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T2.5 – CIRCULAR BY DESIGN

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COMPASS

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 850626

Sustainable Development

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Source: Our Common Future, UNGA, 1987

ITC International Training Centre

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Linear Economy

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Circular by Design

Circular design is the practice of **creating durable, reusable, repairable and recyclable products** that generate zero waste to support a circular economy.

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Circular by Design

Why Circular by Design ?

- Response to climate, cost and sustainability
- Minimizing waste, maximising utility
- Planning for change over decades

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Circular by Design

Circular by Design – Opportunities in Geothermal

- Smarter Planning and Drilling
- Active Reservoir Management
- Real-time Monitoring
- Well Rehabilitation
- Infrastructure Reuse

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Circular by Design

Why Circular Design Makes Sense in Geothermal

- High upfront costs → must last decades
- Harsh environments (corrosion, scaling) → risk of failure
- Environmental permits and infrastructure → hard to replace

So: we must **design for durability, flexibility, and reuse**

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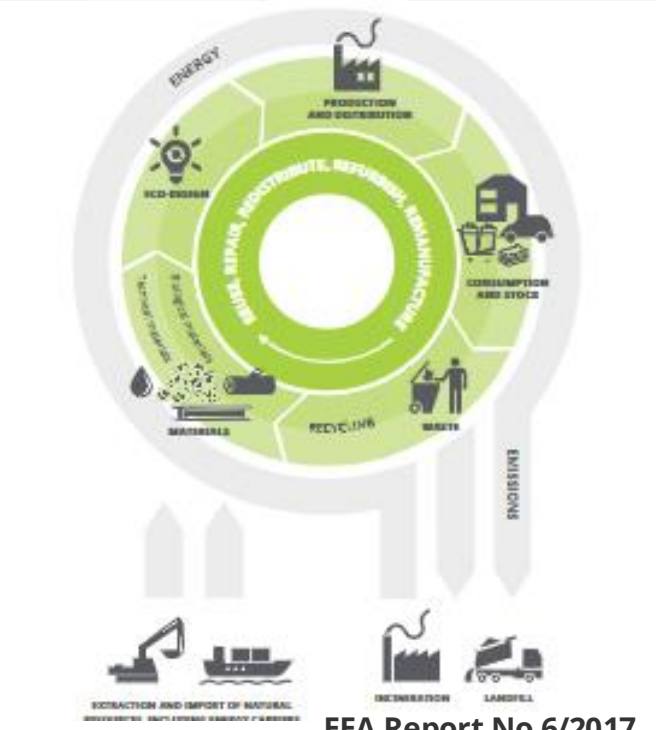
Circular by Design – Well Design

In geothermal energy, circular design is integral. Wells are designed to not only generate energy but also reinject fluids into the earth, creating a closed-loop system that minimizes environmental impact and maximizes energy efficiency.



EEA Report No 6/2017

Circular Well Design focuses on integrating *sustainability*, *reducing waste*, and *maximizing the reuse of materials* throughout the life cycle of the well.

This approach not only reduces the environmental impact but also enhances operational efficiency and reduces costs, making it an essential strategy for the future of energy production.

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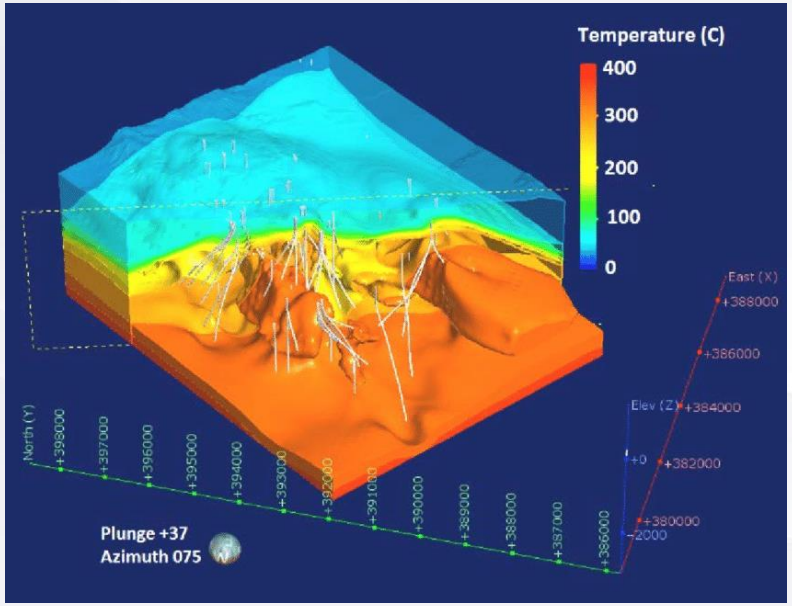
Circular by Design – Key Principles

Resource Efficiency:

Designing wells to minimize the use of materials and energy. This can be done by ***optimizing well placement***, *reducing the materials required for construction*, and *reusing equipment or drilling fluids* wherever possible, ***reduce resource consumption***, and *predict failures*, allowing for ***proactive maintenance*** and extending the well's useful life.



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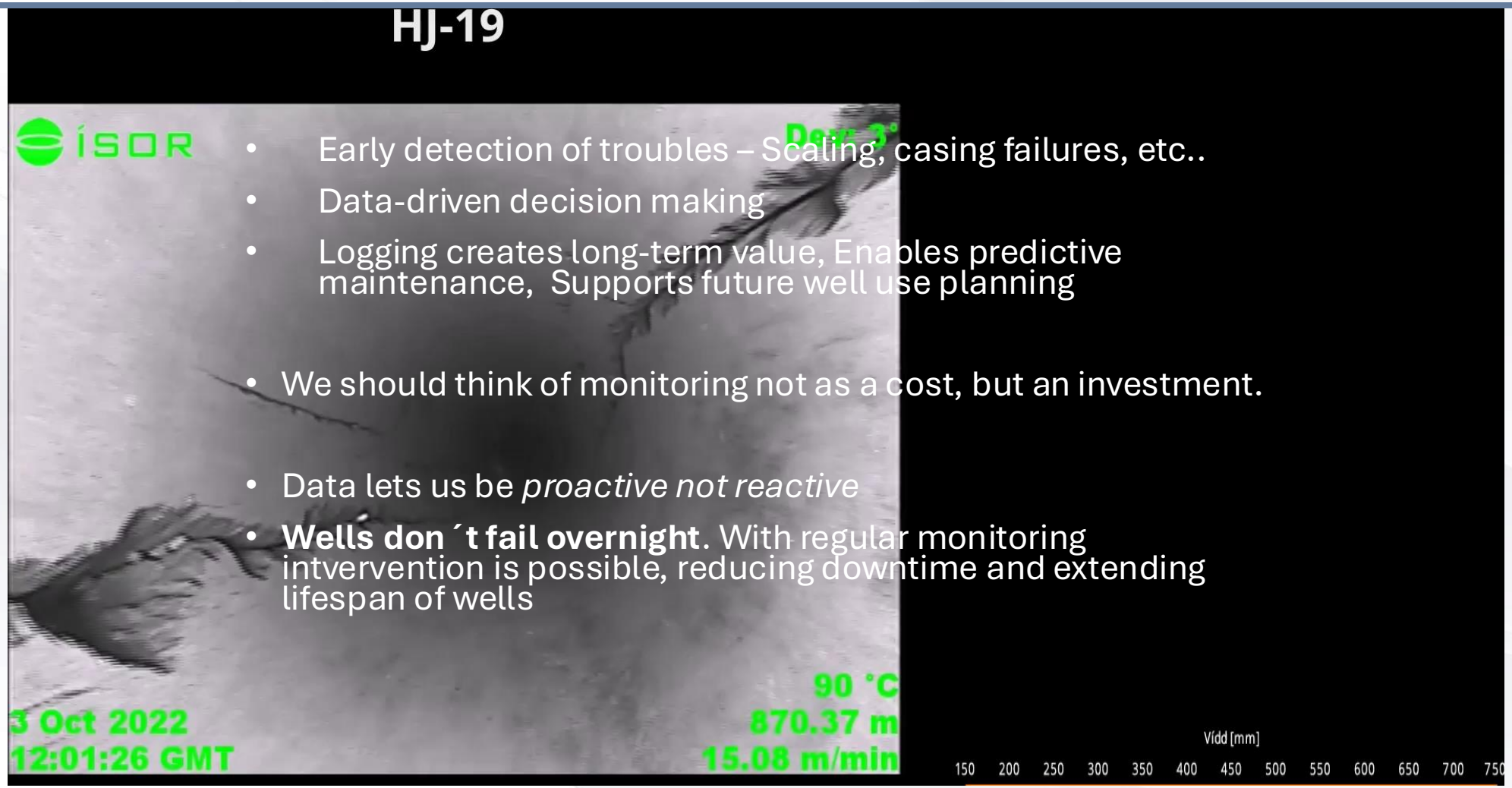
Circular by Design – Well Monitoring



- Early detection of troubles – Scaling, casing failures, etc..
- Data-driven decision making
- Logging creates long-term value, Enables predictive maintenance, Supports future well use planning

- We should think of monitoring not as a cost, but an investment.

- Data lets us be *proactive not reactive*
- **Wells don´t fail overnight**. With regular monitoring intvervention is possible, reducing downtime and extending lifespan of wells

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Circular by Design – Key Principles

Reuse and Recycling:

Instead of discarding materials at the end of a well's life, circular well design aims to reuse components, recycle materials, and regenerate natural systems.

For example, drilling muds can be treated and reused in multiple wells or find another function for abandoned wells.

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Circular by Design – Key Principles

Modular Design for Easy Dismantling:

Wells can be designed using modular components that can easily be dismantled and reused or recycled at the end of their life. This reduces the environmental footprint and cost of decommissioning.

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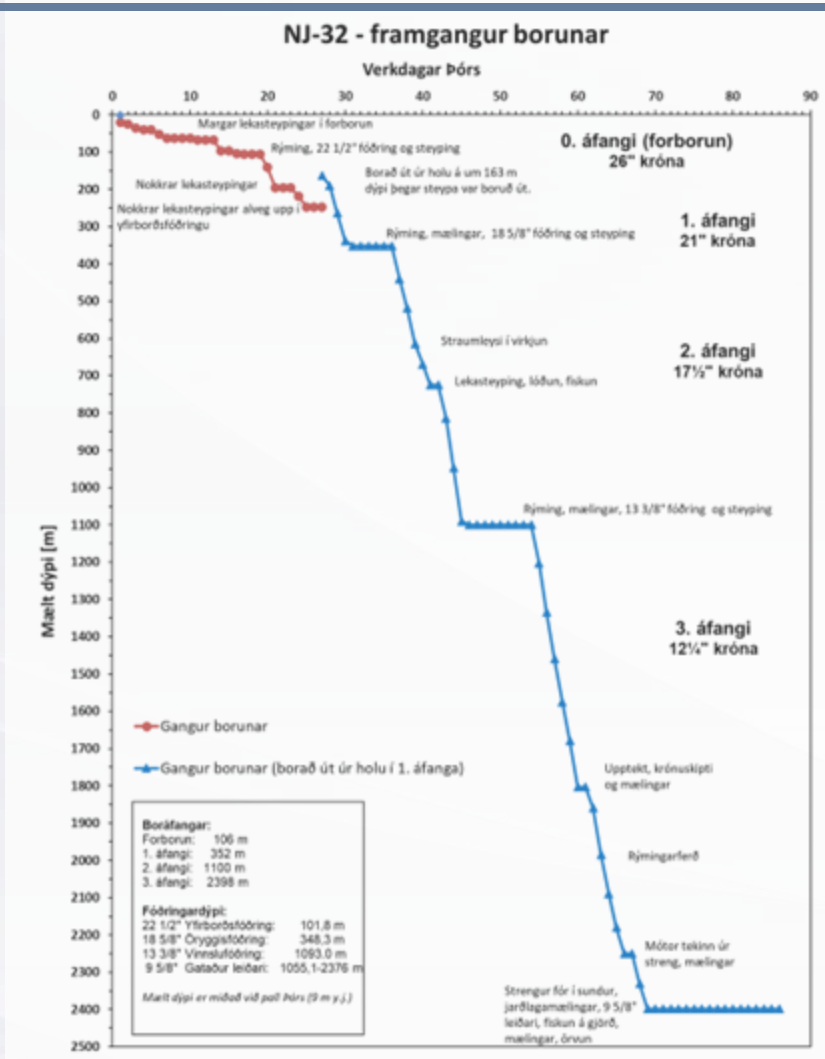
Circular by Design – Key Principles

Waste Minimization:

Circular well design seeks to reduce waste through better material selection, improved drilling techniques, and more efficient resource use. This includes ***reducing the amount of non-productive time (NPT) during drilling*** and optimizing drilling fluids to minimize waste.



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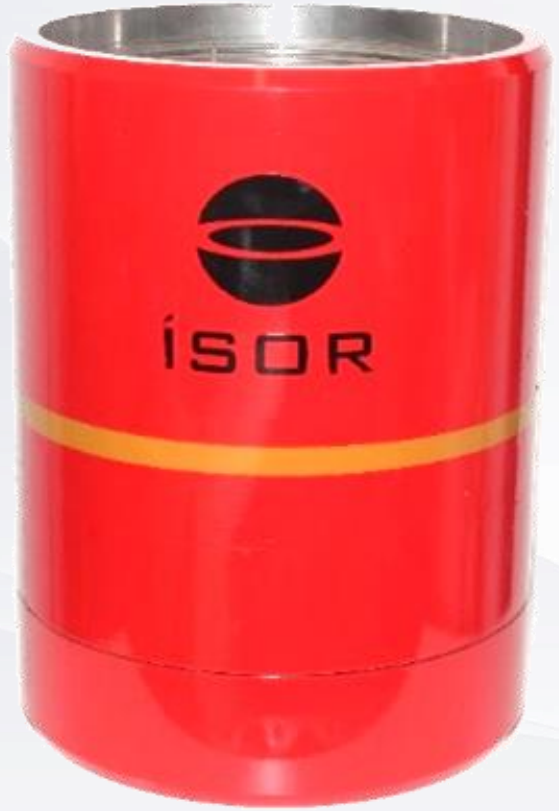
Circular by Design – Key Principles

Extending Well Life:

By focusing on durability and adaptability in the design phase, wells can be designed for a longer operational lifespan. This reduces the need for new wells and prolongs resource extraction, reducing the environmental and economic impact.



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Circular by Design – Key Principles

Design for Decommissioning:

Wells should be designed with the end of life in mind, ensuring that they can be safely and efficiently decommissioned, with materials reclaimed and the site restored to its natural state. This aligns with the principles of circular economy by ensuring that the lifecycle of the well does not end in waste.

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Circular by Design – Practical Applications

- **Practical Applications in Well Design:**
  - **Enhanced Recovery Techniques**: Technologies like CO2 injection or water flooding can extend the productive life of a well, reducing the need for drilling new wells.
  - **Digitalization and Data**: Using advanced digital tools and simulations, companies can optimize well placement, reduce resource consumption, and predict failures, allowing for proactive maintenance and extending the well's useful life.
  - **Geothermal Wells**: In geothermal projects, circular design can focus on sustainable heat recovery, reducing the overall carbon footprint by reusing heat and fluids and designing wells for minimal environmental disruption.
- **Example: Geothermal Wells**
  - In geothermal energy, circular design is integral. Wells are designed to not only generate energy but also reinject fluids into the earth, creating a closed-loop system that minimizes environmental impact and maximizes energy efficiency.

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Circular by Design

In summary, **circular well design** focuses on integrating sustainability, reducing waste, and maximizing the reuse of materials throughout the life cycle of the well. This approach not only reduces the environmental impact but also enhances operational efficiency and reduces costs, *making it an essential strategy for the future of energy production*.

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