CONTINUUM Capital

Underground Infrastructure Conference 2025

Myth-Busting: Investment vs. Benefits of Undergrounding Electric Facilities

Underground Infrastructure Conference 2025

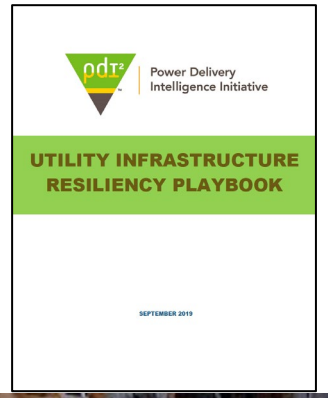
Mark Bridgers – Continuum Capital; Tziporah Feldman – Scenic America

Houston, TX

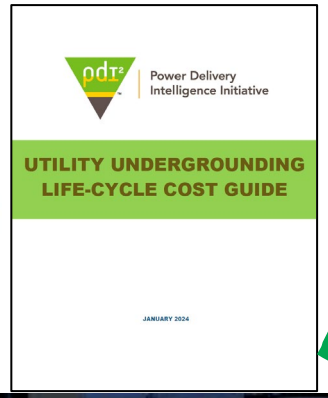
Tuesday, March 4, 2025 - 9:30 am – 10:25 am - Room #360AD / Track V Utilities/Energy

Power Delivery Intelligence Initiative (PDi²)

- Power Delivery Intelligence Initiative, or PDi², is a working group whose aim is to collect and use data to provide an objective means to evaluate power infrastructure investments from the perspective of life-cycle costs to determine which power delivery solutions -- overhead or underground -- to employ.
- You can access information on the undergrounding of electric infrastructure at the following locations:
  - https://pdi2.org/ & https://pdi2.org/research/



Power Delivery
Intelligence Initiative



Objective & Agenda

- Objective:
  - Dispel myths surrounding the cost and impact of “Strategic” undergrounding of electric infrastructure.
- Agenda:
  - Tangible benefits of undergrounding
  - Explore successful undergrounding programs
  - Refute the notion that undergrounding is too expensive
  - Identify undergrounding best practices

Speaker Introduction

- Mark Bridgers– Founder and CEO – Continuum Capital

- Tziporah Feldman – Policy and Research Director – Scenic America

Who We Are

- Scenic America is the only national 501(c)(3) nonprofit organization dedicated solely to preserving and enhancing the visual character of America
- National headquarters office and staff in DC, with over 40 state and local chapters and affiliates, hundreds of volunteers and thousands of supporters

Federal Advocacy

- Scenic America's advocacy efforts helped to expand the National Highway Performance Program support to include undergrounding as an eligible expense when carried out in conjunction with other road work.
- Advocated for an amendment of the Stafford Disaster Relief and Emergency Assistance Act to allow undergrounding following natural disasters.
- Contributed to the provision in the 2021 Infrastructure Investment and Jobs Act towards electric grid resiliency, which includes undergrounding efforts.
    - Bipartisan Infrastructure Law has allocated $10.5 billion to the Grid Resilience and Innovation Partnerships (GRIP) program and Grid Resilience State and Tribal Formula Grants

Promoting undergrounding

- Research, develop, publish, and promote technical standards that reduce the cost of undergrounding overhead wires.
- Educate utility regulators on the feasibility of undergrounding overhead wires.
- Create case studies and technical standards documents to help establish undergrounding in utility companies not yet engaging in undergrounding.
- Advocate for undergrounding by partnering with utility companies and helping with local regulatory pursuits .
- Published “Clear Skies Ahead”, an in-depth economic analysis of undergrounding distribution lines.

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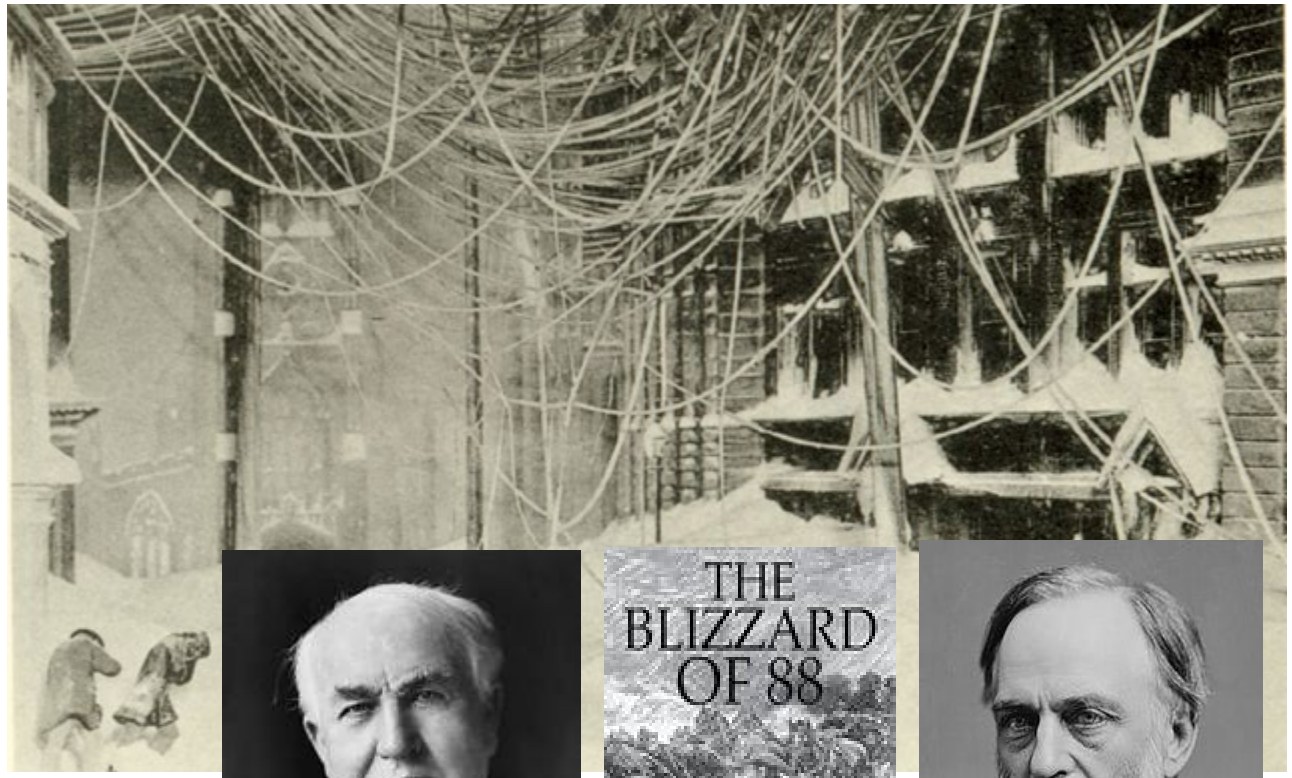
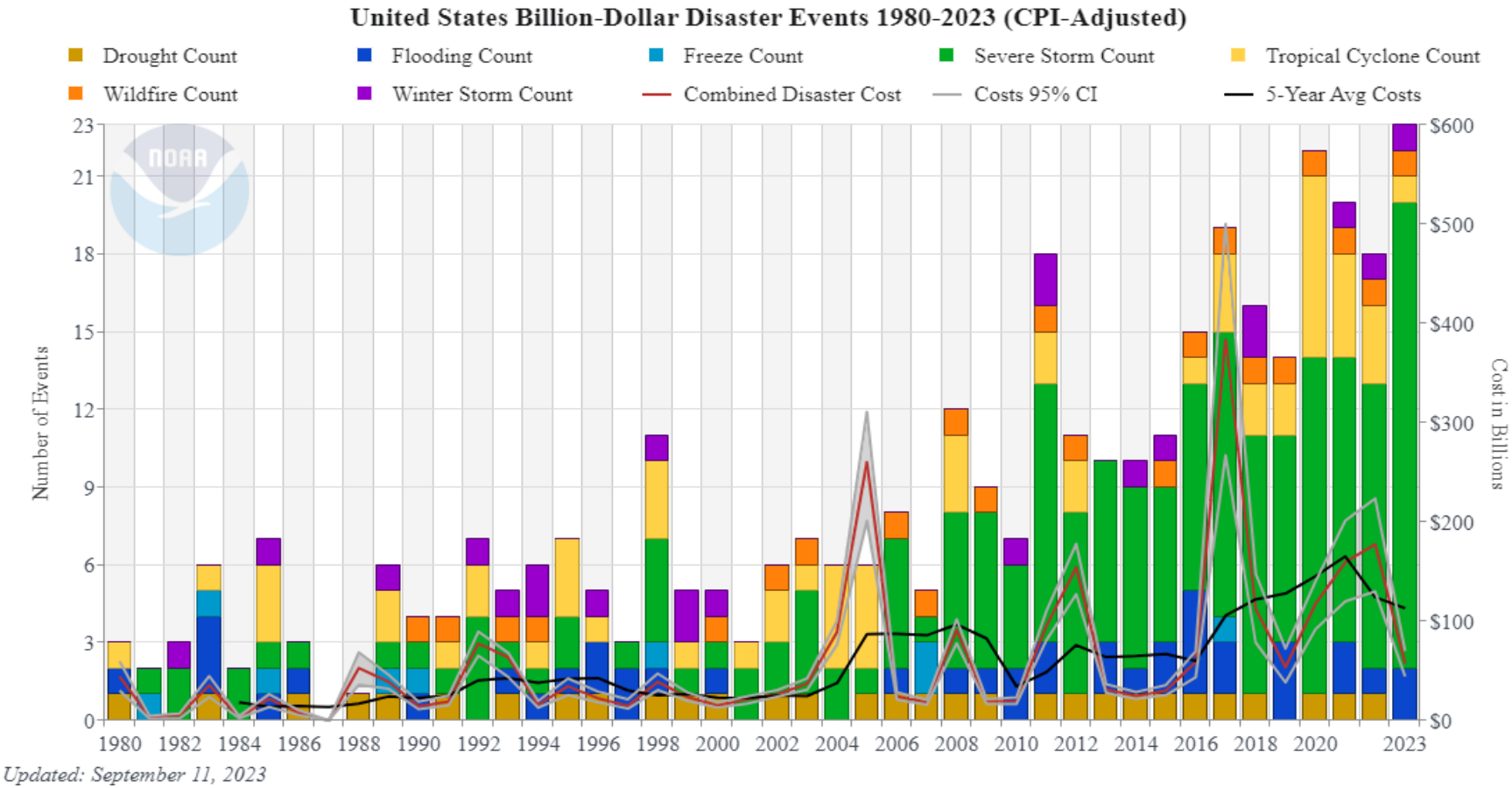
There Is Nothing New About Undergrounding

- Undergrounding is not a new concept. Thomas Edison directed his Edison Illuminating Company to bury wires in conduit, which he referred to as “subways,” when serving parts of New York City.
- Mary Cable, author of The Blizzard of ’88 described how, after the devastating blizzard with its lingering impact on power availability, telegraph communications, and electrocution hazard, the New York City Mayor at the time, Abram Hewitt, demanded that all telegraph and electric utilities serving NYC, not just Edison, place their lines underground.



Billion-Dollar Disaster Event Types by Year



Source: Power Delivery Intelligence Initiative (PDI²), The Utility Undergrounding Life-Cycle Cost Guide, Exhibit 5.2 Billion-Dollar Disaster Event Types by Year, November 2023, pg. 15.
Original Source: National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2023)

“Strategic” Undergrounding Myths

- **Myth 1:** Undergrounding is 10-15x the cost of overhead installation.
- **Myth 2:** Underground maintenance cost far exceeds overhead maintenance cost.
- **Myth 3:** Underground cable fails at a faster rate than overhead cable.
- **Myth 4:** Overhead to underground conversion programs are cost-prohibitive.
- **Myth 5:** Boards, councils, legislators, and regulators will not support “Strategic” undergrounding.
- **Myth 6:** “Strategic” undergrounding is not for Investor-Owned Utilities (IOUs).
- **Myth 7:** Underground faults are hard to find, expensive to repair, and take longer to resolve.
- **Myth 8:** “Strategic” undergrounding is not for municipal or Co-Op utilities.
- **Myth 9:** Undergrounding offers very limited intangible benefits.
- **Myth 10:** The present value of underground vs. overhead cost to install, maintain, and repair is not compelling.

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“Strategic” Undergrounding Around the US

Strategic Undergrounding Programs	
Utility	Program Miles
PG&E	10,000
FPL	~ 5,000
Dominion	4,000
WEC	2,200
TECO	~ 1,000
PECO	1,000
Duke, FL	~ 500
Ameren	400
PEPCO	150
SDGE	~150 per year
Georgia Power	~100 per year
AL Power	~50 per year
San Diego, CA	1,500
Anaheim, CA	240
CO	99% Complete
Austin, TX	Study

Source: Power Delivery Intelligence Initiative (PDI²), The Utility Undergrounding Life-Cycle Cost Guide, Exhibit 2.3 “Strategic” Undergrounding Programs, November 2023, pg. 5.
Interpretive Note: Programs highlighted on map and where IOU, Co-Op, or municipality has published targeted mileage in table.

CASE STUDY – PROGRAM APPROVAL PERSEVERANCE

Power Delivery Intelligence Initiative

PEPCO – (DC PLUG) What caused the delay of program approval initially in DC? Lessons learned and new approach resulting in approval.

- **CHALLENGE – Multiple devastating storms impacting system reliability performance**
- **SOLUTION – Multi-year effort engaging Mayor, the public, and regulators to design "Strategic" undergrounding program**
- **RESULT – DC PLUG program of $500 million jointly implemented**

Source: Utility Infrastructure Resiliency Playbook, Power Delivery Intelligence Initiative (PDi2) Playbook, Mid-Atlantic Utilities Undergrounding Program Case Study.
Original Source: Atkinon, W. (2014). Reliable but Costly. Retrieved from https://www.fortnightly.com/print/17656.
Original Source: Shaw Consultants International, Inc. (2010). Study of the Feasibility and Reliability of Undergrounding Electric Distribution Lines in the District of Columbia. Cambridge, MA: Shaw Consultants International, Inc. Retrieved from https://oca.dc.gov/sites/default/files/dc/sites/oca/page_content/attachments/Study%20of%20the%20Feasibility%20&%20Reliability%20of%20Undergrounding%20Electric%20Distribution%20Lines%20in%20DC%20(July%201,%202010)%20-%20ShawConsultantsforPSC.pdf
Original Source: Linares, C. (2017). Washington, D.C. Regulators to Consider Undergrounding Pepco Distribution Lines. Retrieved from https://www.elp.com/articles/2017/07/washington-d-c-regulators-to-consider-undergrounding-pepco-distribution-lines.html.
Original Source: Morehouse, C. (2019). With storm hardening 'a larger focus,' DC approves PEPCO underground distribution lines. Retrieved from https://www.utilitydive.com/news/with-storm-hardening-a-larger-focus-dc-approves-pepco-underground-distri/550233/

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Truths of Undergrounding

- "Strategic" Undergrounding is for critical segments, not entire system.
- Segments frequently impacted (2 times in 10 years) by storm or fire are economically to underground.
- Communities place high value on undergrounding – 90% of new developments are already undergrounded.
- Improvements in material science and installation techniques dramatically drove down upfront cost and improved life-cycle maintenance performance.

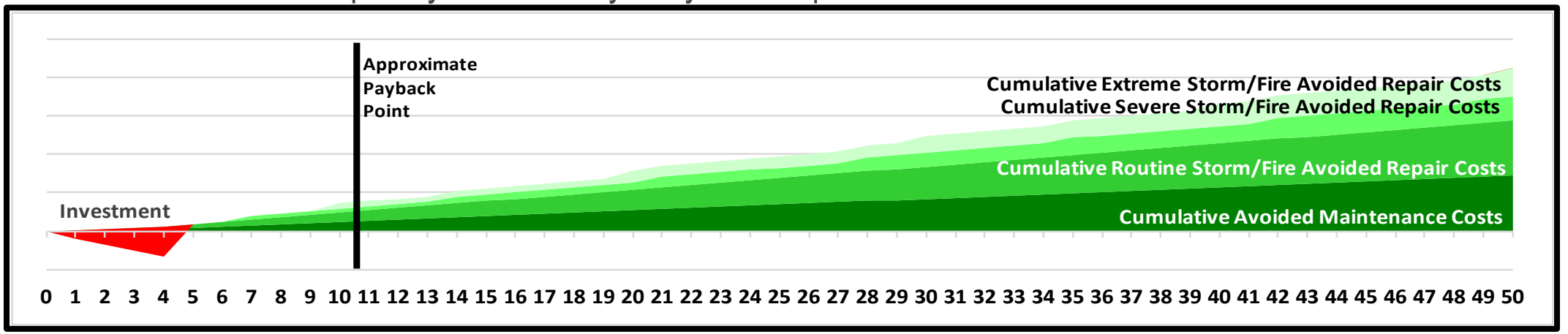
Myth 1 – High Initial Cost of Undergrounding

- Myth 1: Undergrounding is 10-15x the cost of overhead installation.
- Busted: The real cost differential in upfront cost is 2-3x for "Strategic" undergrounding efforts where the intention is to capture the lowest cost life-cycle cost and achieve resiliency and reliability targets for critical line segments. Multiple successful and PUC approved "Strategic" underground programs, including Dominion, are coming in at the 2-3x benchmark. Dominion's Phase II SUP completed 249 miles undergrounded at an average cost of $422,496 per mile – significantly below the legislatively required maximum of $750,000. Nearly every utility system will have line segments that exhibit similar cost/benefit.

Source: Power Delivery Intelligence Initiative (PDI^2), The Utility Undergrounding Life-Cycle Cost Guide, Exhibit 1.1 Myth-Busting, November 2023, pg. 2.
Original Source: Johnson, Brad, Out of Sight, Out of Mind? A study on the costs and benefits of undergrounding overhead power lines, Edison Electric Institute, January 2004.
Original Source: Commonwealth of Virginia, State Corporation Commission, Application of Virginia Electric and Power Company, Report of Deborah V. Ellenburg – Chief Hearing Examiner, November 8, 2018.
Original Source: Underground Electric Transmission Lines, Public Service Commission of Wisconsin, May 2011.

IRR of Life-Time Performance of Undergrounding

- Simplified internal rate of return (IRR) analysis of 5-year undergrounding program and forecast of avoided future costs as returns yields positive IRR with only modeling of:
  - Avoided annual maintenance impact
  - Accelerated recovery, repair, and replacement after routine storms
  - Avoidance of the frequency and severity of system impact due to severe or extreme weather or fire risks



Source: Power Delivery Intelligence Initiative (PDI²), The Utility Undergrounding Life-Cycle Cost Guide, Exhibit 4.2 Simplified IRR Analysis of Life-Time Performance of Undergrounding, November 2023, pg. 13.
559, 603, 610, 616,
Interpretive Note: Demonstration that conservative modeling yields a positive IRR between year 10 and year 20 for a 5-year "Strategic" undergrounding program.. Modeling of a "Strategic" undergrounding program and the resulting avoided annual maintenance impacts, demonstrating accelerated recovery, repair, and replacement after routine storms, and avoidance of the frequency and severity of system impact due to severe or extreme weather or fire risks.

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Undergrounding Construction Best Practices *(1 of 3)*

- A total of 23 Best Practices are highlighted in Power Delivery Intelligence Initiative (PDI2), The Utility Undergrounding Life-Cycle Cost Guide along with industry experts that can assist with the investigation or application of these practices.
- In the following pages, a series of 6 practices are profiled:

Source: Power Delivery Intelligence Initiative (PDI^2), The Utility Undergrounding Life-Cycle Cost Guide, Exhibit 3.2 - Utility Undergrounding Innovation & Transformation Tools, November 2023, pg. 11-15.

Undergrounding Construction Best Practices *(2 of 3)*

Innovation	Description/Definition	Impact
Construction Techniques		
Specialty Installation (Shallow Trench, Direct Bury Cable).	Design/permit modifications for shallow/narrow trench; Direct bury due to high performance materials.	**Reduced Installation Cost:** Achieved by reducing civil work, labor cost (pulling), and material cost (conduit).
High Energy (Natural Gas or Plasma fueled) Boring. (EarthGrid)	Specialized boring techniques to place conduit in hard rock, including a tight turning radius to remain within narrow right of way or easement.	**Reduced Installation Cost:** Achieved via more sites where underground cable can be laid without challenge or risk of blasting or breaking hard rock.
Longer Bore Run & Longer Cable Pull Back.	Traditional 300 ft bore runs increased to 800, and potentially 1,500+ feet, due to equipment capability, pull tonnage, design criteria, conduit lubricants, and tension calibration.	**Reduced Installation Cost:** Achieved by reducing the number of access pits and conduit fusion/solvent or cable splicing requirements.
Improved accuracy, reliability, and speed of commissioning tests.	Early identification, location, and repair of performance issues via factory comparable QC test or Offline 50/60Hz PD tests with 5pC sensitivity.	**Reduced Maintenance Costs & Reduced Installation Cost:** Immediate feedback to crews enables use of lower cost, higher risk installation techniques with confidence.

Source: Power Delivery Intelligence Initiative (PDI^2), The Utility Undergrounding Life-Cycle Cost Guide, Exhibit 3.2 - Utility Undergrounding Innovation & Transformation Tools, November 2023, pg. 12.

Undergrounding Construction Best Practices *(3 of 3)*

Innovation	Description/Definition	Impact
Construction Techniques		
Prefabrication.	Factory-made components tested in a controlled setting (precast manholes, equipment pads, duct banks, etc.).	**Reduced Installation Cost:** Prefab components reduce installation time, work rigor, simplify on-site work, and reduce highly skilled trade requirement. Savings on thermal backfill or concrete curing requirements, conduit fusion/ solvent requirements, no formwork or steel reinforcement needed, etc. 559, 607
3D Design paired with site visualization and mapping.	Dimensionally accurate 3D standards for equipment applied to geographically positioned mapping visualization using geographic information system (GIS) or similar tool.	**Reduced Installation Cost:** Allows for higher accuracy between design and site conditions where knowledge of the road, right of way, and other obstacles are defined and results in reduced installation time and cost. 559

Source: Power Delivery Intelligence Initiative (PDI^2), The Utility Undergrounding Life-Cycle Cost Guide, Exhibit 3.2 - Utility Undergrounding Innovation & Transformation Tools, November 2023, pg. 12.

Thank You

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