Deliverable D 5.1
Demonstrator Designs

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Lead beneficiary:	TUD
Main contact:	John-Alan Pascoe, j.a.pascoe@tudelft.nl

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Document Control Information		
Title	*Demonstrator Designs*	
Scope / purpose of deliverable	*This report documents the selection of the key enabling technologies to be demonstrated and designs of the three demonstrators used for this purpose. This represents a design freeze of the demonstrators, allowing manufacturing and testing to proceed.*	
Expected outcomes / contribution to impact	*Enable manufacturing and testing of the demonstrators* *Documenting key design assumptions and justifying design choices.*	
Editor	*John-Alan Pascoe*	
Reviewer(s)	*WP5 partners*	
Dissemination level	☒ **CO** Confidential (please provide Published Summary) ☐	
Target audience	*Consortium members, especially those involved in manufacturing and testing of the demonstrators.*	
Approved by	☒ LKR (COO) ☒ NLR ☒ DLR ☒ JOANNEUM ☒ JKU	☒ TU Delft ☒ INOCON ☒ INVENT ☒ DTC ☒ RTDS ☒ AELS
IPRs underlined	*No*	
Datasets underlined	*No*	

Date	**Version**	***Change/Comment***
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LIST OF ABBREVIATIONS

CAD	Computer Aided Design
CFRP	Carbon Fibre Reinforced Plastic
EoL	End of Life
FBG	Fibre Bragg Grating
FEA	Finite Element Analysis
FKM	Fluorine Kautschuk Material
GFRP	Glass Fibre Reinforced Plastic
HPDC	High Pressure Die Cast
KET	Key Enabling Technology
LPBF	Laser Powder Bed Fusion
MRO	Maintenance Repair and Overhaul
SHM	Structural Health Monitoring
SIPN	Semi-Interpenetrating Polymer Networks
PET	Poly Ethylene Terephthalate
PVDF	Poly Vinylidene DiFluoride
TEP	Thermal Expanding Particles
TP	Thermoplastic
TRL	Technology Readiness Level
WAAM	Wire Arc Additive Manufacturing
WP	Work Package

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PUBLISHABLE SUMMARY

SUSTAINAIR aims to advance the aerospace industry towards the circular economy model. For this purpose, eight key enabling technologies (KETs) were identified that should be developed further. Within SUSTAINAIR, the ambition is to achieve technology readiness level (TRL) 4, by the end of this project.

The key enabling technologies identified are:

1. **Design for improved maintenance repair and overhaul (MRO) operations of morphing wing structures**
2. **Online process monitoring of induction and conduction welding of thermoplastic composite structures**
3. **Hybrid recycled laminate materials, enabling highly efficient variable thickness parts**
4. **Improvement of processing conditions in Laser Powder Bed Fusion and powder recycling strategies for enhanced titanium powder life cycles**
5. **Advanced near-net shape manufacturing of nano-eutectic aluminium alloys providing repairable, laser-welded structural assemblies**
6. **Piezo polymer SHM sensors in metallic and polymer parts**
7. **Interface design for dissimilar joints by combination of nano- and macro-structured joint interfaces**
8. **Rivet removal robot heat to dismantle EoL aircraft for maximised recyclate value**

Of these technologies, it was decided that the rivet removal robot would be demonstrated within WP2 due to changes in the consortium make-up, and the fact that rivet removal is more relevant for creating 2nd life material. The other technologies will be incorporated into three demonstrators. These three demonstrators serve first to validate achieving TRL4 for these technologies. Secondly, the demonstrators can serve as prototypes for further development of the technologies to TRL 9. Thirdly, the demonstrators can be used in disseminating the results of SUSTAINAIR.

The three demonstrators are designed are:

- **Demonstrator I: Wing segment** (main partners: AIT, INOCON, INVENT, JKU)
  This demonstrator incorporates the following KETs: 1 – Design for improved MRO, 5 – Advanced near net-shape manufacturing, 6 – Piezoelectric polymer sensors and 7 – Interface design for dissimilar joints.
- **Demonstrator II: Hybrid joints** (main partners: DLR, INVENT, JKU)
  This demonstrator incorporates the following KETs 4 – Improvement of laser powder bed fusion (LPBF) powder reuse and 7 – Interface design for dissimilar joints. It also includes a novel SHM system for hybrid CFRP-Ti joints, developed by JKU.
- **Demonstrator III: Stiffened panel** (main partners: NLR, DTC)
  This demonstrator incorporates the following KETs: 2 – Online process monitoring, 3 – Hybrid recycled laminate materials.

This confidential deliverable contains details on the design of each deliverable, enabling manufacturing to proceed. Furthermore, the key design choices have been documented, and the objectives of the demonstrator testing are defined.

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