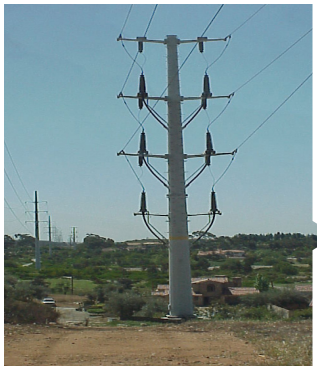


PUGET SOUND ENERGY

energize**EASTSIDE**

underground transmission lines frequently asked questions

With the Energize Eastside project, Puget Sound Energy (PSE) will build a new substation, upgrade approximately 18 miles of existing transmission lines, and continue to implement aggressive conservation to meet the Eastside's electrical demands.

Placing Energize Eastside's transmission lines underground has been a topic of community interest since the project launched. Consistent with this interest, PSE hired POWER Engineers to conduct an underground transmission construction feasibility study from a cost, construction and siting perspective. The report confirmed that undergrounding the project would have more impacts than an overhead line, have significant costs subject to a lengthy schedule, and confront considerable siting obstacles.

Per state regulations, the additional costs of undergrounding must be covered by the local community requesting it. Energize Eastside is planned as an overhead transmission line, as no public entity has agreed to fund the additional costs associated with undergrounding and PSE's schedule can no longer accommodate the time needed to site, engineer, permit and construct underground lines.

We often get questions about placing the lines underground, so we wanted to provide additional details.

Can PSE bury transmission lines underground?

While it is technically possible to build a transmission line underground, it is up to the community to decide whether to make that investment. For Energize Eastside, in addition to the significant siting challenges, no public entity has agreed to invest in undergrounding.

Why is cost sharing required for undergrounding transmission lines?

State regulations require PSE to first consider building overhead transmission lines because of their combination of reliability and affordability, both of which are important to our customers.

Underground transmission lines are considered a "local option" under applicable regulations. This means the local community must pay the cost difference between building overhead and underground lines (rather than having the entire project cost shared by PSE's 1.1 million customers). The requesting community would share the cost of the project from initial preliminary design to construction to ongoing maintenance and repair.

Most communities decide not to invest in undergrounding transmission based on the significant costs and competing investment priorities.

Underground **distribution** cable replacement

Transmission duct bank and vault placement (Source: POWER Engineers)

Why does undergrounding transmission cost more?

Burying the lines increases the cost due to the scale and complexity of underground infrastructure.

Construction costs for an overhead 230 kilovolt (kV) transmission line are about $3 million to $4 million per mile, versus $20 million to $28 million per mile for undergrounding. Additional costs, such as land acquisition and relocation of existing underground utilities, can be very significant – sometimes two to three times the construction costs.

Underground distribution seems fairly common, so why not underground transmission lines, too?

Typical underground transmission lines that move power between substations are larger in scale and more technically complex than the underground distribution lines that serve neighborhoods. The photos on the front page highlight the typical differences in scale between transmission and distribution lines.

The larger underground transmission lines give off more heat than distribution lines. For distribution lines, that heat can be dissipated into the surrounding soil, while the heat from transmission lines is dissipated into thermally-rated fill. In addition, underground transmission cables are typically installed in concrete duct banks that can extend 5 feet or more below the surface causing significant disruption to the local area.

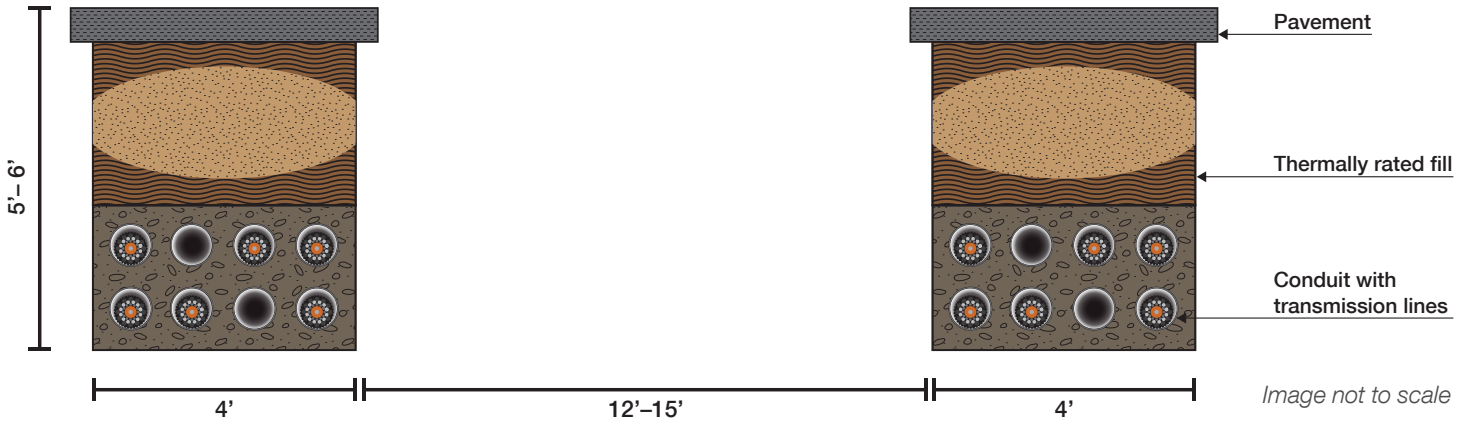
Underground transmission lines are not common. Nationally, less than 1 percent of 230 kV or higher transmission lines are underground. Underground transmission lines are most commonly seen in dense urban areas where overhead lines are infeasible, such as in downtown areas like Manhattan or Los Angeles.

What are the challenges to placing Energize Eastside underground?

In 2014, POWER Engineers conducted a feasibility study for undergrounding Energize Eastside. They confirmed while it is technically feasible to construct the project underground, this approach would face some real challenges on the Eastside and would be more impactful than overhead lines.

The challenges of undergrounding 230 kV transmission lines on the Eastside include:

- **Undergrounding is more costly and requires cost sharing with requesting communities.** PSE shared the cost difference with local cities and they did not express interest in pursuing this option.
- **Finding a new corridor between Redmond and Renton.** The existing utility corridor cannot accommodate the underground transmission lines, so that means placing them somewhere else, such as city streets or a new corridor. This would significantly add to the cost of the project, the differential of cost being borne by local communities.
- **Lengthy design, permit and construction schedule.** Based on current estimates, it would take at least six years for us to design, negotiate easements, permit, procure materials, and construct the underground transmission lines. Such a schedule would mean PSE would have a long-term plan for rolling blackouts until the new underground transmission lines are built.
- **Finding adequate space for garage-sized underground facilities.** Undergrounding requires the construction of underground vaults the size of a two-car garage approximately every ¼ mile to ½ mile. To accommodate each underground vault, we would need at least 30-foot by 50-foot easements.
- **Construction work is more intensive.** Underground lines require a large trench for the conductors, conduit, and vaults along the line. For each mile of



Typical underground concrete duct banks for two 230 kV lines

construction, we'd need about 500 dump trucks for excavation haul off, 200 dump trucks for thermal concrete backfill, and another 300 dump trucks for the balance of the trench backfill (i.e., about 1,000 truckloads per mile).

- **Moving existing utilities.** There is a complex infrastructure of natural gas, sewer, water and communication lines beneath our roads and utility corridors. Adding the large footprint of underground transmission lines would mean potentially moving existing utilities, which could increase project costs and limit project feasibility.
- **Increased impact to trees and aboveground landscaping.** Trees and shrubs are not allowed to grow over the trench for inspection and operational reasons (e.g., roots cannot be allowed to grow into the conduits).

Based on these significant challenges, we've planned Energize Eastside as an overhead transmission project.

Could PSE use undergrounding for portions of the project?

Undergrounding the project in segments would face similar challenges as doing so for the entire route. As discussed earlier, the existing utility corridor will not accommodate the underground transmission lines. Therefore, PSE would still need a new corridor to underground segments, which would be more impactful than overhead transmission lines.

What are the trade-offs between overhead and underground transmission lines?

	Overhead 230 kV transmission lines	Underground 230 kV transmission lines
Construction costs[1]	• $3 million to $4 million per mile • Costs shared between PSE's 1.1 million customers	• $20 million to $28 million per mile • Costs shared with requesting party (i.e., city)
Construction impacts	• Construction entails removing existing poles, setting new poles and stringing wire within existing utility corridor	• **Easements:** New utility corridor required at 30 feet to 50 feet wide to place underground concrete duct banks • **Substantial trenching** to fit concrete duct banks • **Large vaults:** Concrete access vaults (20 feet by 30 feet) required every 1/4 mile to 1/2 mile • May require moving existing underground facilities
Vegetation	• Trees under 15 feet in height allowed	• No trees or shrubs for width of new corridor
Reliability	• Lines can fail due to equipment failure • Susceptible to wind, ice storms and third party damage (i.e., car/pole accidents) • Outages infrequent	• Cable can fail due to corrosion, fatigue, other stress • Susceptible to root intrusion and third party damage (i.e., excavation) • Outages very infrequent
Outage Repair	• Easier to find a problem and repair • Repairs typically made within a day during normal weather; longer during storms	• Locating problems and making repairs can take more time, and in some cases for several weeks • Worldwide, there are a limited number of highly trained crews for repair
Maintenance	• Costs less to repair, upgrade and relocate	• Costs more to repair, upgrade or relocate
Aesthetics	• Poles, wires and support anchors visible	• Vaults and transition structures less visible

1 These cost estimates include design, engineering, materials and construction. Additional costs, such as right-of-way acquisition, relocation of underground utilities, permitting and mitigation, can be very significant.

PSE PUGET SOUND ENERGY

Photo of underground utility construction methods

Splicing vault installation (Source: POWER Engineers)

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Thank you for your interest in Energize Eastside.

pse.com/energizeeastside 1-800-548-2614 energizeeastside@pse.com