AEROSPACE JOINING TECHNOLOGY ROADMAP



JOINING TECHNOLO		H2) Sealing and assembly of gas and liquid hydrogen fuel cells H3) Fabrication of lightweight aluminium tanks for gas and liquid hydrogen storage (e.g. FSW, MIG/MAG, LBW); note that composite tanks are also being considered for some designs H4) Fabrication of compact heat exchangers to manage cryogenic temperatures required for liquid hydrogen storage (e.g. FSW, Diffusion, Brazing, Arc welding, EBW, LBW)	
·	TAILORED BLANK FABRICATION	T1) Tailored blank fabrication of large monolithic metallic structures, including nacelle lip skins, landing gear, pylons, wing ribs and integrally stiffened skin/fuselage panels (e.g. RFW, LFW, FSW, EBW, LBW)	
		T2) Joining of additively manufactured parts to expand complexity, including AM-AM and AM-wrought materials (e.g. RFW, LFW, Diffusion, EBW)	

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		2022	2025	2030	2040	2050
JOINING TECHNOLOGY ENABLERS AND CHALLENGES	ASSEMBLY	metallic assemblies (e.g. FSW, Re F5) Adopting welding processes structures for airframe, with reduce FSSW, most likely in combination C1) Improving the reliability of co- co-bonding) C2) Further developing certifiabil co-curing, adhesive bonding, frid mechanical fastening C3) Improving the sustainability soldering, welding fillers/fluxes,	using on torque of one-way ssembly e associated tions managing es more es structures g processes for replacing fasteners in fill FSSW, LBW, RFW, Adhesive bonding) as a means of fabricating integrally stiffe uced mass, lower cost and low distortion	(e.g. FSW, LBW, Refill thods (e.g. co-curing, ding methods (e.g. ve to traditional g. adhesives, brazing, ite-composite and g topology optimised	hesively bonded joints	
JOINING TEC	INSPECTION & AUTOMATION	 12) Improving reliability of NDT m adhesive bonding of composite- joints, diffusion bonding in super 13) Use of artificial intelligence to 14) Improving practices for verify quality of mechanically fastened 	assist joining process development and ring the 16) Shift towards in-lin d joints -service prognostic inspection and struct	d quality assurance e automated NDT	nachine learning)	
	DESIGN & SIMULATION	cases and design joints more acc overruling traditional design man structural redundancy) D2) Creation of digital twins for jo (aiming to optimise factory layou	l simulation to understand loading curately (complementing or nuals; removal of unnecessary pining processes and simulation of manu it, predict flow and assess feasibility of o g methods with future decommissioning	perations)	ead time and assist	
	RESOURCES	 Training, up-skilling, u Enhancement and co Supply chain develop Research, developmed Certifying, developing Cross-sectoral network Electrification, Designed Further certifying use Developing framework 	ent and certification of new materials (in g standards and improving design methor rking especially with automotive (Autor n and numerical analysis methods, In-lin d Gas (certification of manual welders), - e of composites and adhesives for prima rks for accelerating qualification of new and battery technology.	cluding the creation of a shared material prope ods for welding processes. nation, Flexibility in manufacturing and building e inspection, end-of-life requirements), Rail (for Grid power supply, linked with charging infrast ry structures.	g block process development, r certification and safety	