GUARDIANS OF THE FLOW SECURING CRITICAL INFRASTRUCTURE WITH A NEW GENERATION OF SKILLED LABOUR

DINKO CUDIC, IPLOCA – NEXTGEN

THE AGENDA / OUR ROADMAP

The Current Landscape & The Skills Gap

- Mapping of pipelines and skilled forces to support construction and rehabilitation

The Technological Revolution (Robotics, Data, Digital Twins)

- What are the possibilities and capabilities of new technologies

The Green Shift: Sustainability & Rehabilitation

- Repurposing of existing pipeline networks and nonintrusive rehabilitation

The Skilled Worker of the Future: New Roles & Evolving Skills

- Combining skills and experience with technologies and robotics through digitalisation

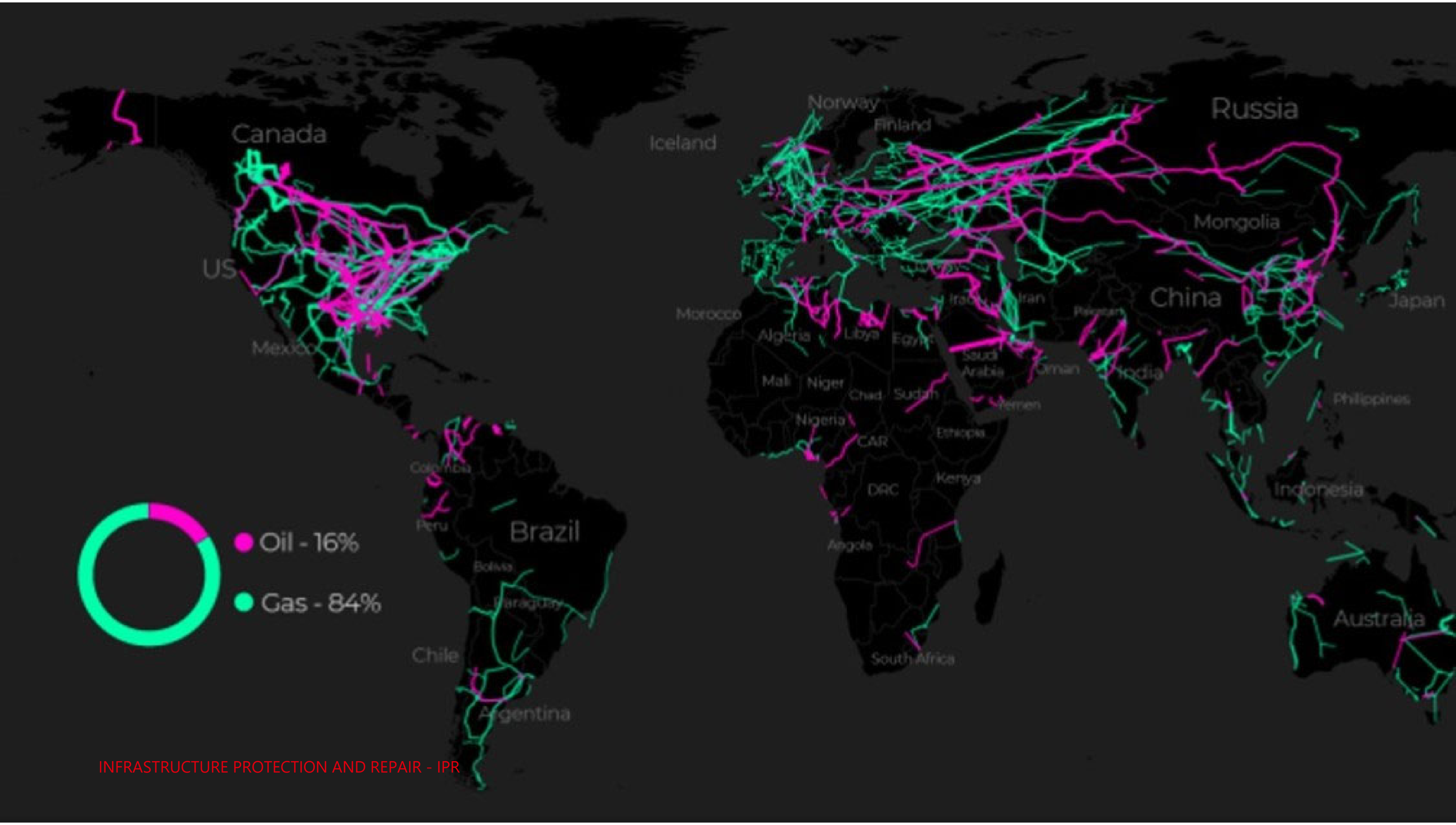
A Call to Action: Investing in the Next Generation

- How to make the construction and rehabilitation of pipelines attractive to future generations

INTRODUCTION

Why This Matters Now

- Pipelines are the arteries of our modern world (energy, water). A massive portion of the existing pipeline infrastructure is aging, requiring inspection and rehabilitation.
- Simultaneously, new pipelines for hydrogen, CO_2, and water are on the horizon. **The traditional workforce is retiring, creating a critical skills gap.**



INFRASTRUCTURE PROTECTION AND REPAIR - IPR

AGING INFRASTRUCTURE IS A GROWING CRISIS

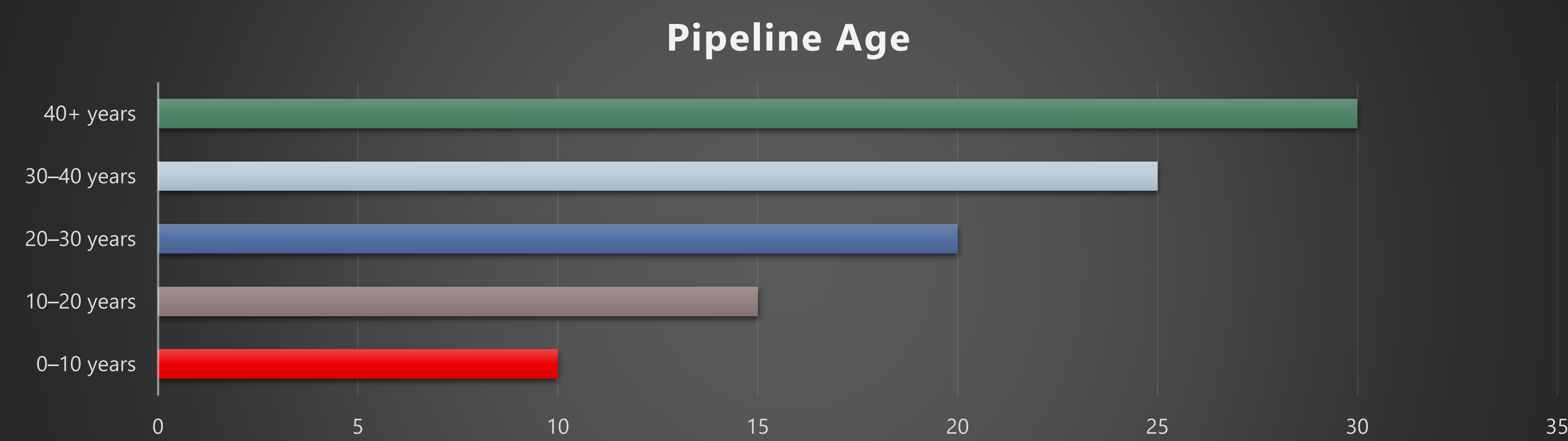
Half of U.S. pipelines are over **50 years old**

Globally, Oil & Gas companies **lose up to $88 billion annually** due to unplanned downtime

Between 2009 and 2018, **pipeline failures caused $5.3 billion** in damages

Sourcing – Sustainalytics.com; Maxgrip.com; World Oil Magazine July'21

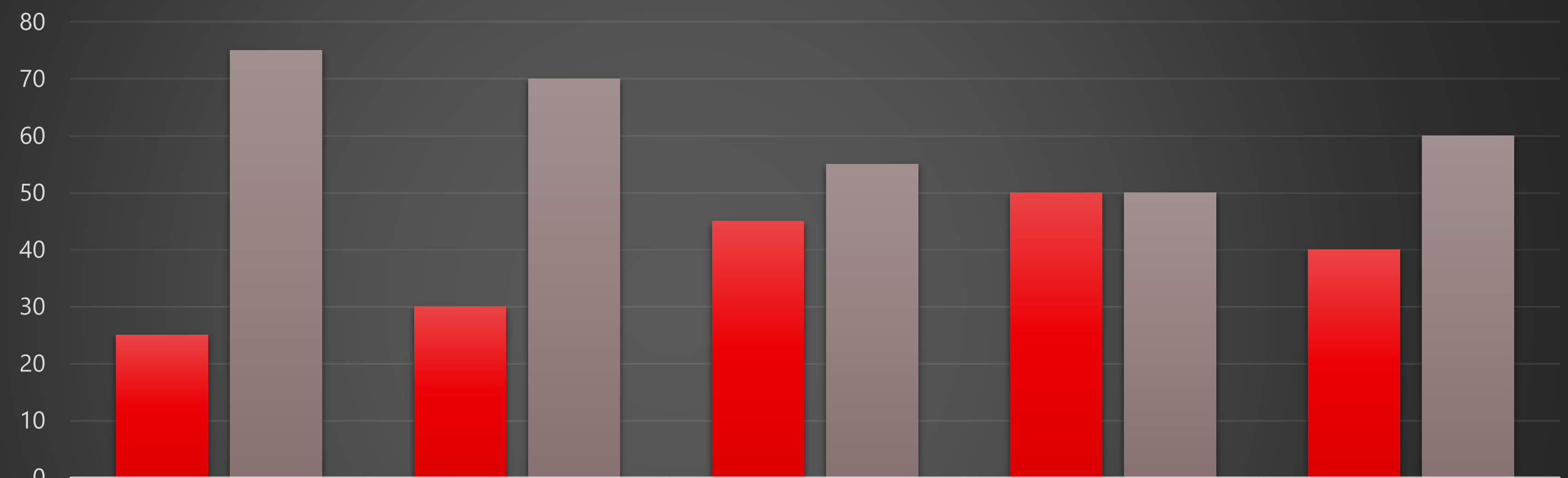
GLOBAL AGE DISTRIBUTION OF PIPELINES



	0–10 years	10–20 years	20–30 years	30–40 years	40+ years
Pipeline Age	10	15	20	25	30

- Estimated global distribution of pipelines by age group, **over 55% are older than 30 years**

NEW VS REHABILITATED PIPELINE PROJECTS BY REGION



	North America	Europe	Asia	Africa	South America
New Construction (%)	25	30	45	50	40
Rehabilitation (%)	75	70	55	50	60

- Comparison of pipeline project focus across regions, more pipelines are ready for rehabilitation

THE CHANGING LANDSCAPE

The Challenge: An Aging Network & A Retiring Workforce

The "**Silver Tsunami**" or mass retirement of aging professionals, especially those with decades of field experience in pipeline construction, engineering, and maintenance.

- **Impact on Skills**: As seasoned workers exit the industry, there's a loss of institutional knowledge, technical expertise, and mentorship for younger employees.
- **Workforce Shortage**: The construction and infrastructure sectors are already facing labour shortages; this demographic shift intensifies the gap.
- **Urgency**: According to industry reports, millions of infrastructure workers are expected to retire between 2021 and 2031, creating a critical need for succession planning and recruitment.
- **Response Strategies**: Companies are investing in training programs, apprenticeships, and automation to bridge the skills gap and retain operational efficiency

PIPELINE OPERATIONS

Profile demand

Function	Current Status	Future Demand Trend
Welders	High shortage	Increasing
Pipefitters	Moderate shortage	Stable to growing
Heavy Equipment Operators	High demand	Increasing
Inspectors & QA/QC	Limited availability	Increasing
Project Managers	Skills mismatch	High demand
Digital Technicians	Emerging role	Rapid growth
Blasters	Niche availability	Stable
Painters (Coating Specialists)	Moderate shortage	Increasing

SKILLED LABOUR REALITY

Age profile & generational gap

Feature / Role	Welders	NDT Technicians	Coaters
Typical average age (illustrative)	45–53 yrs	40–50 yrs	42–52 yrs
Typical entry age	18–25 yrs	20–28 yrs	18–26 yrs
Proportion near retirement (55–65)	High	Moderate–High	High
Age gap vs new generation (<35 yrs)	~10–25 yrs	~10–20 yrs	~10–25 yrs
Entry barriers for youth	Low (apprenticeship)	Higher (certifications)	Low–moderate
Recruitment difficulty (qualitative)	High	Moderate–High	High
Upskilling time to core competency	Months → years	Months → years (Level 2/3)	Months (specialist longer)
Transferable paths	Welding → supervision/robotics	Inspection → integrity/engineering	Coating QA/QC → specification/product rep

NOT FOR EVERYONE?

How is this industry attractive?

- **Isolation & Lifestyle**: Long stints away from home, limited social life, and harsh conditions can clash with younger generations' desire for work-life balance and flexibility.
- **Environmental Values**: Many Gen Z and Millennials prioritize sustainability and may be hesitant to work in fossil fuel-related industries.
- **Tech Expectations**: Younger workers often seek roles with digital tools, automation, and career growth—areas where traditional pipeline welding may lag unless modernized.
- **Safety Concerns**: Remote welding can involve physical risks, including exposure to toxic fumes, extreme weather, and heavy machinery

THE OPPORTUNITY

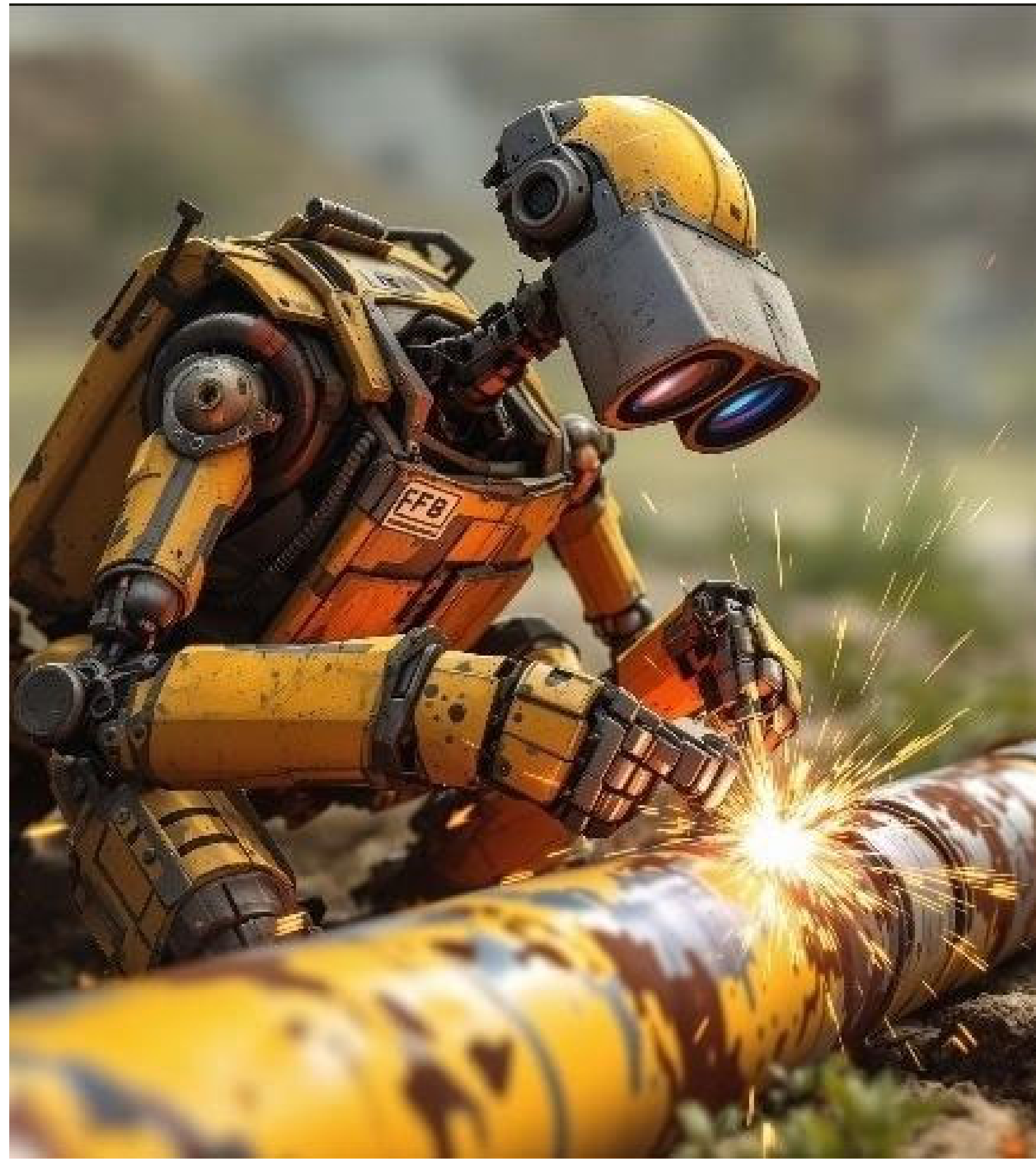
A New Era of Construction

- This challenge is also an opportunity to reinvent the industry. We can build smarter, safer, and more sustainably. This attracts a new, tech-savvy generation. Robotics, new materials (e.g., composite wraps, HDPE) and numerous other methods are emerging.

THE OPPORTUNITY

A New Era of Construction

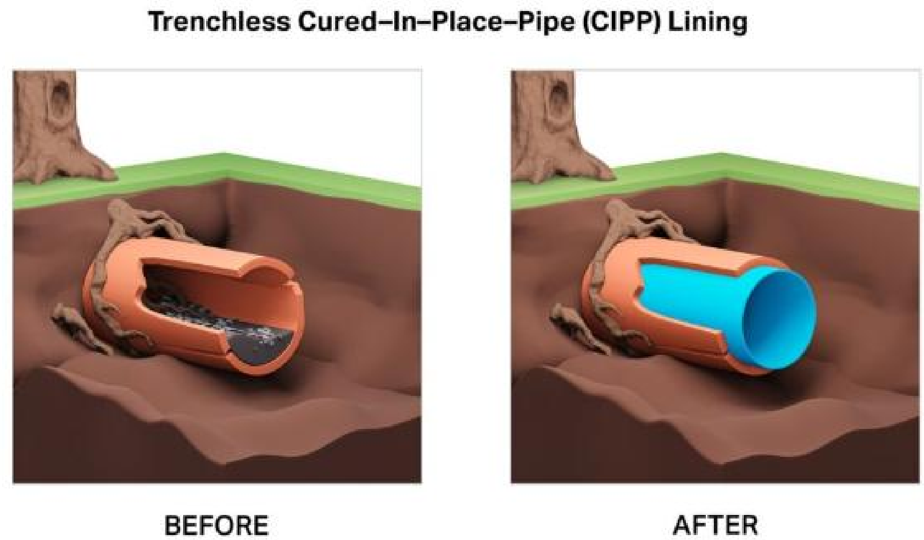
- **Construction**: Robotic trenching, automated welding systems, automated NDT, automated coating
- **Rehabilitation**: Robotic crawlers for surface preparation, internal spraying (e.g., epoxy liners) or external coating, robotic cutters for precise repairs.
- **Inspection**: UAVs (drones) for right-of-way monitoring. "Pigging" robots with advanced sensors (LIDAR, ultrasonics) for internal inspection.



ADVANCED MATERIALS & TECHNIQUES

Repurposing

- **Trenchless Technology:** HDD (Horizontal Directional Drilling), pipe bursting, sliplining. Minimizes surface disruption – a huge skill area.
- **Rehabilitation:** Cured-in-Place Pipe (CIPP), spray-in-place liners, composite reinforcement.
- **New Pipelines:** Materials for hydrogen embrittlement, CO_2 transport.



THE DATA DELUGE & DIGITAL TWINS

Augmented reality

All these robots and sensors generate massive amounts of data. The skill is no longer just in collecting it, but in *managing and interpreting* it.

- **Digital Twins:** Creating a virtual, real-time replica of a pipeline. Allows for simulation, predictive maintenance, and planning rehabilitation without physical intrusion.
- **AI & Predictive Analytics:** Using AI to analyze inspection data and predict *where* a failure might occur, moving from reactive to proactive maintenance.

THE HUMAN ELEMENT - THE FUTURE SKILLED WORKER

Evolving Skillset

The job is shifting from pure brawn to a blend of brains and skill.

- **Traditional Skills Still Needed:** Understanding of engineering principles, safety protocols (confined space, H2S awareness), mechanical aptitude.
- **New Tech Skills:** Robotics operation & maintenance, data analysis, drone piloting, GIS software, digital literacy.
- **Soft Skills:** Critical thinking, problem-solving, adaptability, continuous learning.

Overlap of "Traditional Trade Skills," "Digital & Tech Skills," and "Critical Thinking."

NEW ROLES ON THE HORIZON

We haven't always done it this way!

- **Pipeline Data Analyst:** Interprets sensor and inspection data.
- **Robotics Technician:** Maintains and operates inspection/repair robots.
- **Digital Twin Manager:** Oversees the virtual model.
- **Trenchless Technology Specialist:** A highly sought-after expert.

THE GREEN SHIFT

Sustainability as a Driver

- Rehabilitation is inherently "green" – it reuses existing infrastructure. New pipelines are for decarbonization (hydrogen, carbon capture). Skills in environmental monitoring, methane leak detection (using lasers & satellites), and ecosystem restoration are becoming core to the job.

THE CALL TO ACTION

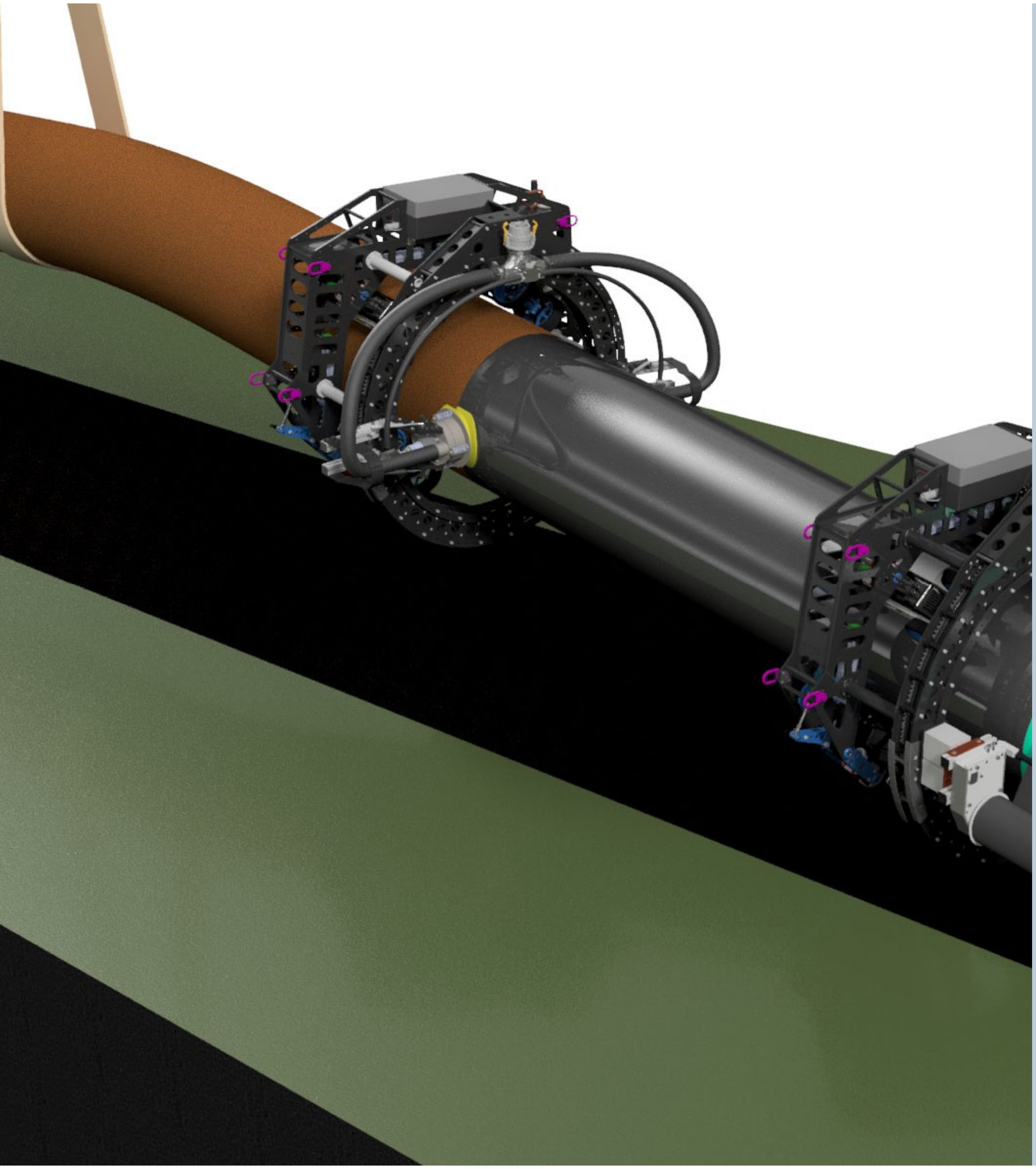
Bridging the Gap: Training & Education

- **Modernizing Apprenticeships:** Integrate tech modules (drones, data loggers).
- **Industry-Academia Partnerships:** Develop specialized college certificates and degrees.
- **Upskilling the Current Workforce:** Continuous training programs are essential.

MAKING THE INDUSTRY ATTRACTIVE

Rebrand the industry!

- It's not just dirty, manual labour. It's a high-tech, critical, and well-paying career that is building a sustainable future. Focus on safety, environment, waste management, technology, and work-life balance (e.g., fly-in/fly-out rotations).



COATING SOLUTIONS TOWARDS NET ZERO

PIB BASED TECHNOLOGY OVERVIEW

- SFL Polyisobutene (PIB) based coatings are **permanent corrosion prevention solutions**
- Amorphous, non-crosslinked nature of the coatings offer instant tack and constant dispersive **adhesion to almost any substrate with minimum surface preparation**
- The formulations have no hazardous materials and are environmentally friendly conforming to industry standards of **Safety, Environment and Sustainability**

PIB BASED COATING / SEALING

Buried and submerged infrastructure-corrosion prevention

Atmospheric corrosion prevention

Wet substrate application – condensing lines, splash zone

Field Applied Robotic Coating Solutions

Sealing and waterproofing

HERO Applications

Henkel

SURFACE PREPARATION

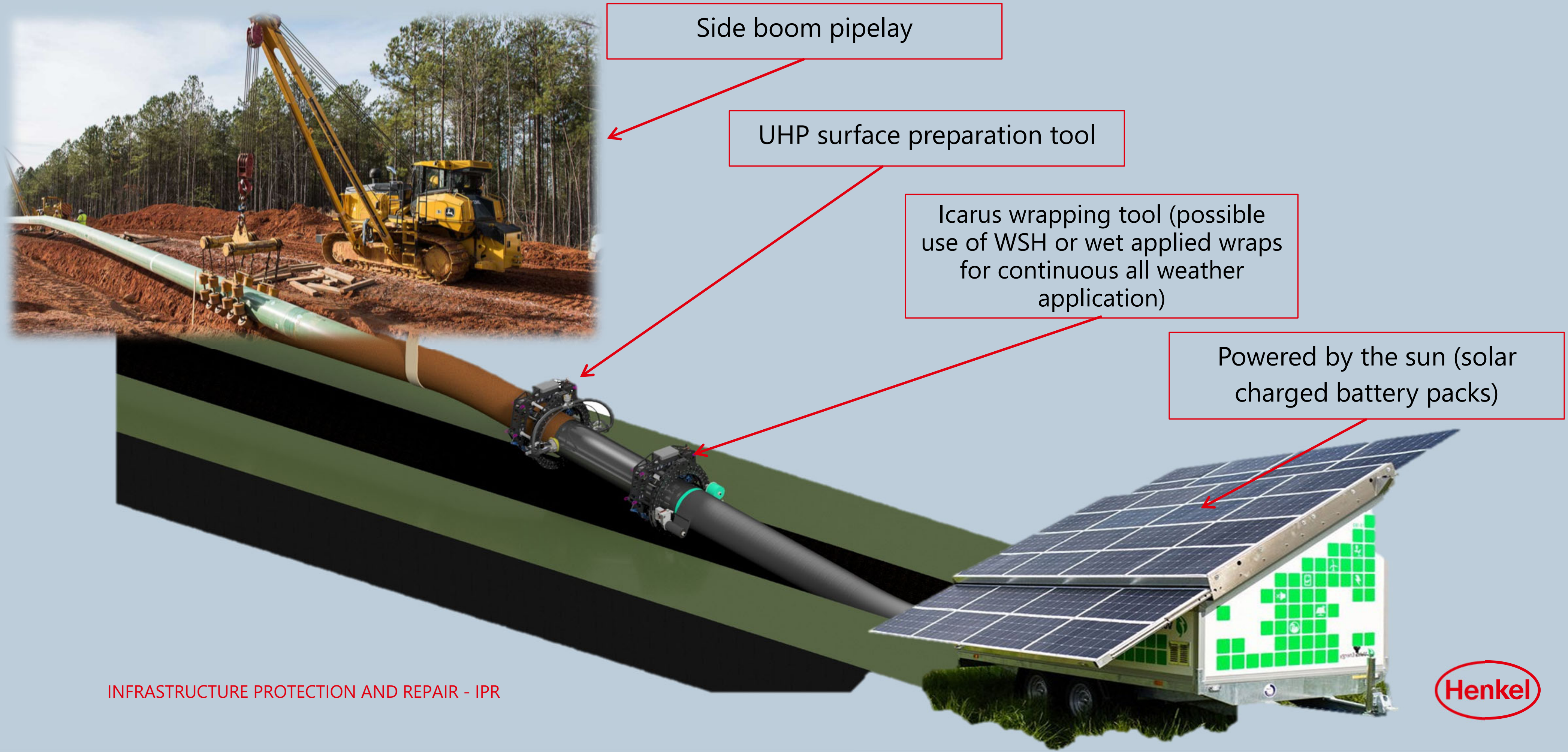
- UHP, removing rust and old coatings
- Closed system with vacuum preventing environmental contamination from rust and old coatings
- No dust creation
- Coatings are filtered out for waste management
- Water is filtered out and can be reused for the UHP cycle (great benefit in remote areas with limited water access)
- Consistent and uniform 360-degree surface preparation
- ATEX certified
- Live data collection, video recording and visual inspection

Henkel

APPLICATION OF COATING

- Consistent and uniform application with controlled tension
- Two or three layers
- Live data recording and live video feed for inspection
- Optional NDT (UT) add on
- Current design for 20” to 34” pipe size
- ATEX approved option
- Onshore and offshore applications (extreme conditions)
- Vertical and horizontal application

NET ZERO ONSHORE INLINE PIPELINE COATING



TO CONCLUDE

Key Takeaways

- The future is a fusion of **traditional expertise** and **cutting-edge technology**.
- **Rehabilitation** is a massive growth area demanding new skills.
- The skilled worker is becoming a **"Tech-Enabled Tradesperson."**
- **Investment in training and rebranding** is critical to securing our pipeline infrastructure for the future.

THE FUTURE OF CRITICAL INFRASTRUCTURE LOOKS BRIGHT