FACT SHEET

Undergrounding

Information for landowners and communities

NOVEMBER 2023

Transgrid

The challenges of putting high voltage transmission lines underground

Transgrid is responsible for planning and building significant amounts of transmission infrastructure to transition the NSW electricity system from a grid traditionally supplied on fossil fuels to one powered by renewable energy. Understandably, landowners and local communities want to know why overhead transmission is the preferred method of delivery.

This factsheet outlines how we consider the feasibility of overhead and underground options when planning transmission infrastructure, some of the frequently asked questions and explains the technical reasons why it is a challenge to install high voltage transmission lines underground.

How we review transmission line options

We review all reasonable options to address an identified need. We progress the options that are credible to detailed assessment, such as through the Regulatory Investment Test - Transmission (RIT-T) process. In accordance with the RIT-T requirements we consider all credible options as those which:

- address the Government's identified need,
- are commercially feasible and meet with regulatory requirements for prudency and efficiency,
- are technically feasible, and
- can be implemented in sufficient time to meet the identified need.

Pictured: HVDC cable solution

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Where transmission lines may address an identified need, we consider high voltage alternating current (HVAC) and high voltage direct current (HVDC) overhead and underground options to determine which are credible. As part of this process, we consider:

- **HVAC and HVDC solutions**
  - The backbone of the grid is HVAC. It is economical and flexible, allowing the configuration and integration of the grid to be adjusted and new generation to be readily connected.
  - HVDC can cost much more than HVAC installations due to the need for converter stations, and they are less flexible when it comes to facilitating multiple intermediate connections along the route.
  - Given the cost and complexity, we typically consider HVDC as a credible option where there is a need to transmit power efficiently from point to point over a long distance. For example, we have presented a HVDC concept for the Remote Inland Renewable Energy Zone (REZ) in our 2023 Transmission Annual Plan Report.
  - HVDC may also be considered as a credible option where there is a need to interconnect asynchronous networks, networks which operate at difference frequencies, or where full control of power flows is required.
- **Overhead and underground solutions**
  - Overhead lines are both technically and commercially preferred where there is a need for hundreds of kilometres of cabling.
  - Underground cables are typically considered where overhead lines are not possible, such as in urban areas where overhead lines are not possible due to space constraint and additional easements are unavailable to be obtained or for subsea links.
  - Underground cables over long distances are also, in the case of HVAC not technically feasible, and in the case of HVDC, are significantly more expensive than the equivalent overhead option. Underground cables also result in significantly more ground disturbance and environment impacts during construction, and greater ongoing restrictions on land use into the future compared with the equivalent overhead option.

Frequently asked questions

Other long-distance transmission projects are going underground. Why isn't Transgrid following suit?

Around the world, HVDC transmission lines are going underground in a number of locations. For example, Germany is undergrounding the 700km Suedlink from the country's north to Bavaria and BadenWürttemberg. Also, a 540km transmission link is being undergrounded between Quebec's hydropower stations and New York City. In Australia, the Marinus Link developer is undergrounding 80km of the link from Tasmania, at the point where it comes onshore in Gippsland, Victoria.

These projects use high voltage direct current HVDC underground cables to transmit power efficiently from point to point over a long distance. HVDC is less flexible when it comes to facilitating multiple intermediate connections along the route. As the backbone of the renewable grid is made up of HVAC transmission lines to collect and deliver power along their route, converter stations (large and technically complex systems) are required at each end to convert electric power from AC to DC and vice versa. These would make future integration of additional renewable energy connection along the route much more complex and expensive. The converter stations present significant challenges in terms of site placement, land use, increased complexity and costs. **Nowhere in the world is anyone undergrounding HVAC cables over long distances well in excess of 130km.**

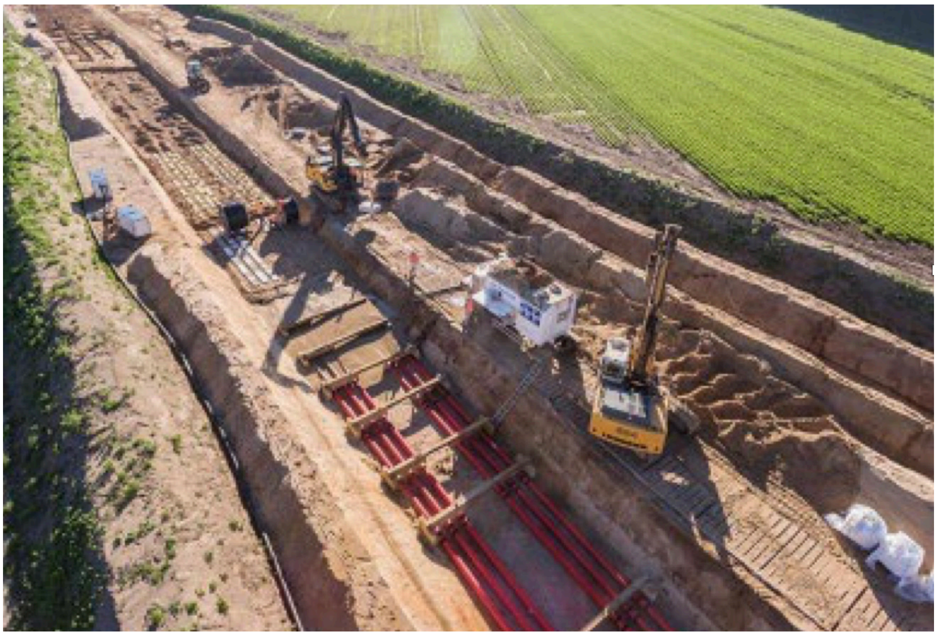
Why not? Why are HVAC cables different?

The use of HVAC underground cables is the preferred choice in some situations for example in a relatively short route length (approximately 50km) and in densely populated areas where space is premium. However, HVAC underground cables pose technical limitations over long distances. Long distance HVAC underground cables have high electrical capacitance (the ability of the system to store an electric charge), which reduces the amount of power they can carry and requires compensation equipment. The longer the cable, the greater the capacitance), this is why reactive compensation sites are required more frequently along the length of the underground cable installation for long HVAC cables. The reactive compensation sites will also require large areas of land at regular intervals along the route. It is also noted as transmission voltages increase from 220/330/500 kV, there are added technical complexities and capacity associated with installations such as the need to duplicate cables in parallel to provide the required capacity.

Undergrounding also has other considerations when compared to an overhead line:

- **Significant ground disturbance during construction** – Underground high voltage cables need to be adequately spaced for good heat dissipation. Thermally stable backfill is typically required to ensure a known thermal conductivity around the cables which dissipates heat from the cables to maintain the cable rating (capacity to carry current). Cable trenches are excavated over the entire route of the cable, and an access track is required beside the trenches during the cable installation and subsequently during operation. Stockpiling of large amounts of soil throughout the route is also required, resulting in a work area that can be up to 65m wide.

- **Significant environmental impact** – Trenching requires removal of all above-ground vegetation during construction throughout the entire route. This impacts the biodiversity above the ground including sub-surface flora and fauna habitats, soils and watercourses. Vegetation management is also required throughout the operation of the cable.
- **Greater biosecurity risk** - There are greater biosecurity risks due to the larger quantities of soil disturbance and vehicle movement required for construction of underground transmission lines compared to overhead line construction. The access roads also need to accommodate the significant weight of the underground cable and soil removal.
- **Restricted land use** – Farming activities will be restricted on the easement of an underground cable as the root systems of larger plants can damage the thermal cable backfill and impact the performance of the cables. Deep crop cultivation, vineyards and orchard operation are prohibited to avoid the risk of damage to the cable system. Whereas with overhead lines, farming activities can be carried out as long as mature growth is under four metres and machinery is under 4.3m.
- **Construction is more disruptive** – Because of the large amount of excavations required, underground cable construction sites require significant management of heavy plant and machinery to control construction traffic, excessive noise, vibration, visual intrusion and dust generation.
- **Longer time to repair** - In the event of a cable fault, locating and repairing the fault can be challenging and time-consuming compared to an overhead line. This increases the time required to restore the power supply.



Pictured: Direct buried cable installation in a rural area. This buffer will run the entire length of the route.

But doesn't Transgrid put HVAC lines underground in cities?

Yes, but only over relatively short routes in urban areas where overhead lines are not possible due to space constraint and additional easements are unavailable to be obtained. This was the case for Transgrid's 20km Powering Sydney's Future 330 kV high voltage AC cables, which were installed underground, mostly under roads, through a high-density part of Sydney. In rural areas, where there is a need for hundreds of kilometres of cabling, undergrounding HVAC cable is not technically or commercially viable.

How expensive would it be to put cables underground?

Construction costs vary based on the topography involved however it is at least double the cost of overground. This is calculated on the additional excavation work, use of specialised equipment, more expensive cable material for underground infrastructure, and increased construction time frame. For HVDC undergrounding, additional converter stations would be required to connect to the existing transmission AC network. For long distance HVAC undergrounding, reactive compensations stations would be required more frequently along the length of underground cable installation.

What about the bushfire risk of overhead high voltage transmission lines?

For decades we have safely operated thousands of kilometres of high voltage transmission lines in NSW and the ACT. The safety of all people comes first, so our network planning, design, construction, operation, and maintenance takes bushfire risk and prevention into consideration every step of the way.

Every year, we carry out a comprehensive bushfire prevention program including helicopter inspections, aerial imagery, 3D laser scanning, vegetation management and network maintenance to help protect local communities from bushfires.

The transmission network also has duplicated high-speed protection systems which clear faults on the network much faster and much more reliably than distribution networks, significantly lowering the risk of fire ignition.

Frequently asked questions

Transgrid acknowledges that both overhead and underground transmission systems have a range of impacts for local communities. Whilst there is greater visual impact with overhead lines, undergrounding causes a greater negative impact for the environment, for farmers and for communities. It also results in a much larger cost to energy consumers. The significant cost of undergrounding would also result in costly delays to the delivery of a clean, affordable, and secure electricity network. The future grid will integrate new renewable energy generation and benefit millions of Australians across NSW, the ACT, Victoria, South Australia and Queensland.

Pictured: Typical Reactive compensation site

Pictured: HVAC-HVDC Converter station site

In rural Australia, undergrounding HVAC cables is likely to have worse outcomes than overhead systems – for the environment, for farmers and for communities. It could also delay our national energy transition and result in additional costs to everyone's power bills.

Connect with us

Transgrid is committed to working with landowners and communities as we deliver on the Government's energy transition. We want to find solutions that work for everyone. Please contact us for more information.

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