

Overhead and underground transmission

March 2024

This factsheet provides information about two types of transmission infrastructure – overhead powerlines and underground cables.

In Victoria, high voltage alternating current (HVAC) overhead is used for most of our existing 6,500 km transmission network.

Overhead is commonly used because it has better power transfer capacity, is easier to maintain, costs less to build and allows for the connection of new generation and storage along the line.

At other times, underground can be the best solution, for example where no additional connections are required or where terrain does not allow for overhead.

What's the difference between alternating current and direct current?

HVAC and high voltage direct current (HVDC) are two different systems used for transmitting electrical power over long distances.

AC flow

Alternating current (AC) periodically changes direction. It is the standard form of electricity used in homes and most industries.

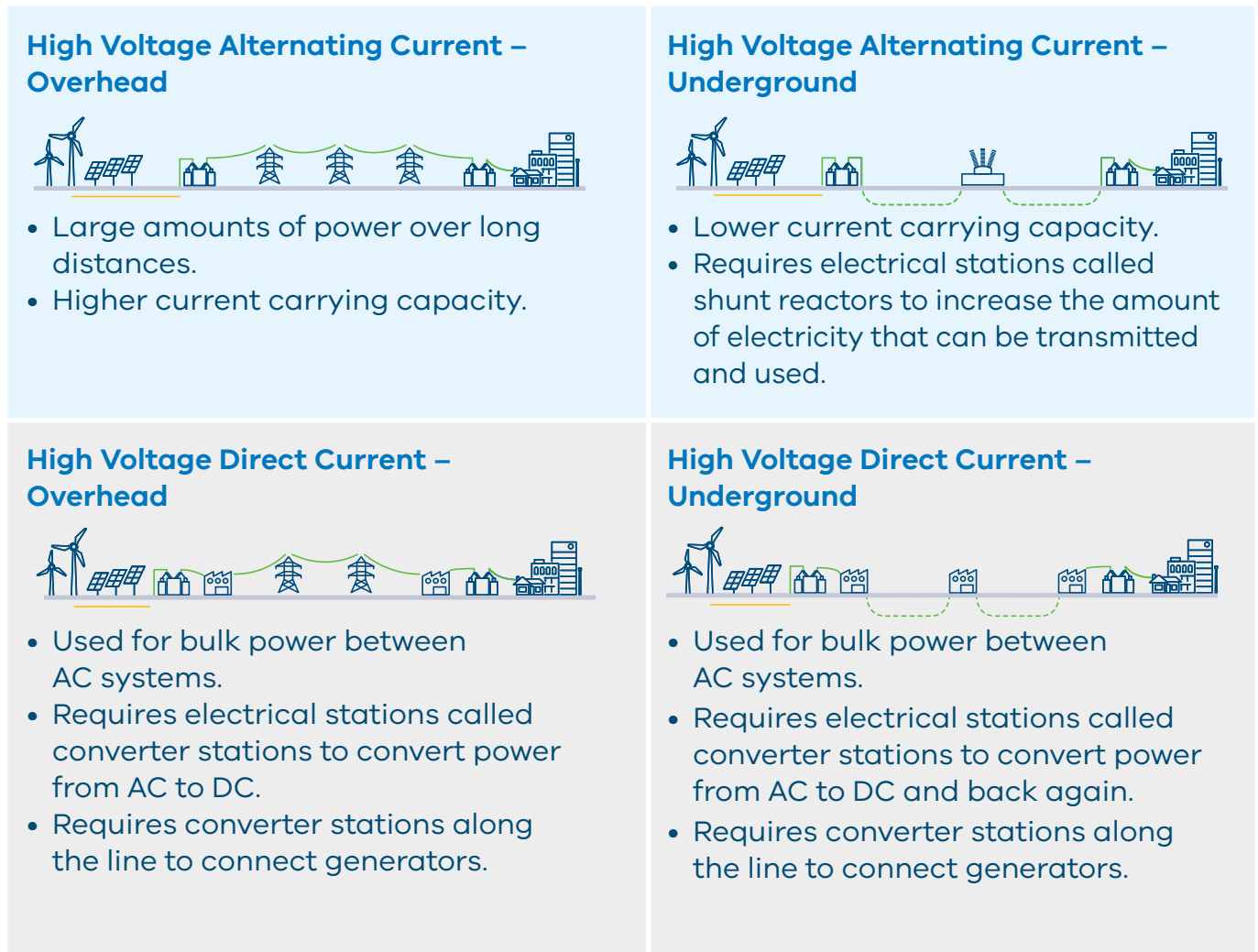
DC flow








Direct current (DC) flows consistently in one direction. Renewable energy sources like solar and wind generate DC electricity, which needs to be converted to AC for use by homes and businesses.

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Figure 1 Transmission infrastructure types

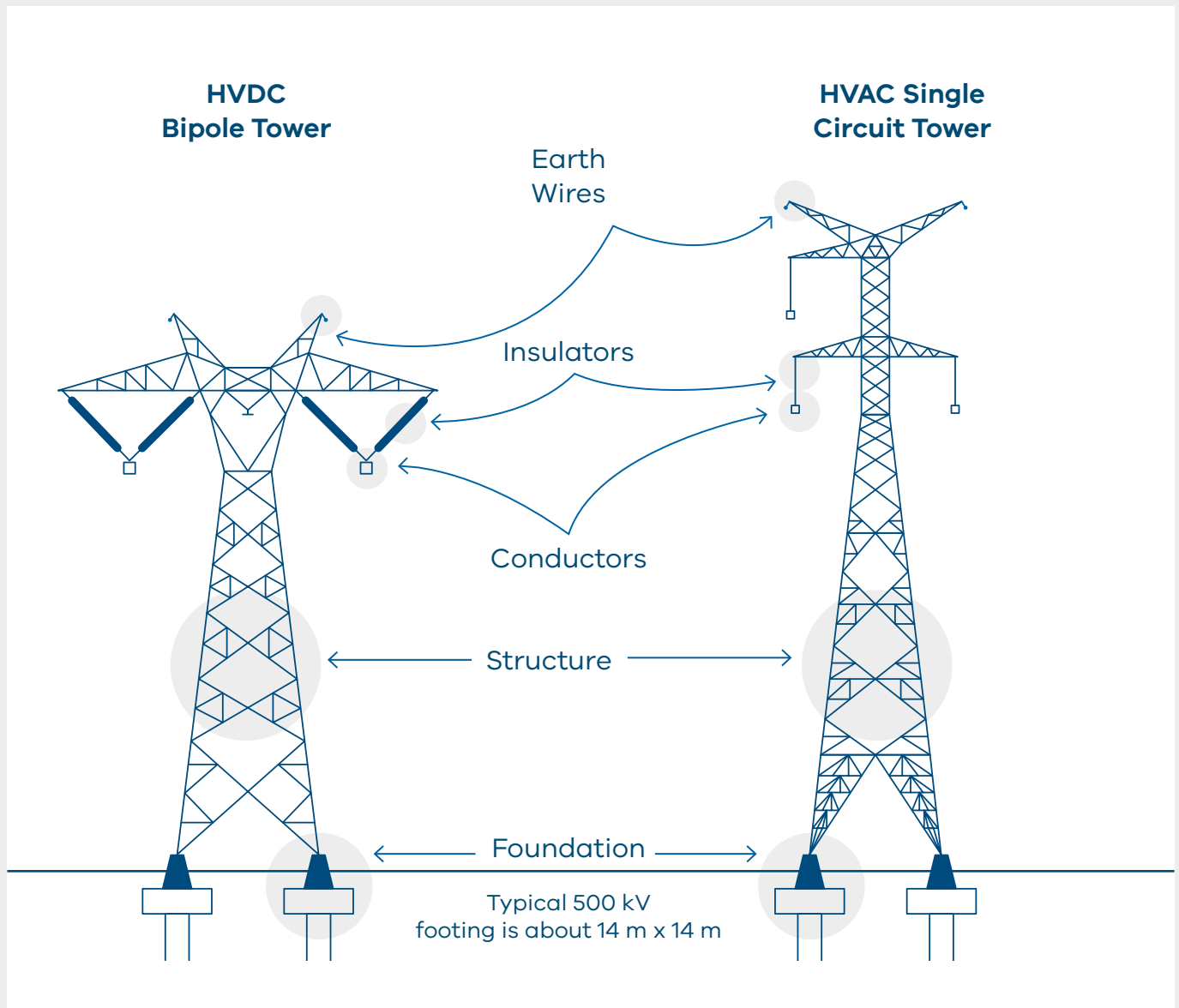


 Transmission tower
  Supporting infrastructure
  Converter station
 Overhead line
  Underground cable
  Generation connection
  Shunt reactor

Overhead transmission

Most of the transmission infrastructure around the world uses overhead powerlines at voltages of 100 kilovolts and above. Overhead powerlines are used for both HVAC and HVDC transmission, with HVAC more commonly used. The lines are strung between towers or poles along a long transmission corridor. Transmission towers can be between 45 m and 80 m tall and easements for overhead can be between 40 m and 100 m wide.

Figure 2 Transmission tower connection



Visual impacts

Overhead powerlines have a high visual impact due to visible infrastructure.

Biodiversity

Overhead transmission easements have fewer restrictions on vegetation, but vegetation must be kept to certain heights to meet safety requirements.

Land access and use changes

Many activities, including most farming practices, can continue under overhead powerlines, subject to height restrictions.

Cultural heritage

Overhead powerlines are less likely to disturb cultural heritage sites and historical assets due to there being less ground disturbance.

Effectiveness

Overhead powerlines maintain a cooler temperature than underground cables because they are suspended in the air, which improves the lines' ability to carry more current. New energy generation sources like solar and wind farms are relatively easily connected to HVAC overhead powerlines.

Maintenance

Crews can rectify faults and issues on overhead powerlines quickly (1 to 2 days) compared to underground cables which need to be excavated to gain access to the trenches and cables.

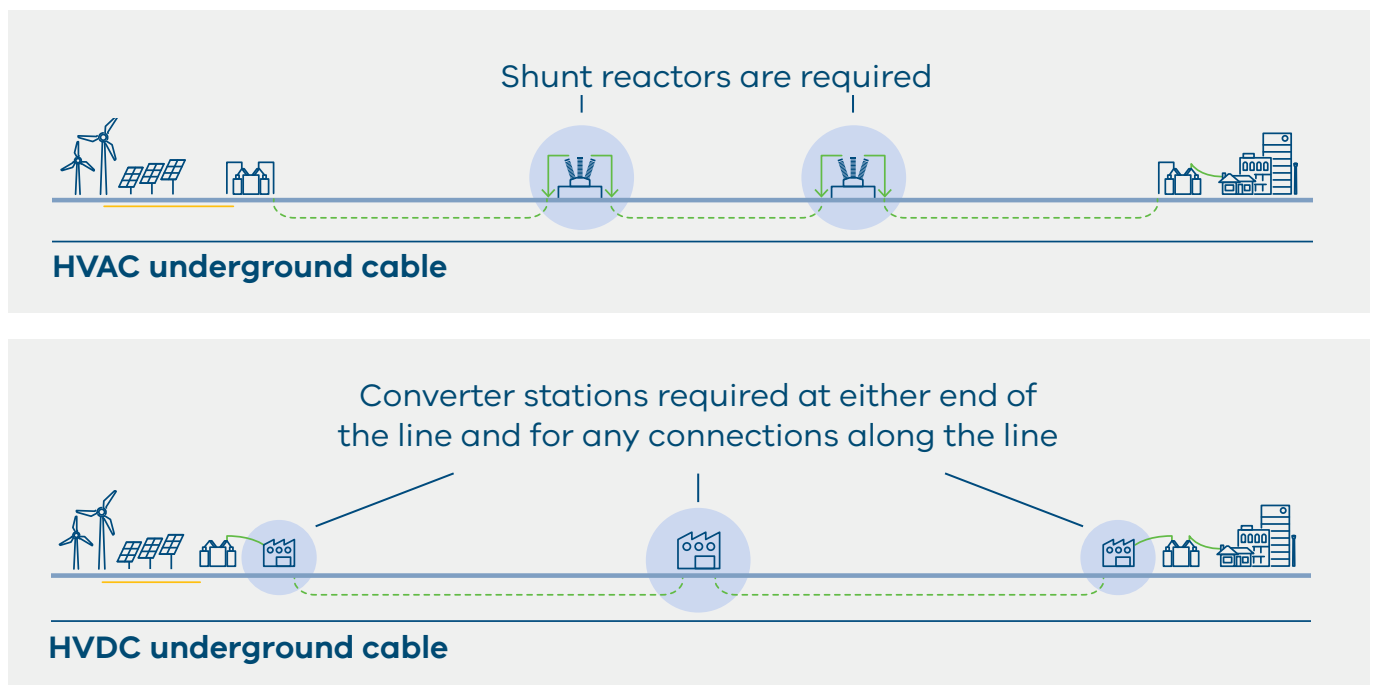
Additional infrastructure

Terminal stations are required at either end of the line to transfer power between different voltage levels.

Underground transmission

HVAC and HVDC power can also be transmitted through underground cables. Cables are buried in the ground at a depth of at least 1 m or installed in ducts along the bottom of a trench.

Figure 3 Above-ground infrastructure to support underground lines



More information

Further information about different types of infrastructure visit energy.vic.gov.au/renewable-energy/vicgrid/for-community-landholders-and-traditional-owners

Visual impact

Less perceived visual impact, as transmission infrastructure is buried underground. However, above-ground stations are required at certain points, which can change the visual impact in these locations.

Biodiversity

Ground disturbance along the entire length of the trench, including vegetation clearing and impacts on natural habitats. Large rigid cables reduces ability for route to avoid sensitive areas.

Land access and use changes

Significant restrictions in the way land can be used for buildings, farming, dams and tree planting. No vegetation with deep roots can be planted in the easement, and cropping opportunities are limited.

No excavation, deep ploughing or heavy machinery can be used. More invasive and longer occupation by transmission companies for maintenance.

Effectiveness

When cables are underground, their heat dissipates through the ground, which is less effective than with overhead powerlines. When lines are hotter, they carry less current, which limits the capacity of underground cables.

Maintenance

Unlike overhead where faults are easily visible. Maintenance for underground faults are invasive and time-consuming as large excavation of land is generally required to find the fault. Underground faults typically take 5 to 9 days to fix. However, faults are less likely due to the added protection underground trenching provides.

Additional infrastructure

As with overhead transmission, terminal stations are required at either end of underground transmission lines to transfer power between different voltage levels.

In addition, significant above-ground infrastructure is required for underground transmission. HVAC underground requires a 4 hectare (ha) electrical station, called a shunt reactor, every 30 km to 50 km. Shunt reactors maintain voltage stability to increase the amount of electricity that flows through a cable.

HVDC requires large converter stations of up to 7.5 ha at either end of the line and anywhere there is a connection along the line to convert power from AC to DC and back again.

Cost

Cost is an important factor when planning electricity infrastructure, as more expensive projects result in higher power bills for all energy users.

The construction cost of undergrounding is much greater than for overhead, depending on a range of factors that are specific to each project. Underground cables will generally cost many times more than the comparable overhead powerline option.

This is because underground construction is more labour-intensive and takes longer with trenching and the installation of cable joints and joint pits at regular intervals along the line. There is also the requirement for significant additional above-ground infrastructure like shunt reactors for HVAC and converter stations for HVDC. All these

additional costs are ultimately paid for by Victorians in their power bills.

Victoria needs to build a significant amount of transmission infrastructure to carry power generated by new renewable energy across the state. If all the required transmission infrastructure was built underground, this would add significantly to the average annual household bill.

While more costly, there may be cases where undergrounding is selected as the best solution. Transmission planners will always complete detailed analysis of a specific project on its own terms and assess a range of factors in selecting the best option. Cost is an important consideration that is weighed against other factors in making these decisions.

Contact us



Phone: 1800 418 341

Email: vicgrid@deeca.vic.gov.au

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