

# Major Technical Accomplishments

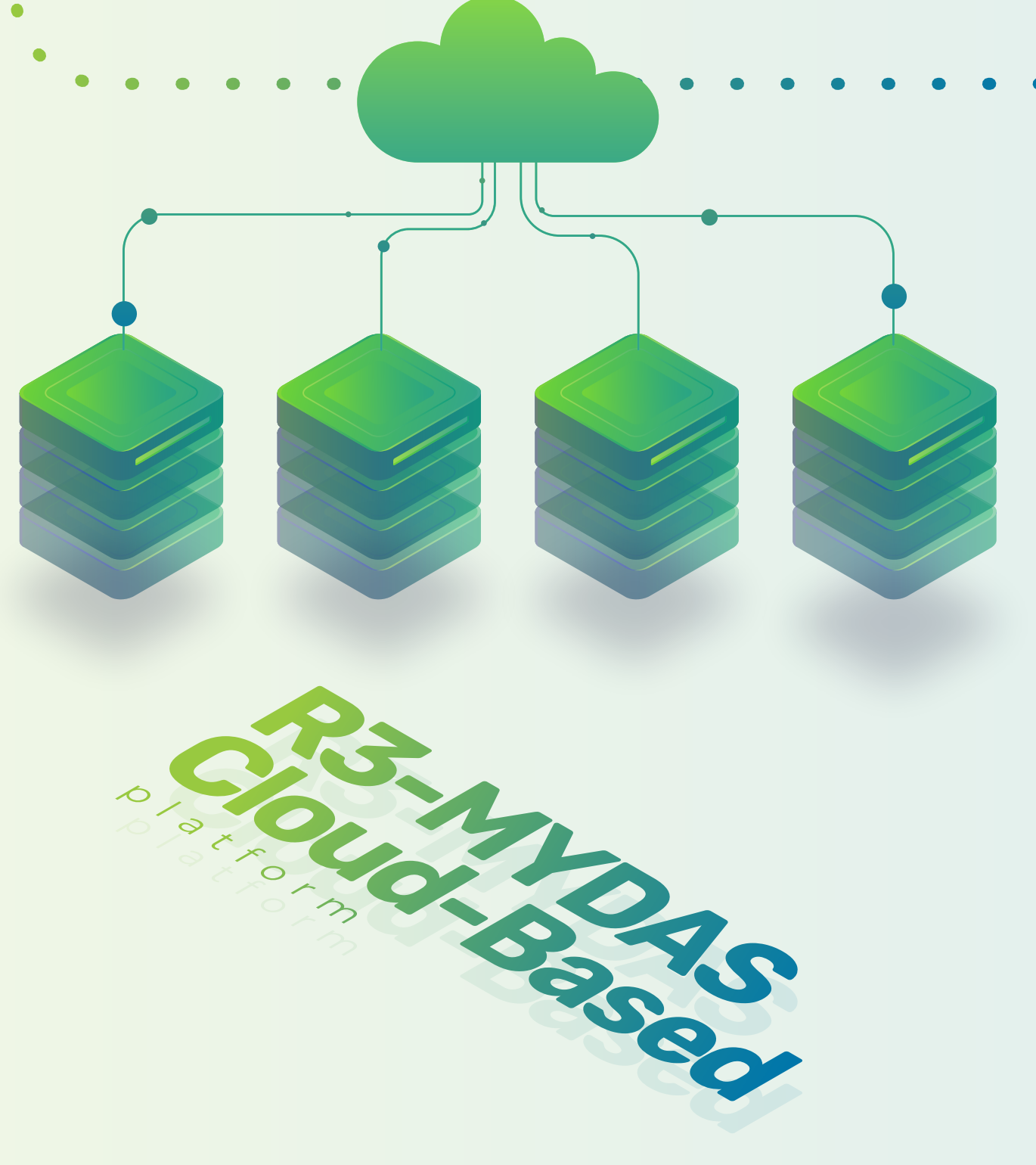
## 01 Demo Cases



**OIL & GAS COMPONENTS**  
Automated Laser Cladding Breakthrough: Dual 3D scanning sensors and advanced algorithms enable precision remanufacturing of components like crankshafts. Enhanced by CSEM's 3D thermal field prediction for real-time control.

**WIND TURBINE GEARBOXES**  
Advanced Gearbox Remanufacturing: Ikerlan's sophisticated induction hardening simulation models predict post-manufacturing gear state and fatigue.  
Key achievements include 97% estimated reuse rate (target 99%) and 90% prevention rate for premature failures. Testing confirmed a 15% torque density increase.

**E-VEHICLE BATTERIES**  
Revolutionary SoH Estimation: AVL's hybrid AI estimates Battery State of Health (SoH) with a single charge-discharge cycle, replacing time-consuming data collection.  
Automated Dismantling Advances: SPIN/CSEM innovations include adaptive screw extraction and high-precision torque estimation for faster, safer automation.



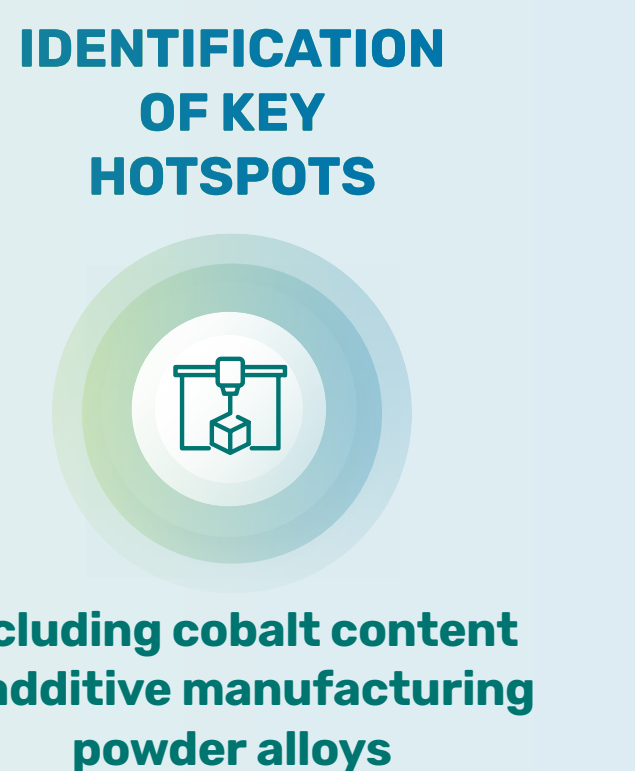
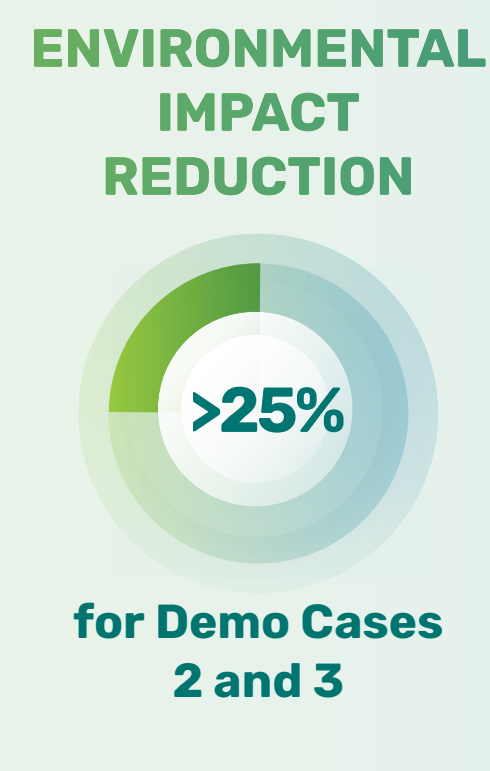
## 02 Marketplace & Digital Infrastructure Development

Significant progress achieved in developing the marketplace platform with International Data Spaces (IDS) standards compliance.  
**Key implementations include:**

- User interface with secure authentication
- Digital Product Passport (DPP) for batteries and other energy products
- Blockchain infrastructure for secure data anchoring
- Data governance building on Eclipse Dataspace Components (EDC)

## 03 Sustainability Impact Assessment

**LIFE CYCLE ASSESSMENT RESULTS**  
Preliminary LCA analysis demonstrates superior environmental performance of circular remanufacturing scenarios versus linear approaches:



## 04 Standardization & Framework Development

**COMPREHENSIVE STANDARDS MAPPING**  
EWF completed extensive mapping of existing standards across oil/gas components, electric vehicle batteries, and wind turbine gearboxes.  
**Critical standardization gaps identified include:**

- Absence of robust frameworks for battery passports in second-life applications
- Insufficient guidance on fatigue assessment of repaired gearbox components



## 05 Cognitive Mechatronics & AI Integration

**ADVANCED MACHINE LEARNING APPLICATIONS**  
CSEM developed neural operator-based modeling approaches for laser cladding process optimization, implementing Fourier Neural Operators (FNOs) and Convolutional Neural Operators (CNOs) for real-time thermal field prediction. Deep learning screw detection models achieved high accuracy in automated battery dismantling operations.



## 06 Training & Skills Development

**COMPREHENSIVE TRAINING FRAMEWORK**  
The consortium completed skills gap analysis and developed targeted training curricula for remanufacturing professionals. A foundational cross-use case knowledge-sharing workshop was delivered, marking progress toward the 100 training hours target within the project.

## 07 Dissemination & Impact

**EXTENSIVE STAKEHOLDER ENGAGEMENT**  
The project achieved strong dissemination results with 104 stakeholders mapped across categories including OEMs, suppliers, remanufacturing companies, and research institutions.  
**Social media engagement grew significantly:**

