Ongoing research into failure rates and demographics of cables in North America

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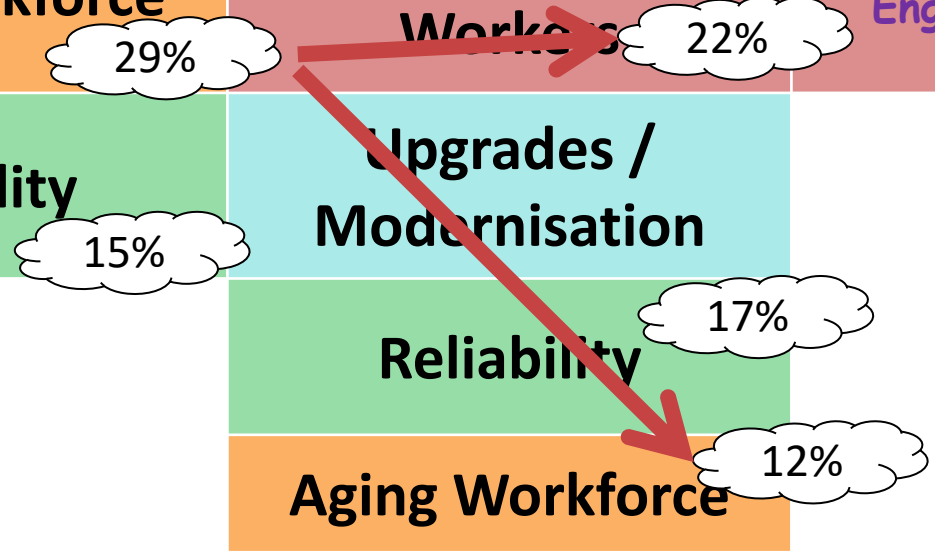
Distribution Asset Top 3 Challenges: Black & Veatch

	2016	2019	2024	Towards 2028
1	Reliability	Aging Infrastructure	Renewables	Renewables
2	Aging Infrastructure	Renewables	Aging Infrastructure	Supply Chain
3	Aging Workforce	Aging Workforce	Lack of Skilled Workers	Lack of Workers Engineer, Maintain, Operate
4	Renewables	Reliability	Upgrades / Modernisation	
5			Reliability	
6			Aging Workforce	



Source: Black & Veatch Annual Electric Reports

Ageing Infrastructure – what do you need to know?

- How much
- How old
- What is failing
- Is my system failing at a high rate
- What is a typical failure rate

- Generally information is not available in one place within a utility
- It most often resides as “Institutional Knowledge” within the ranks of long term experienced engineers

Can the Internet and AI help us?

what is the reliability of electric distribution components

The **reliability of electric distribution components** is a critical factor in maintaining the overall performance and stability of a power distribution system. Reliability here refers to the **ability of a component to perform its intended function without failure over a specified period under normal operating conditions.**

Component	Typical Reliability	Common Issues
Transformers	High (MTBF: 20–40 years)	Overheating, insulation breakdown, oil leaks
Circuit Breakers	High (MTBF: 15–30 years)	Mechanical wear, contact erosion
Switches (e.g., reclosers)	Medium-High (MTBF: 10–20 years)	Mechanical failure, control logic issues
Fuses	High (simple and passive)	Nuisance blows, aging of material
Cables & Conductors	Medium-High (life expectancy: 30–50 years)	Insulation failure, corrosion, physical damage

What is the failure rate of underground power cables

The failure rate of underground power cables can vary depending on factors like cable type, installation quality, and environmental conditions. Studies indicate that a significant portion of failures—over 50%—are related to installation issues, such as poor insulation surface preparation or improper techniques [1]. Other causes include aging, external damage, and manufacturing defects [1].

If you'd like, I can help you explore specific types of cables or mitigation strategies to reduce failure rates!

[1] www.jicable.org

A Review of the Reliability of Electric Distribution System Components: EPRI White Paper

1001873

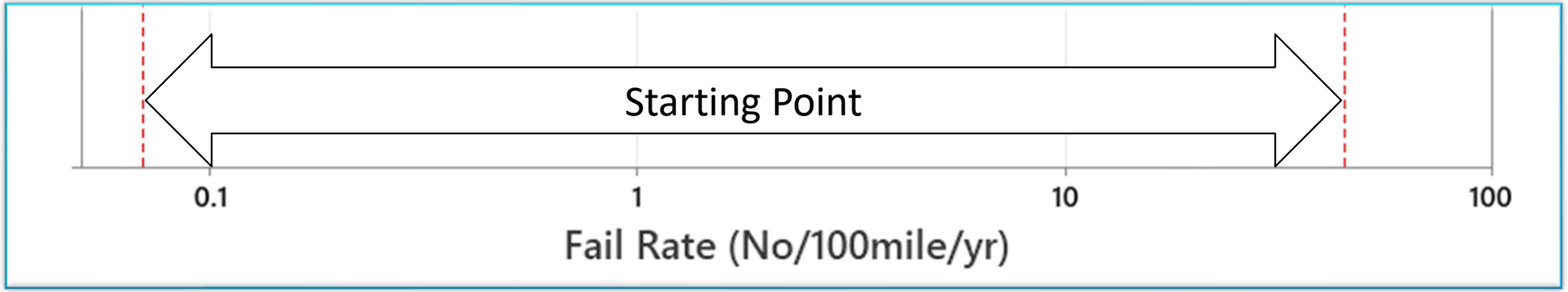
Technical Progress, December 2001

0.07 to 45
fails / 100 miles / year

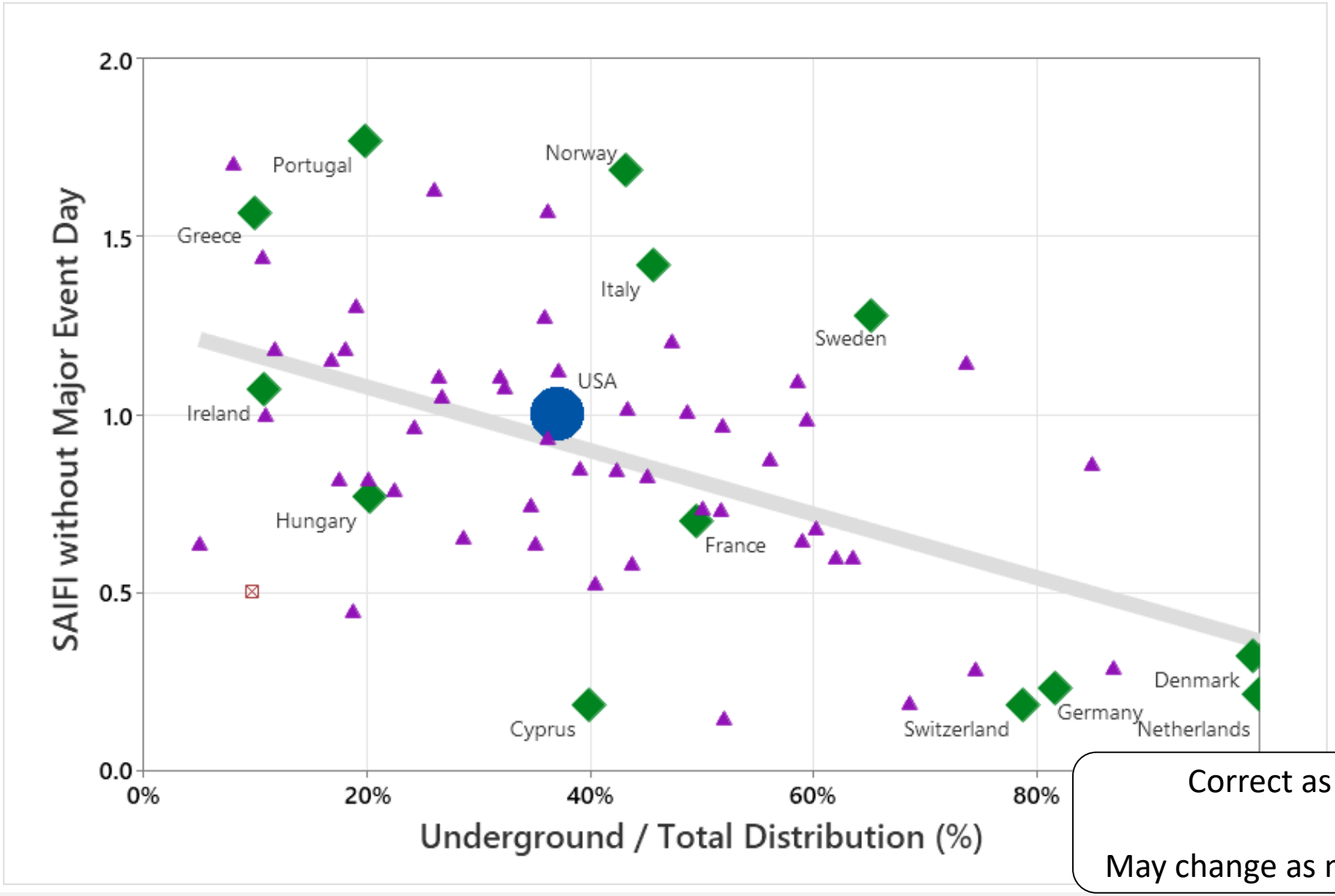
Age of the data sources
1974 - 2000

Approach

- Reach out to a wide range of utilities
- Select a specific time
- Request information / “Institutional Knowledge” available to hand
  - Failures, Source of failures
  - Lengths installed & being installed
  - Age estimates



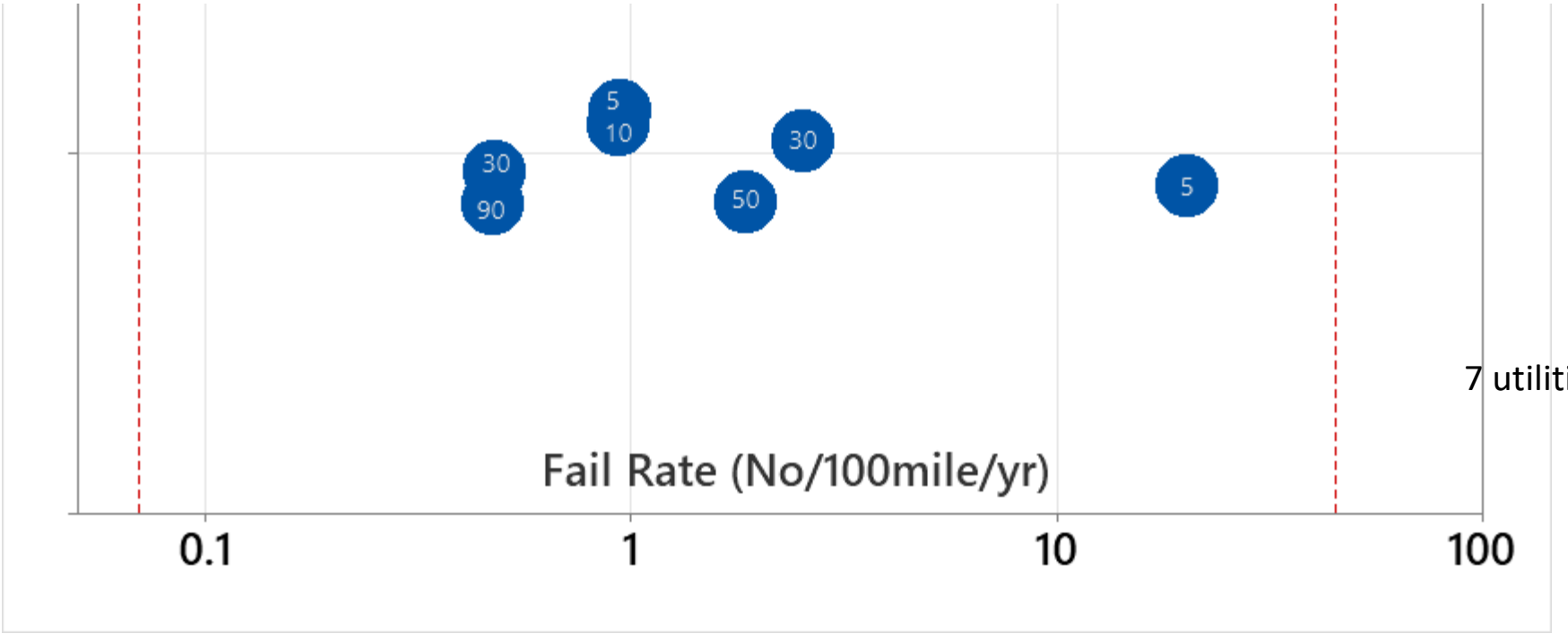
Impact of Undergrounding on Reliability



Correct as of March 2025

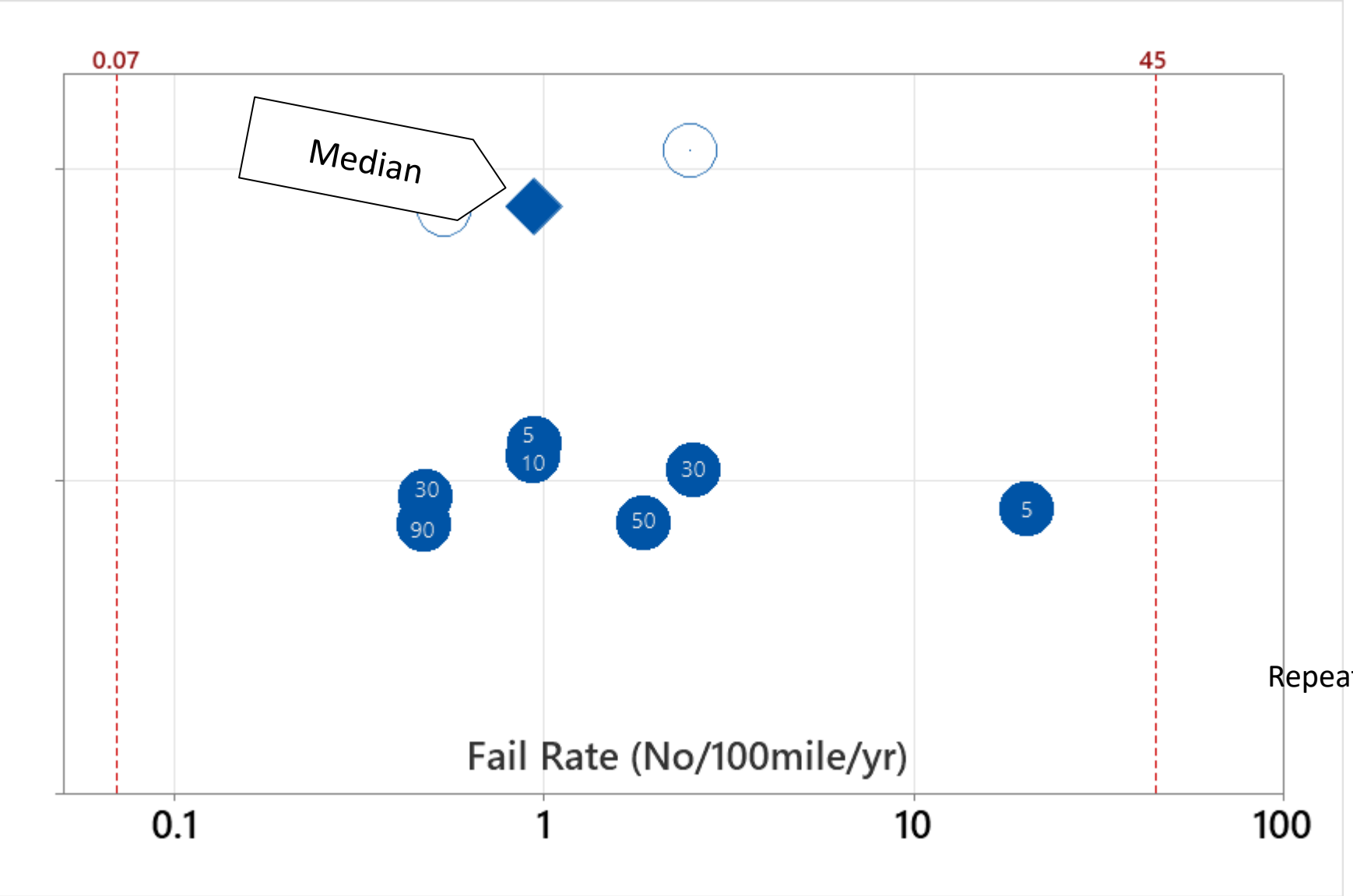
May change as more data is included

Failure Rate Estimation



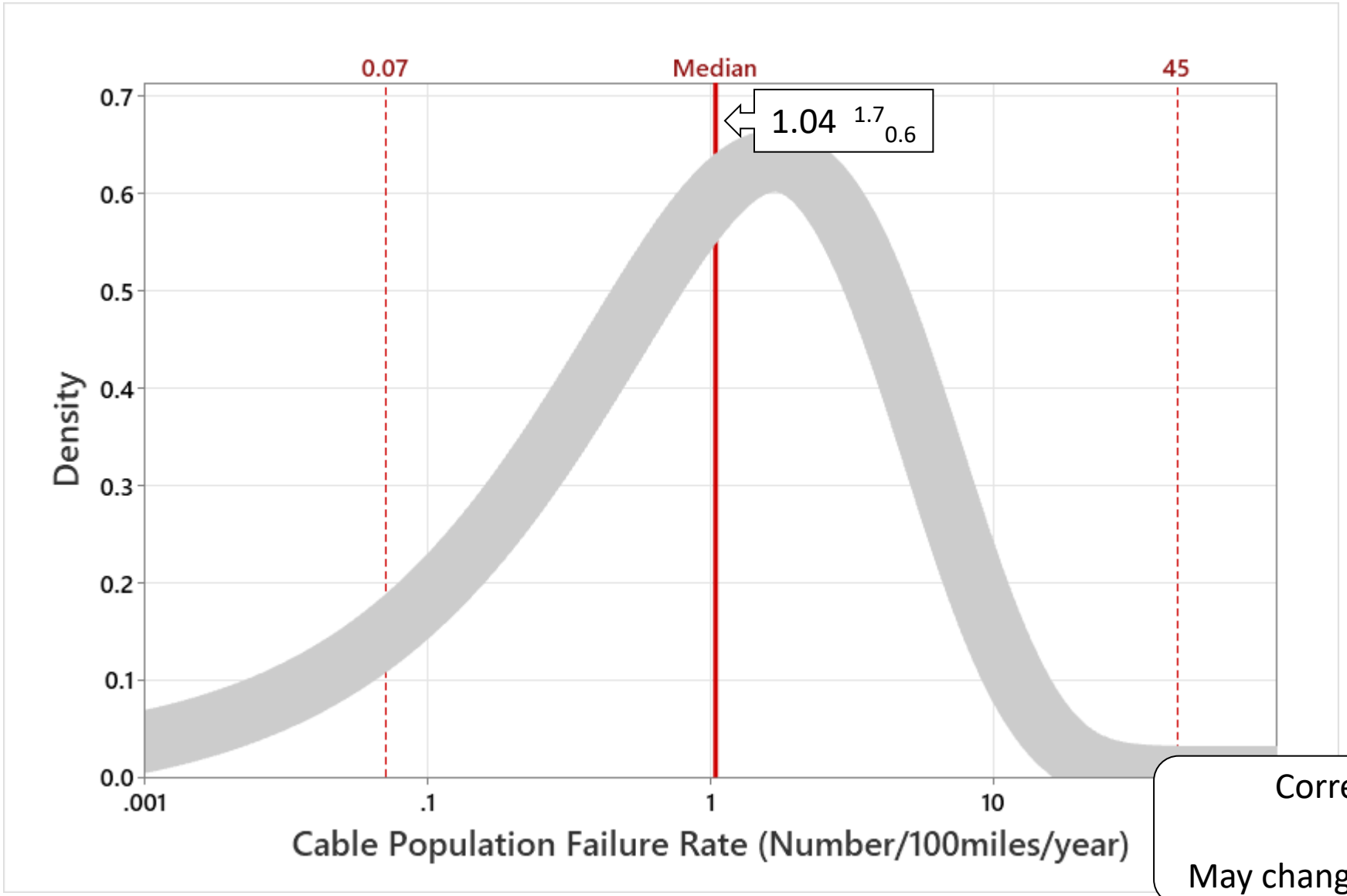
7 utilities

Failure Rate Estimation



Repeat for >30 more utilities

Estimated Failure Rate - respondents



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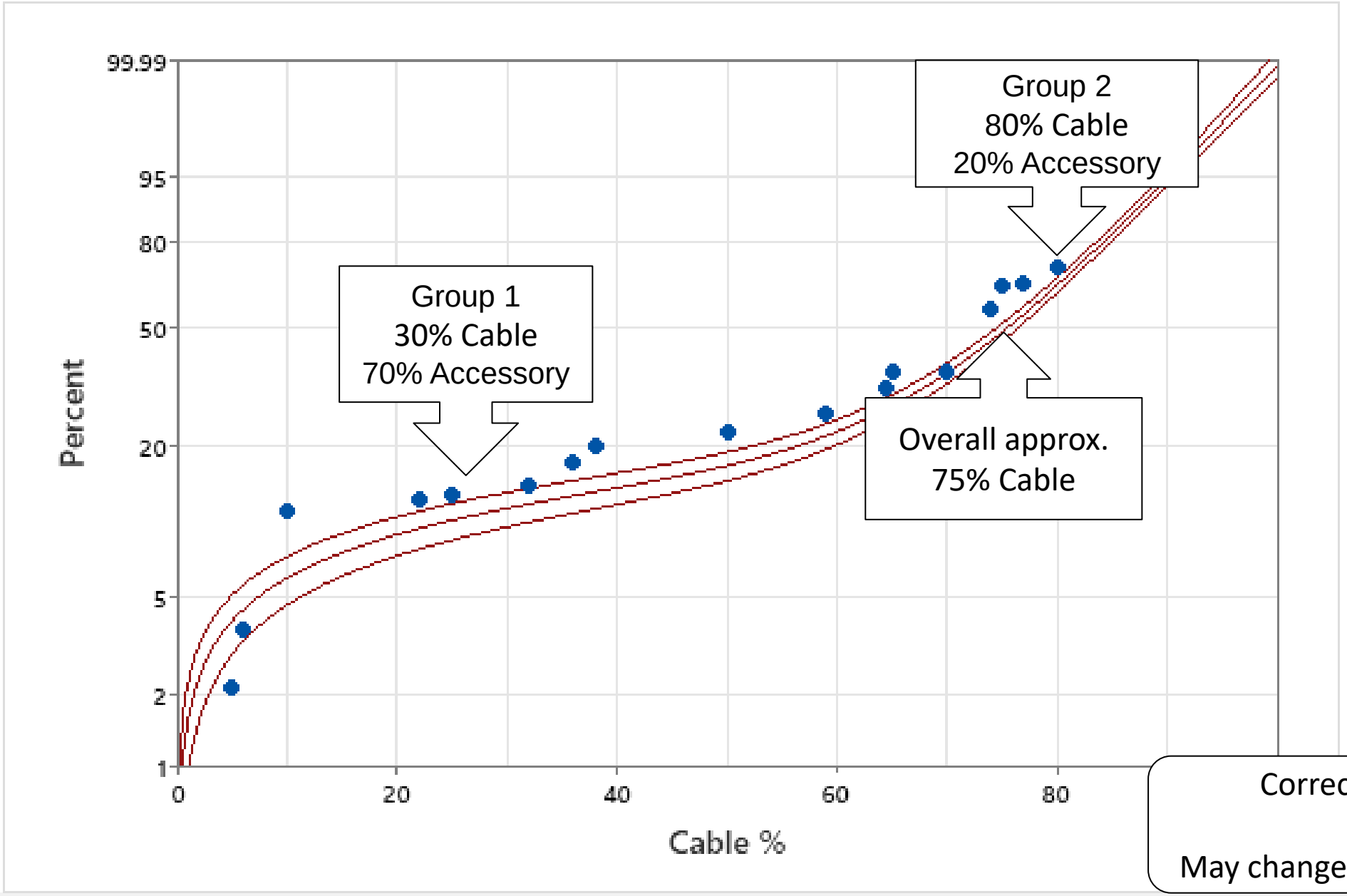
Source of failures – accessories / cable



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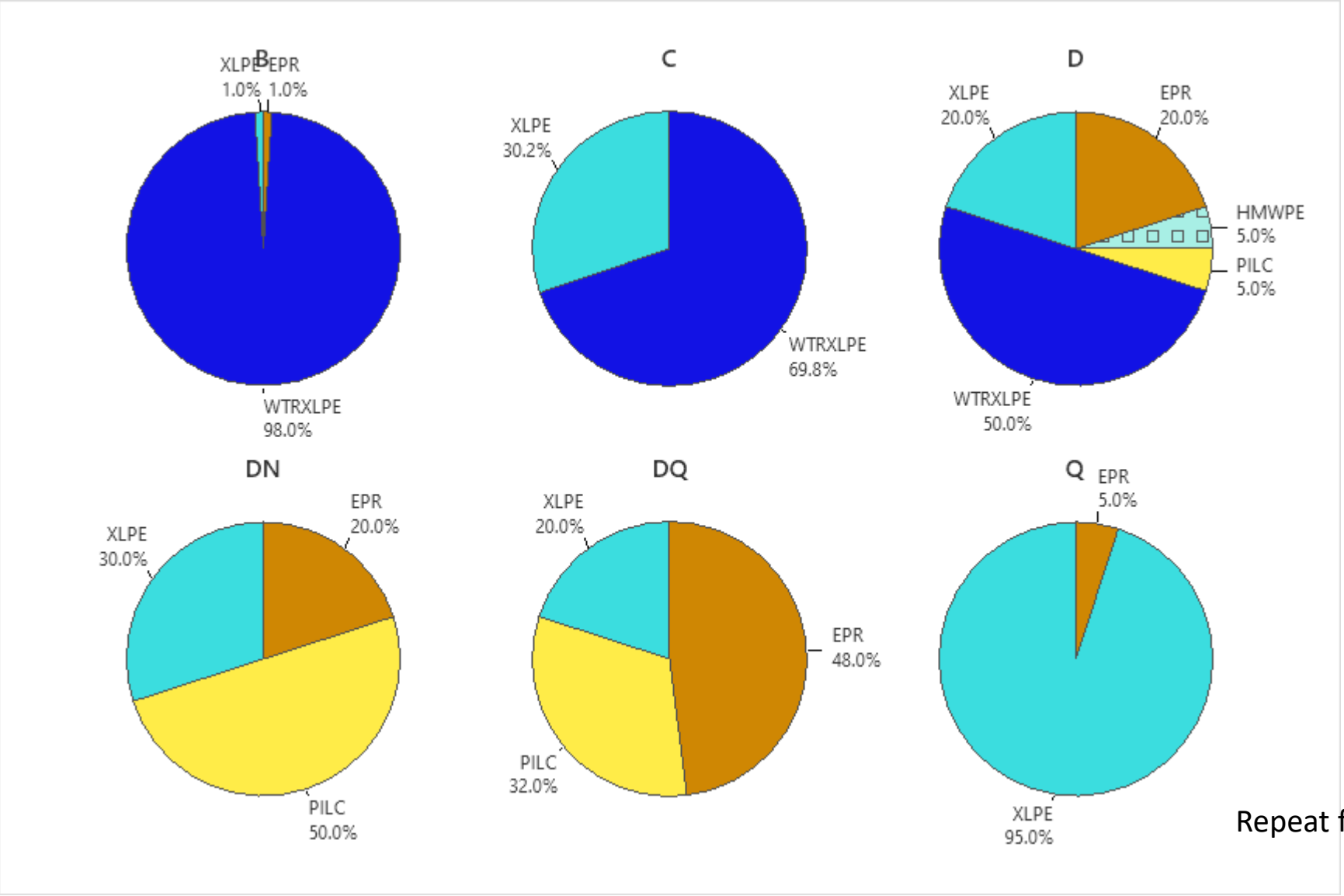
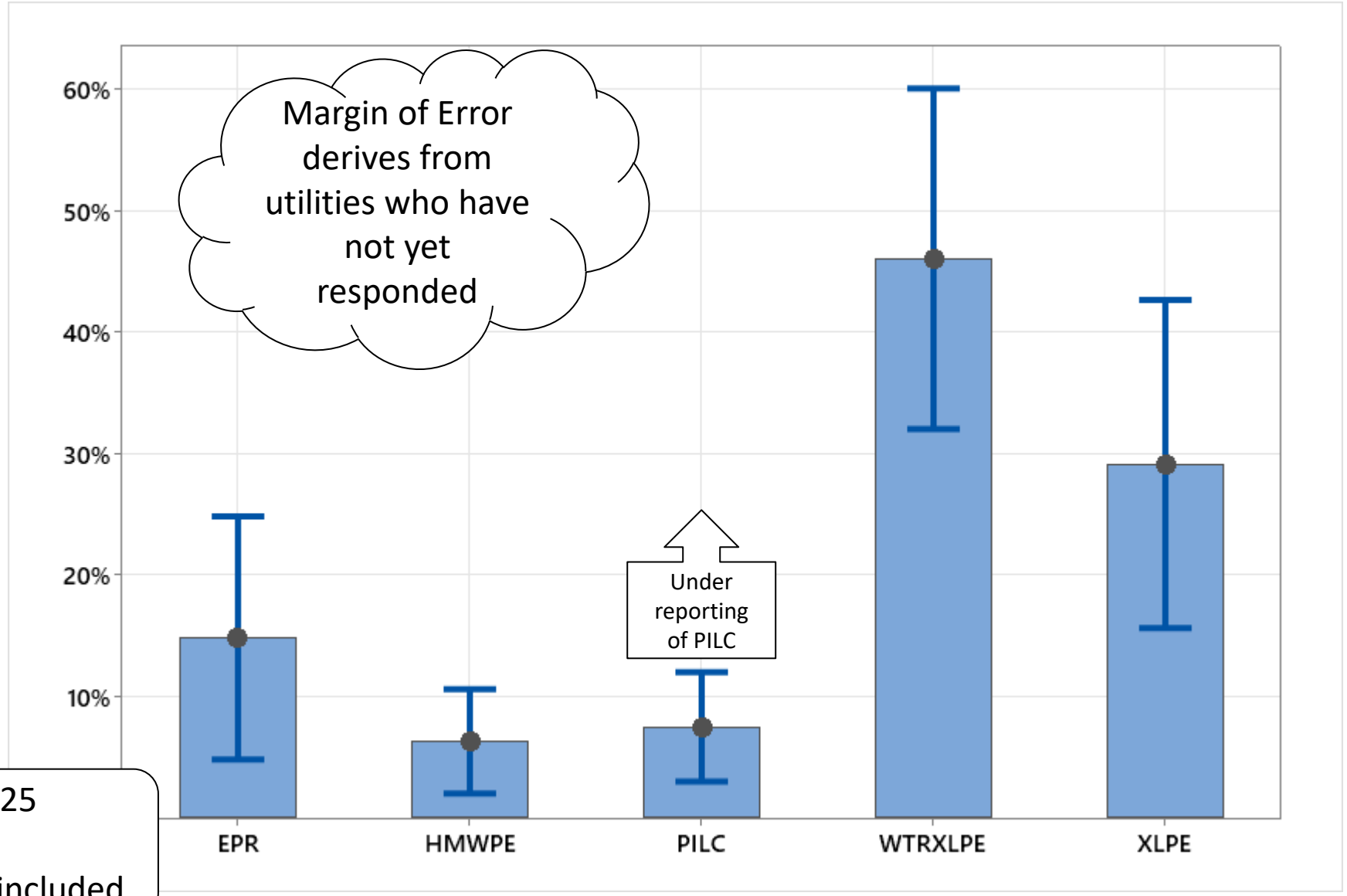
Population Disbursement



Repeat for >35 more utilities

Estimate of Cable Technologies: current Fleet - respondents



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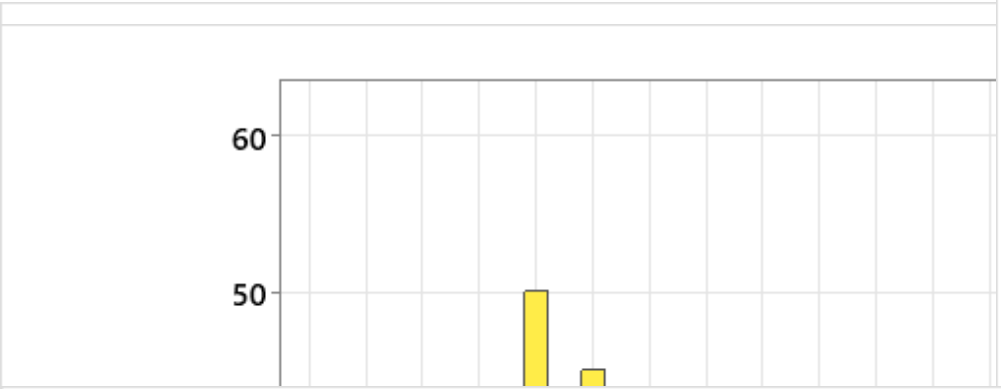
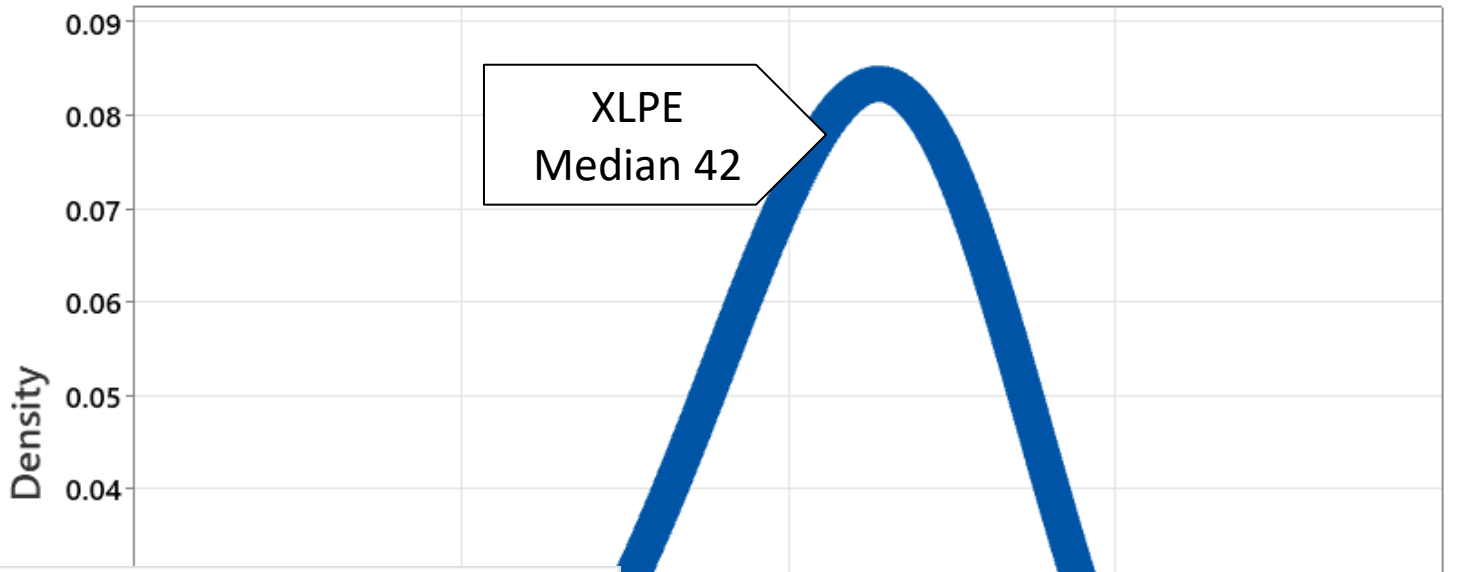
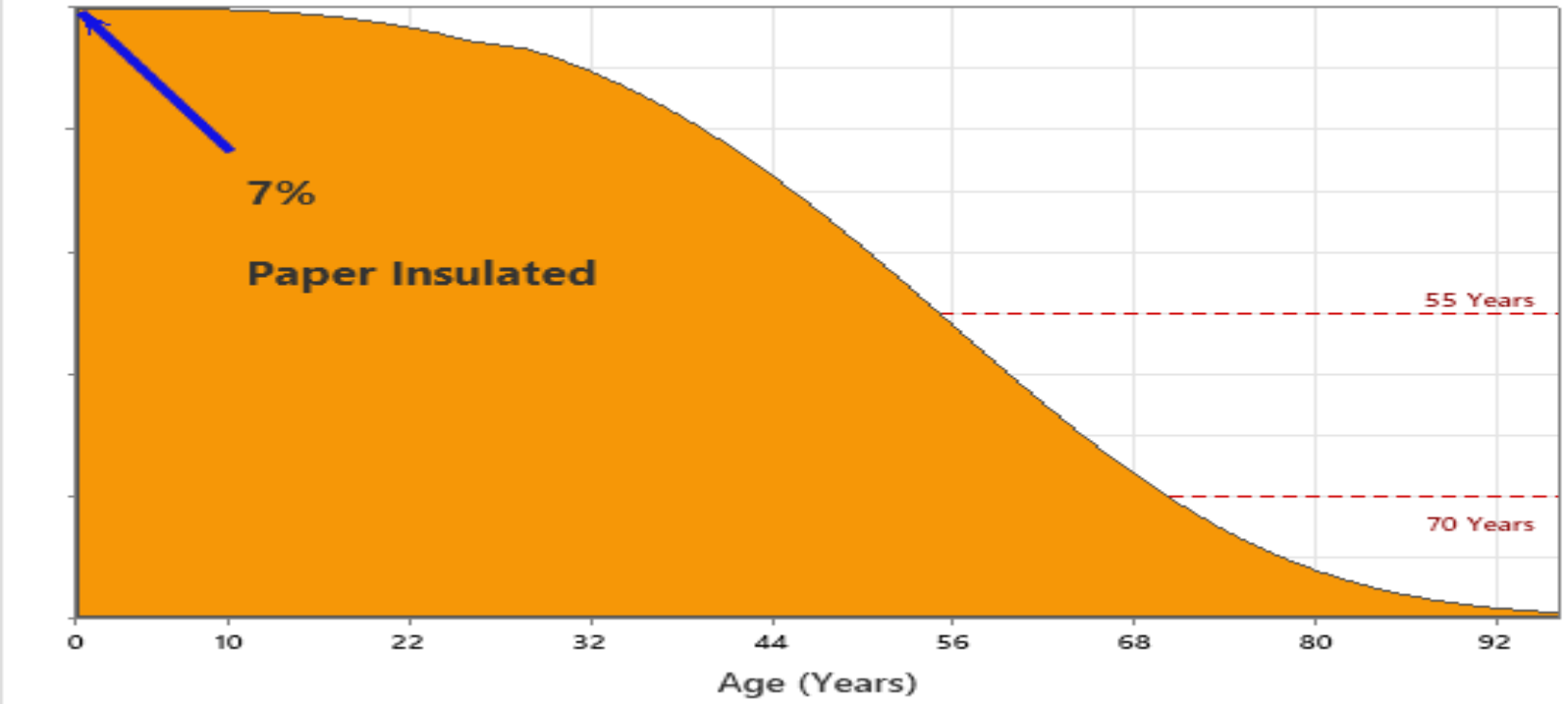
Age Disbursement



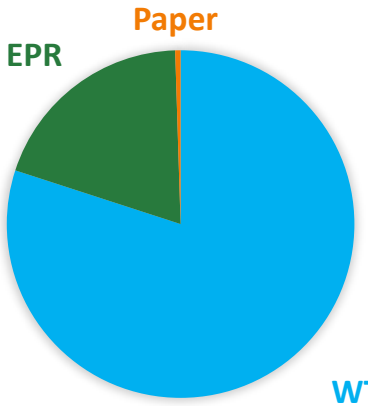


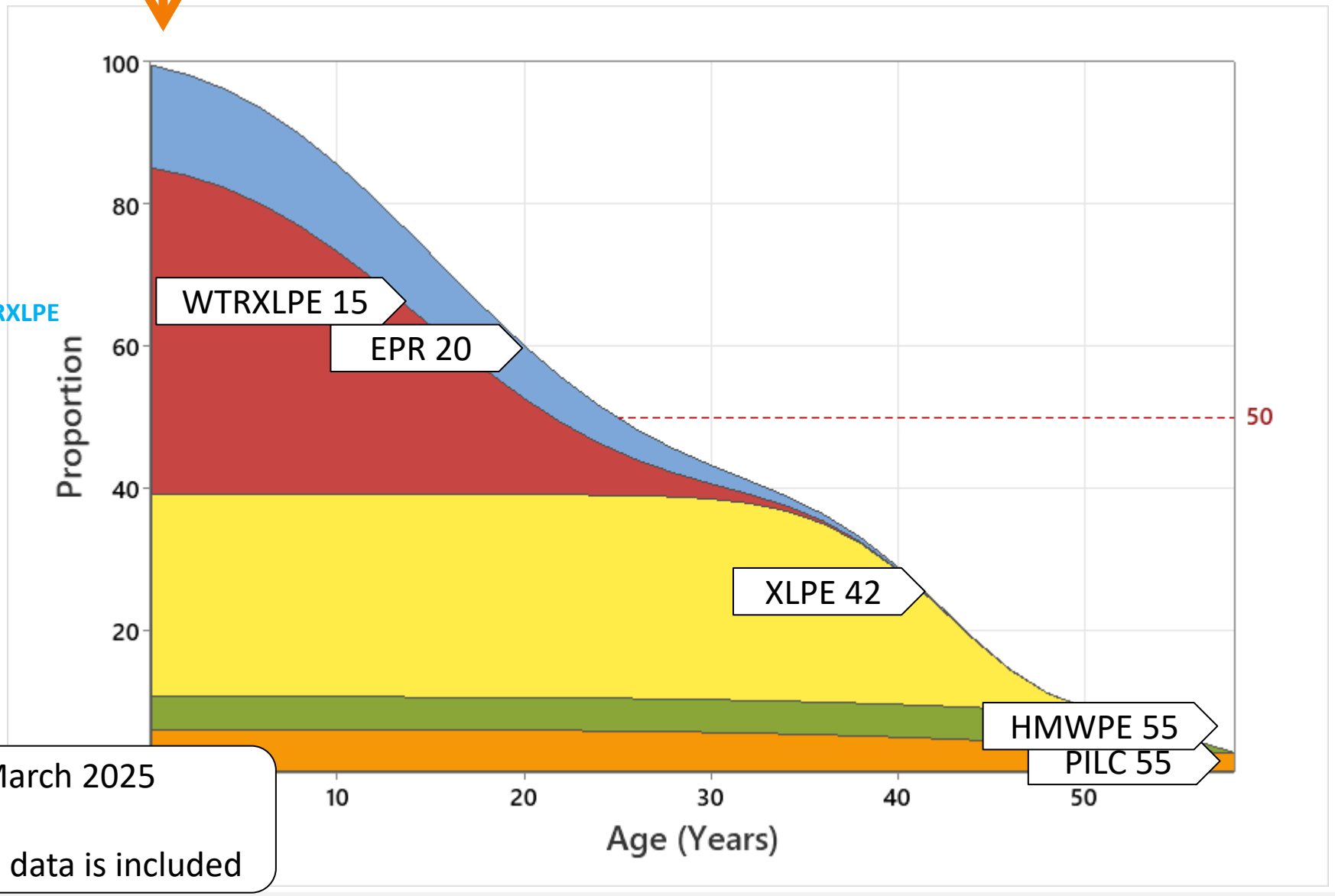


Repeat for >40 more utilities

Age Distribution & Median Age: current Fleet

CURRENT INSTAL





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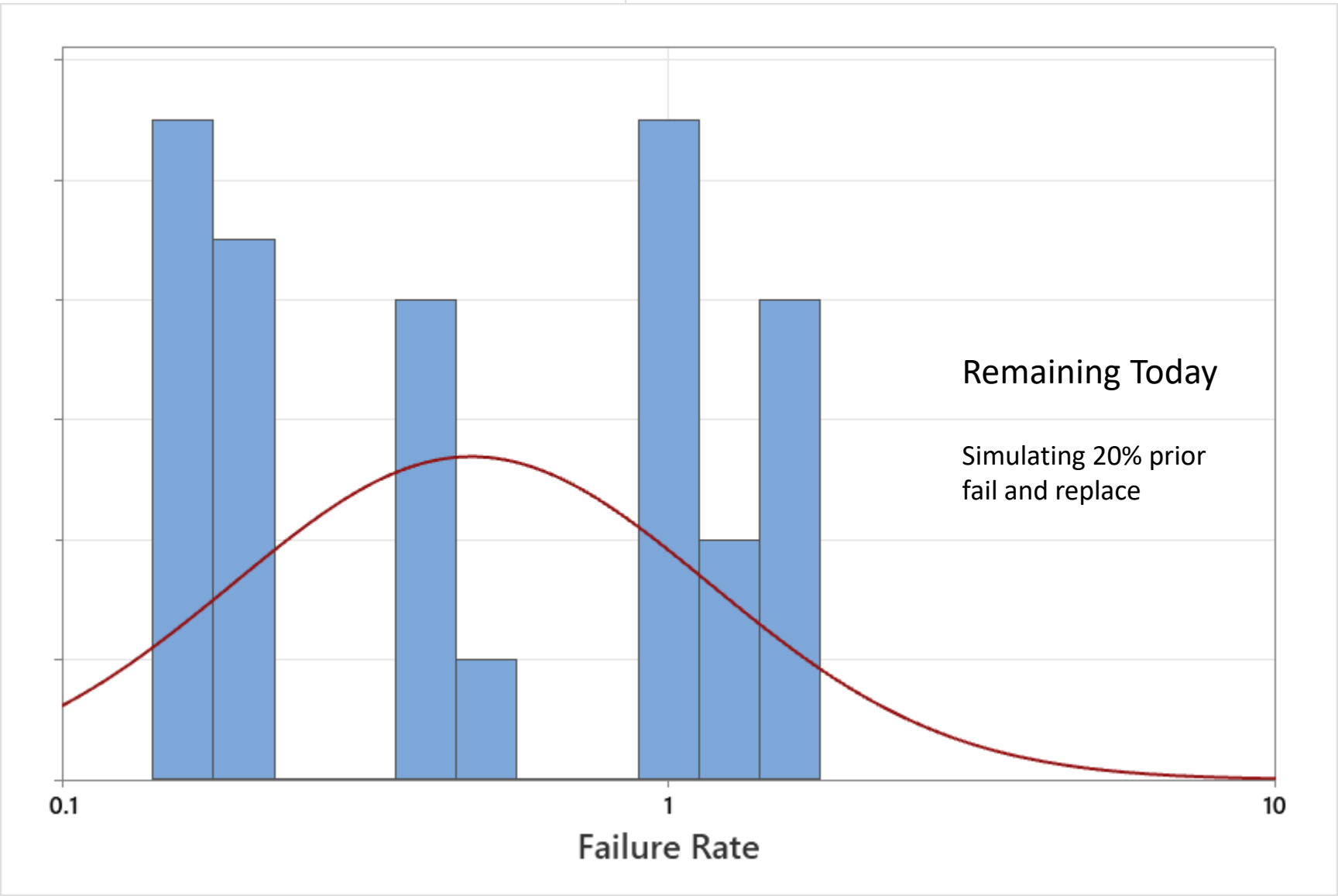
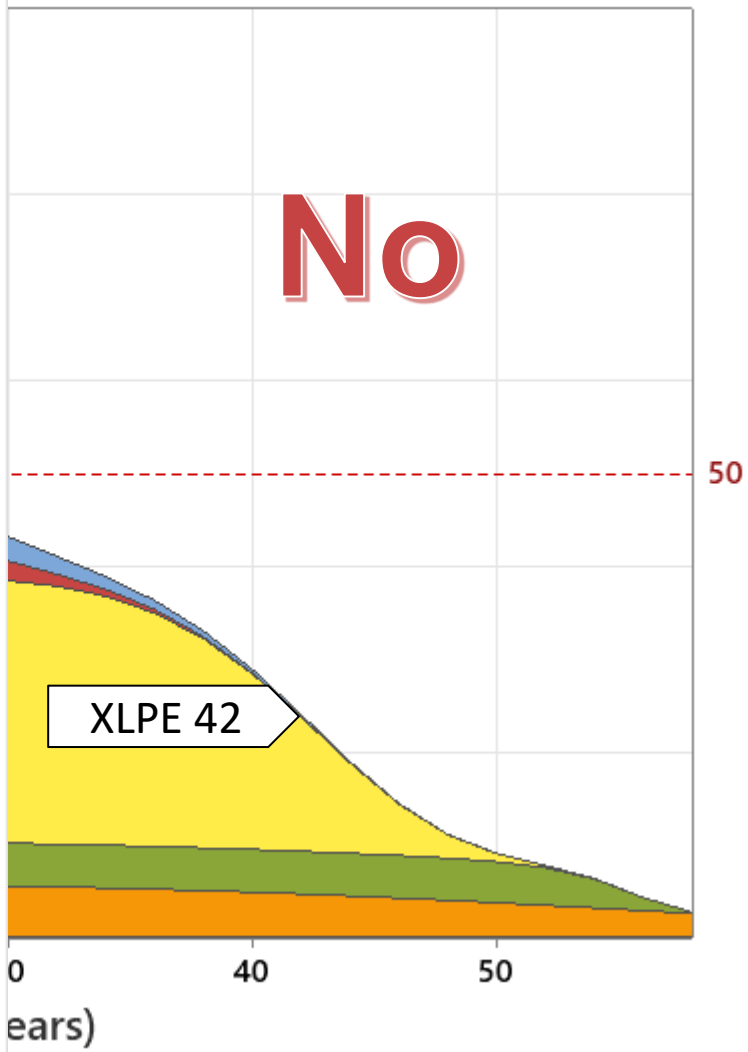
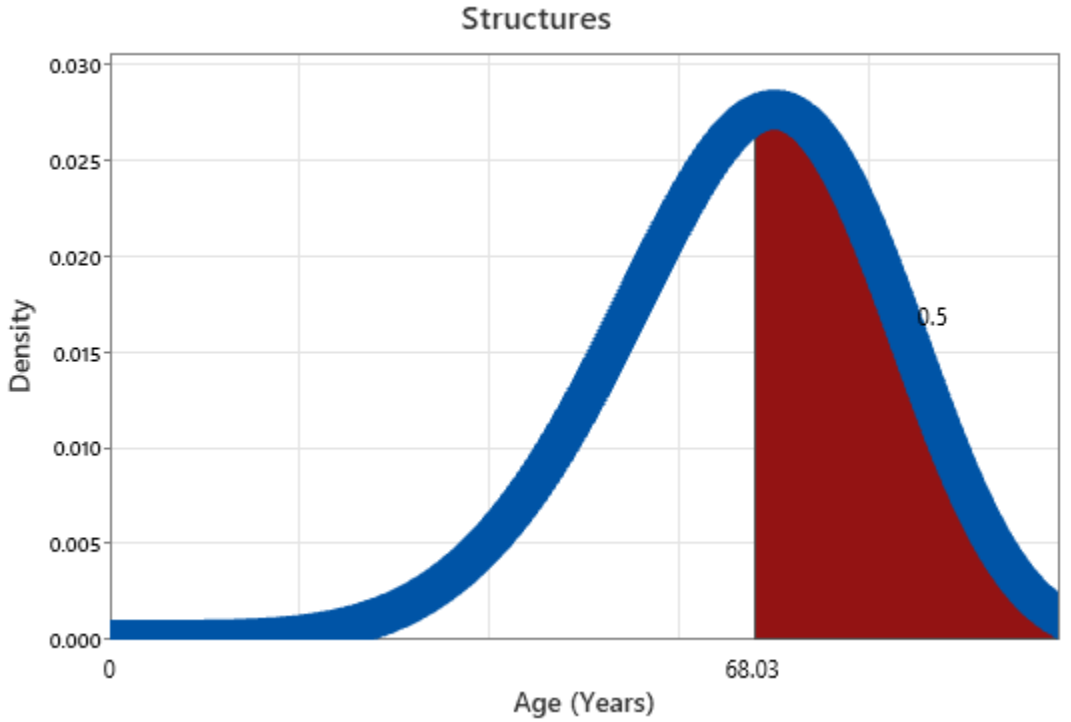
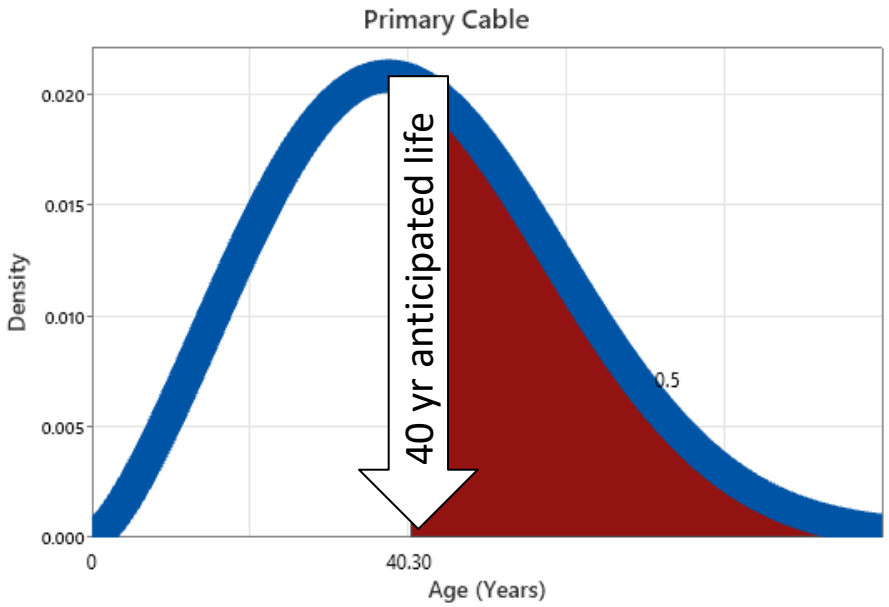
Does this mean the life expectancy of XLPE was 42 Years?

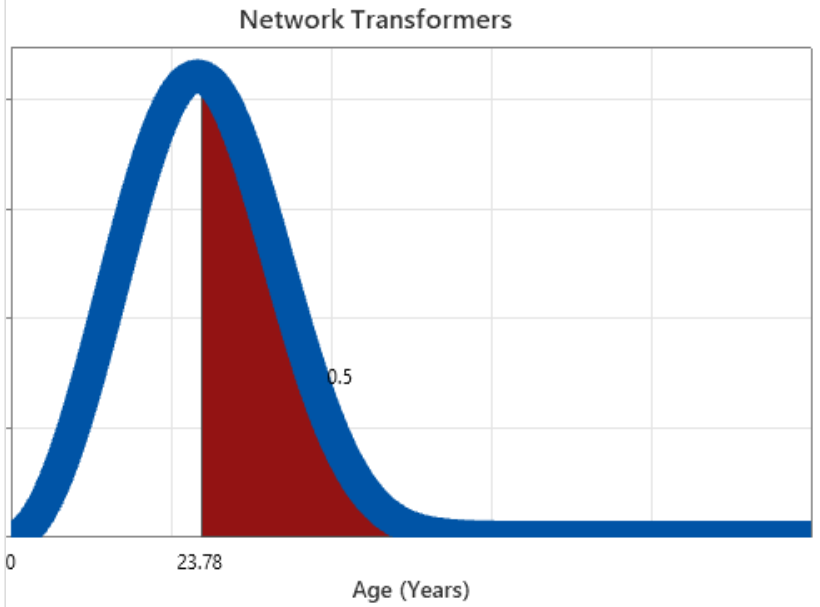


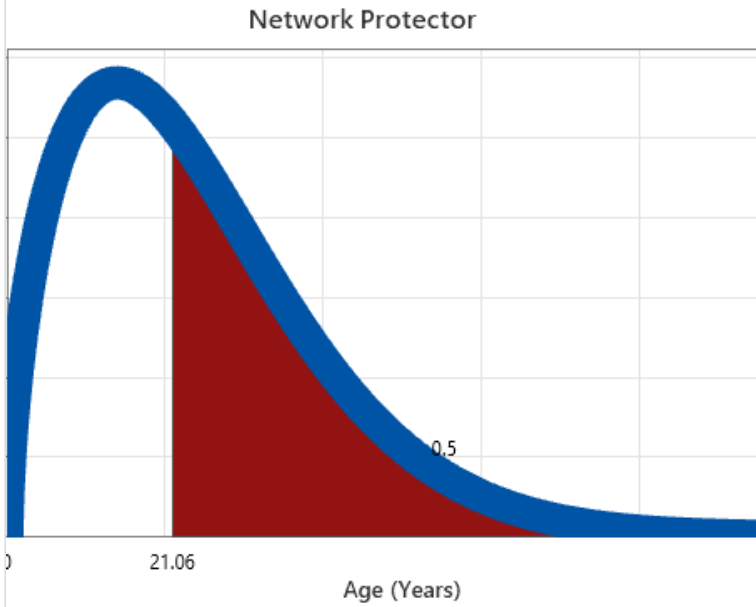


Multi Component - Networks









In Conclusion

1. Initially optimistic that it would be straightforward to capture Failure and Demographic Data
2. “Institutional Knowledge” is quickly leaking away. This will make managing the health of ageing assets more difficult in years to come
3. We are making strides – this work
4. AI can assist but not solve – use some real intelligence to point the AI in the correct direction
5. Set yourself up for success in the future – talk to me at this meeting on how to participate in the improving the info to hand

Hopefully, with your assistance, this will be out of date by the next meeting as we add information from more utilities

Nigel Hampton has more than 35 years of experience in the MV, HV & EHV cable field at BICC in the United Kingdom, Borealis in Sweden, NEETRAC, UL Solutions and currently EPRI in the United States. He has been active in the international community of CIGRE participating in WG's on Space Charge, Water Tree Diagnostics, HVDC Testing and most recently as the US representative on the Reliability Analysis Group for HV & EHV. Nigel currently Chairs IEEE400.0 Field Testing Techniques and IEEE400.2 Field Testing using VLF Sources. Nigel has served as the Technical Advisor to the AEIC Cable Engineering Committee since 2008.

His current research interests include: Extruded MVDC, VLF Diagnostics, Cable System Ageing, Forensics, HV & EHV Cable Systems.