure (up to 500kV).” Curtin Institute for Energy Transition, November 2023. https://research.curtin.edu.au/ciet/engagement/publications/transmission-infrastructure/.

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