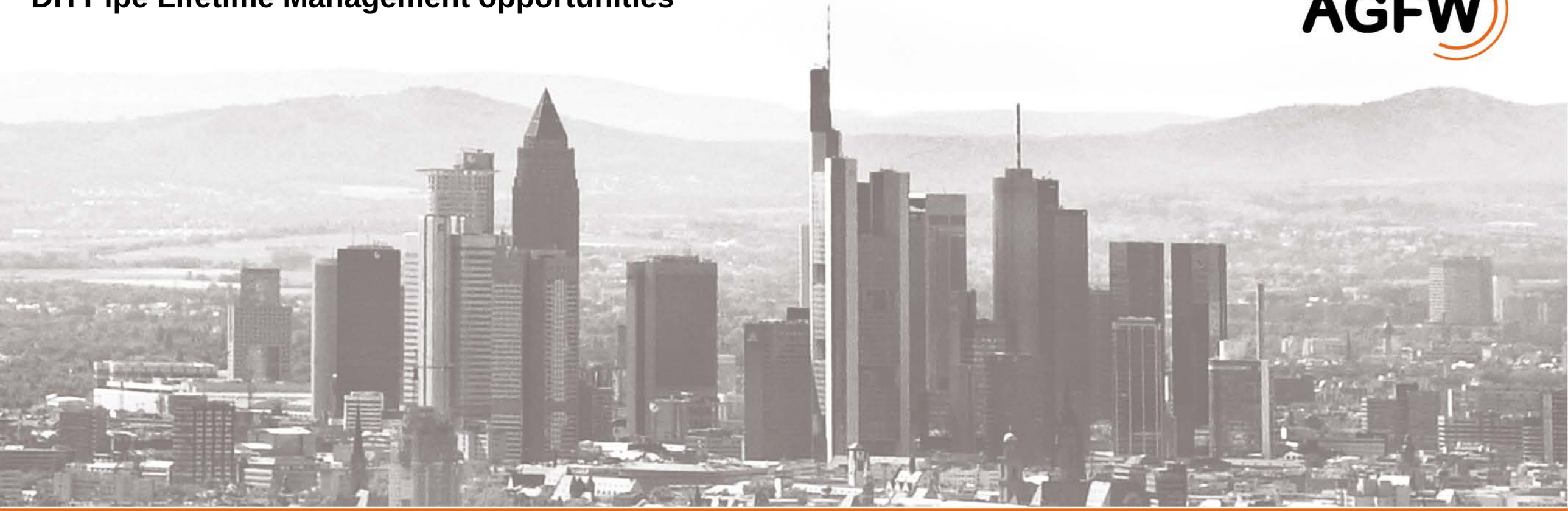
DH Pipe Lifetime Management opportunities



Sebastian Grimm M.Sc.

Department of Research & Development

AGFW | Energy efficiency association for heating, cooling an CHP

WÄRME | KÄLTE | KWK

“Product Lifecycle” of DH Pipes

Overview on relevant national and European standards and acknowledged rules of technology for DHC

Established methods & Ongoing research activities

National research project DH pipe restorations – with Cured-in-place pipe (CIPP) systems

“Product Lifecycle” of preinsulated bonded DH Pipes

Design → Production → Installation → Operation → Condition assessment → Restauration

“Product Lifecycle” of preinsulated bonded DH Pipes

Relevant Standards

- **AGFW FW 401** Installation and calculation of preinsulated bonded pipes for district heating networks
- **EN 253** Bonded single pipe systems for directly buried hot water networks – Factory made pipe assembly of steel service pipe, polyurethane thermal insulation and a casing of polyethylene;
- **EN 13941** District heating pipes – Design and installation of thermal insulated bonded single and twin pipe systems for directly buried hot water networks
- **EN 448, EN 489, EN 14419, EN ISO 9001, …**

- Dimension of the pipes
- Quality requirements of the materials
- Requirements for material interfacing (e.g. welding methods)
- Qualification requirements for the workers (e.g. underground working, sleeve installer)
- Etc.

“Product Lifecycle” of preinsulated bonded DH Pipes

Relevant Standards

- **EN 13941** District heating pipes – Design and installation of thermal insulated bonded single and twin pipe systems for directly buried hot water networks
- **AGFW FW 510** - Requirements for circulation water in industrial and district heating systems and recommendations for their operation
- Etc.

- Max. temperature change rate of 10 K/h
- Number of full action cycles (depending on pipe character)
- Operation temperature level (up to 120°C and max. 140°C for max. 300h/year)
- Etc.

“Product Lifecycle” of preinsulated bonded DH Pipes

Relevant Standards

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- **AGFW FW 510** - Requirements for circulation water in industrial and district heating systems and recommendations for their operation
- Etc.

- Water treatment techniques
- Operation mode (low-salt or salty water)
- Conditioning
- Monitoring of water quality
- Hygienic, toxicological and environmental aspects

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- Etc.

Property	Unit	Low -salt		Salty
Electrical conductivity at 25 °C	µS/cm	10 - 30	> 30 -100	≥ 100 - 1500
Appearance		clear, free of suspended substances		
pH value at 25 °C		9.0 – 10.0	9.0 – 10.5	9.0 – 10.5
Oxygen	mg/l	< 0.1	< 0.05	< 0.02
Sum of alkaline earth (hardness)	mmol/l (°dH)	< 0.02 (< 0.1)	< 0.02 (< 0.1)	< 0.02 (< 0.1)

“Product Lifecycle” of preinsulated bonded DH Pipes

Design → Production → Installation → Operation → **Condition assessment** → Restauration

Established methods

- Crawler eye (for hooded channels)
- Statistic methods of service lifetime prediction
  - Number of full action cycles
  - Number of damages per km trace
- Leak detection
- Water losses (refills per year)
- Thermal imaging (via airplane, drone)

Source: AGFW

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www.upgrade-dh.eu

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Source: SCANDAT GmbH

“Product Lifecycle” of preinsulated bonded DH Pipes

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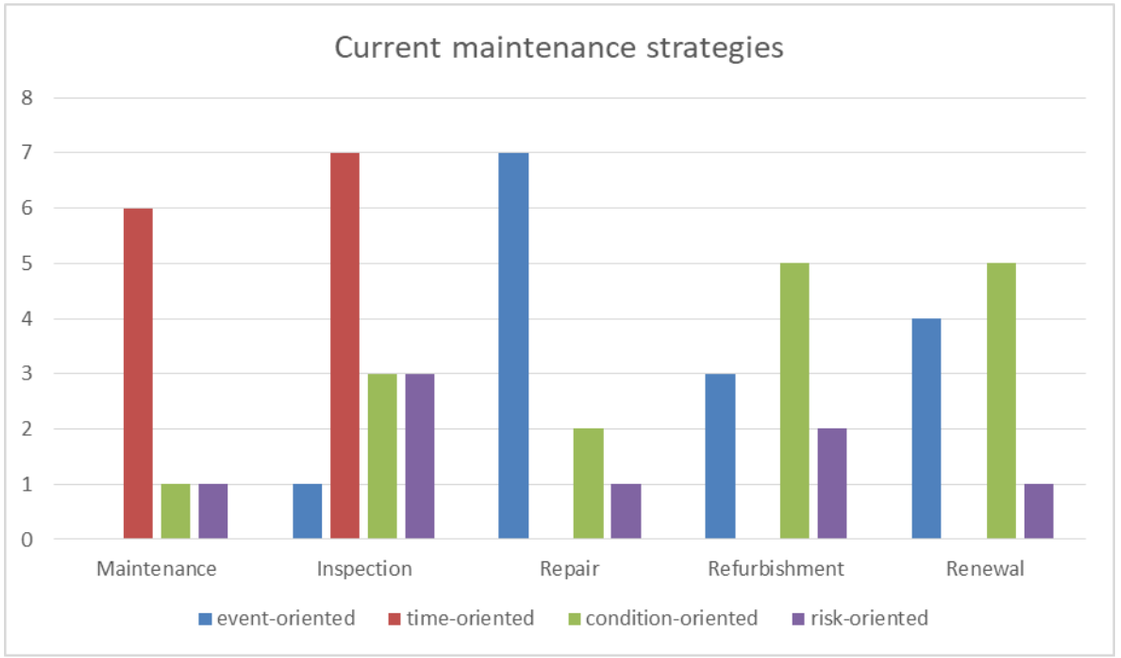
- Collection of statistical data – „AGFW Damage Database“
- Finalised national research project on operational life span analysis of heating grids– „Technische Gebrauchsdaueranalyse“
- RISE Plug Method
- Consolidation of the international research results within the framework of a new IEA DHC Task Shared project



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Improving:

- statistical lifetime models
- thermal ageing models
- damage accumulation theories

“Product Lifecycle” of preinsulated bonded DH Pipes

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Source: Exemplary overview of various piping systems from AGFW Bestands- & Schadensdatenbank

Current Information on Database (01.09.2020):

- Acquisition status (iventory): approx. 41,000 data records
- Acquisition status (damage): approx. 1,200 data records

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New information on:

- material degradation of the individual system components (PUR-foam, steel, PE casing)
- Aging processes
- Failure criteria

EN publications

- Villalobos F., Hay S., Weidlich I., Wolf I. "Design, Construction, and Operation of a Monitored District Heating Pipeline System", Journal of Pipeline Systems, Engineering and Practice, August 2019, Volume 10 - Issue 3, American Society of Civil Engineers, 2019.
- Hay S., Villalobos F., Weidlich I., Wolf I., "Analyses of Axial Displacement Measurements from a Monitored District Heating Pipeline System", In: Energy Procedia, Volume 149, 16th International Symposium on District Heating and Cooling, DHC2018, 9–12 September 2018, Hamburg.

“Product Lifecycle” of preinsulated bonded DH Pipes

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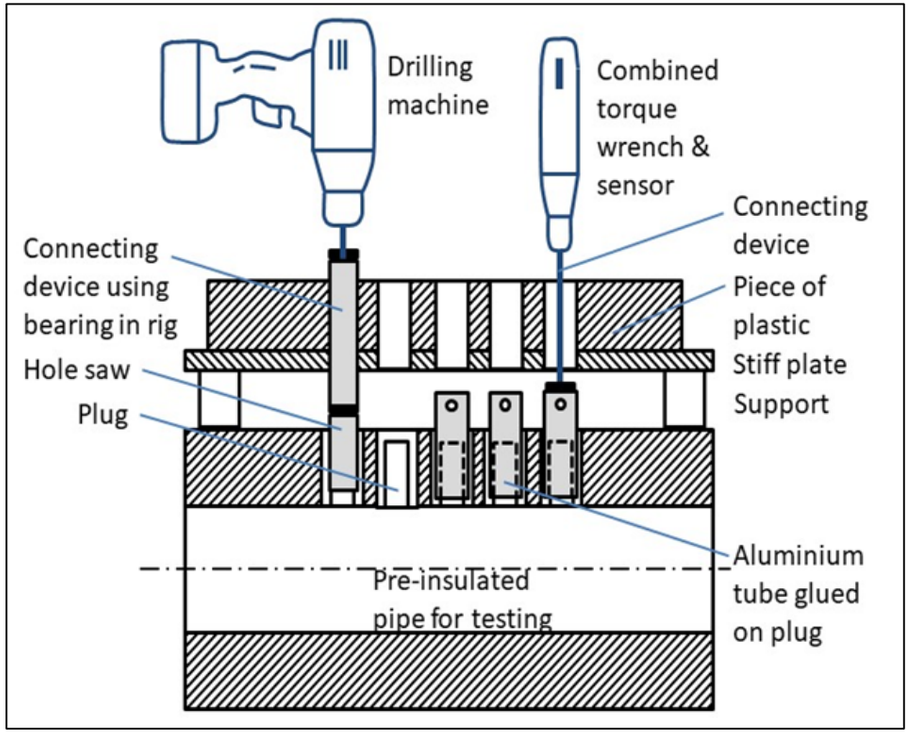

Source: IEA DHC - Annex XII final report Effects of Loads on Asset Management of the 4th Generation District Heating Networks

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“Status assessment, ageing, lifetime prediction and asset management of District Heating (DH) Pipes”

Project objectives

- There is a need to revise the current Standards in order to gain more realistic results
- Improve calculation rules and models for lifetime prediction of DH pipes
- Suggestions for the revision of the current Standards and Recommendations
- Further information (participation): here

“Product Lifecycle” of preinsulated bonded DH Pipes

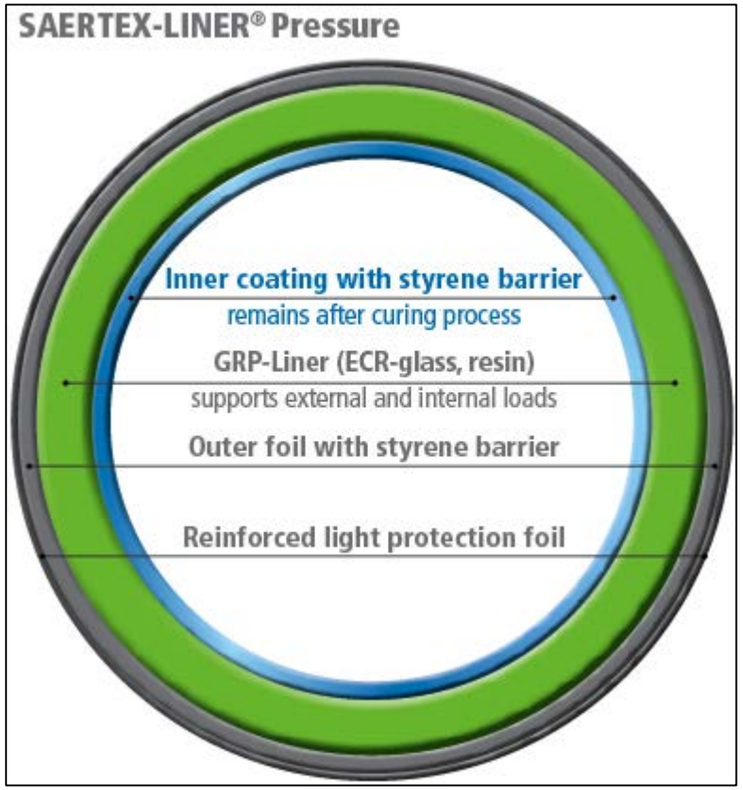
Design → Production → Installation → Operation → Condition assessment → **Restauration**

Ongoing national research project:
“Possibilities and restrictions of district heating pipe restorations – with Cured-in-place pipe (CIPP) systems“ – FW-Liner

Supported by:

Federal Ministry
for Economic Affairs
and Energy

on the basis of a decision
by the German Bundestag

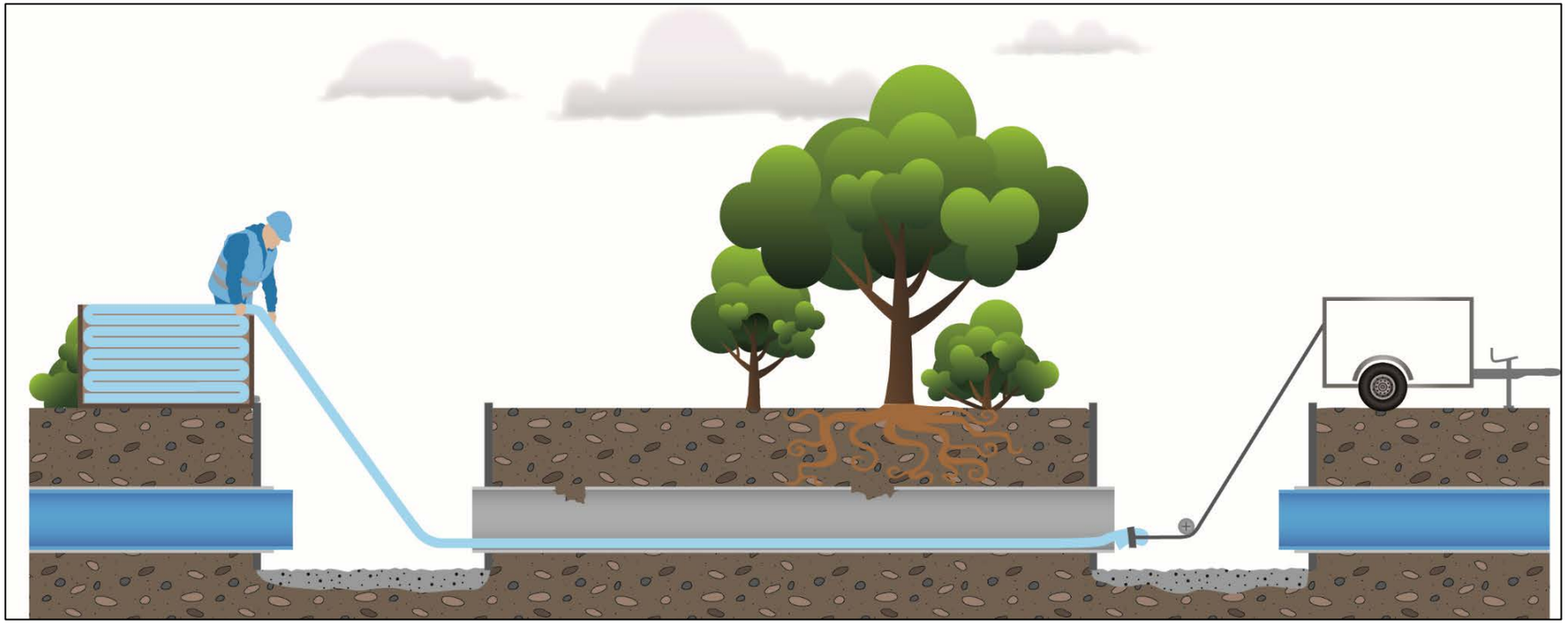


Source: SAERTEX multiCom®

“Product Lifecycle” of preinsulated bonded DH Pipes

Design → Production → Installation → Operation → Condition assessment → **Restauration**

Step 1



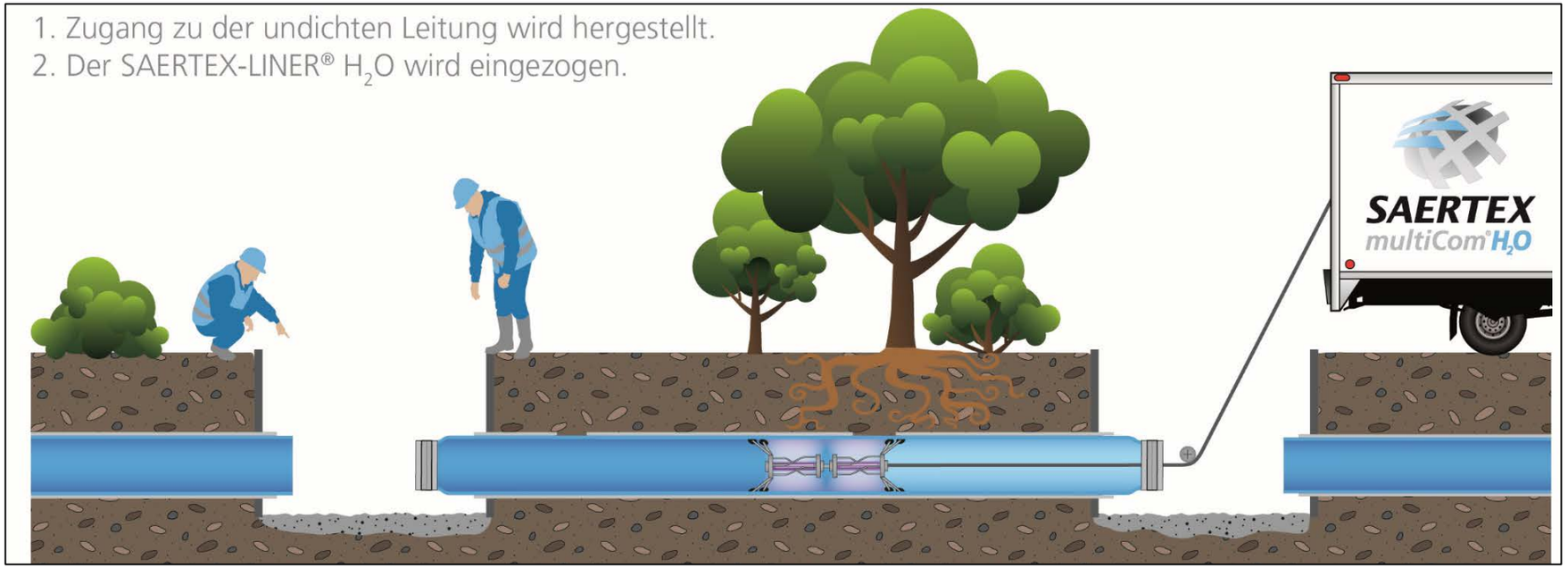
Source: SAERTEX multiCom®

- Identify the imperfect part of the pipe
- Create access to the effected area
- Pull in the flexible tube of fiberglass plastic

“Product Lifecycle” of preinsulated bonded DH Pipes

Design | Production | Installation | Operation | Condition assessment | Restauration

Step 2



Source: SAERTEX multiCom®

- Pressurise the flexible tube
- Harden the system with ultra violet light

“Product Lifecycle” of preinsulated bonded DH Pipes

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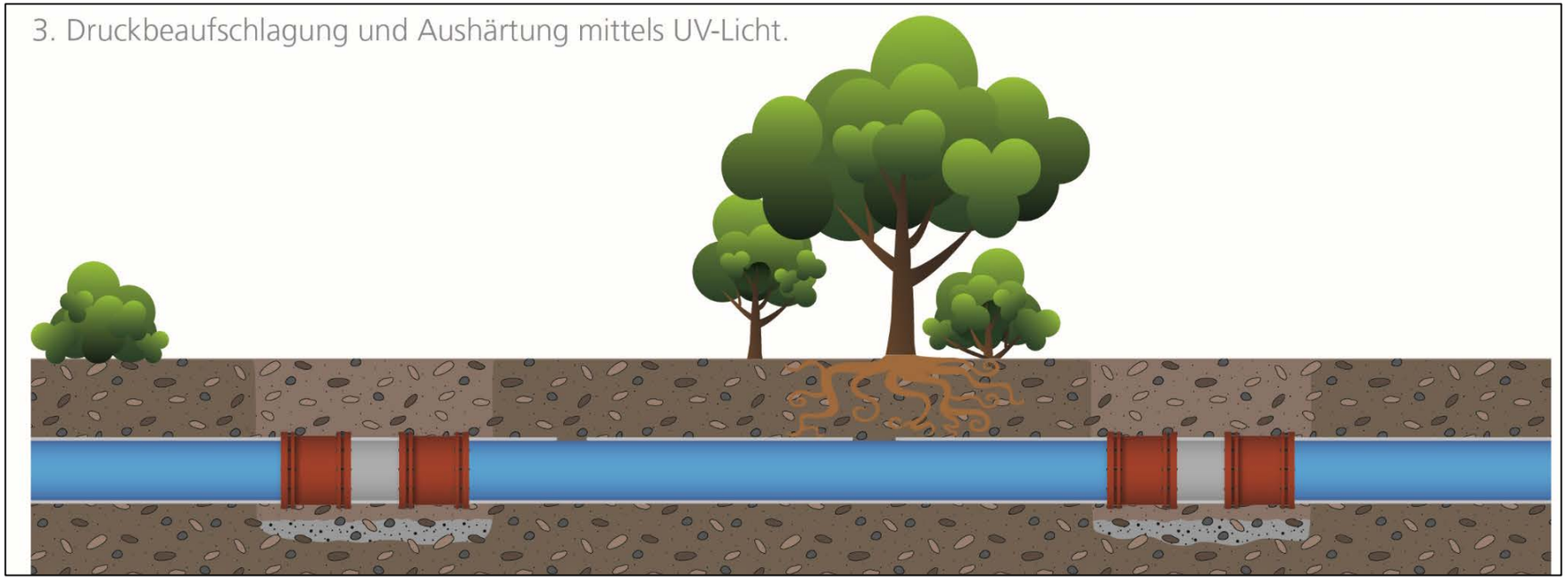
Step 3



Source: SAERTEX multiCom®

- The restored pipe will be reconnected to the grid
- And enter into service

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fernwärme
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