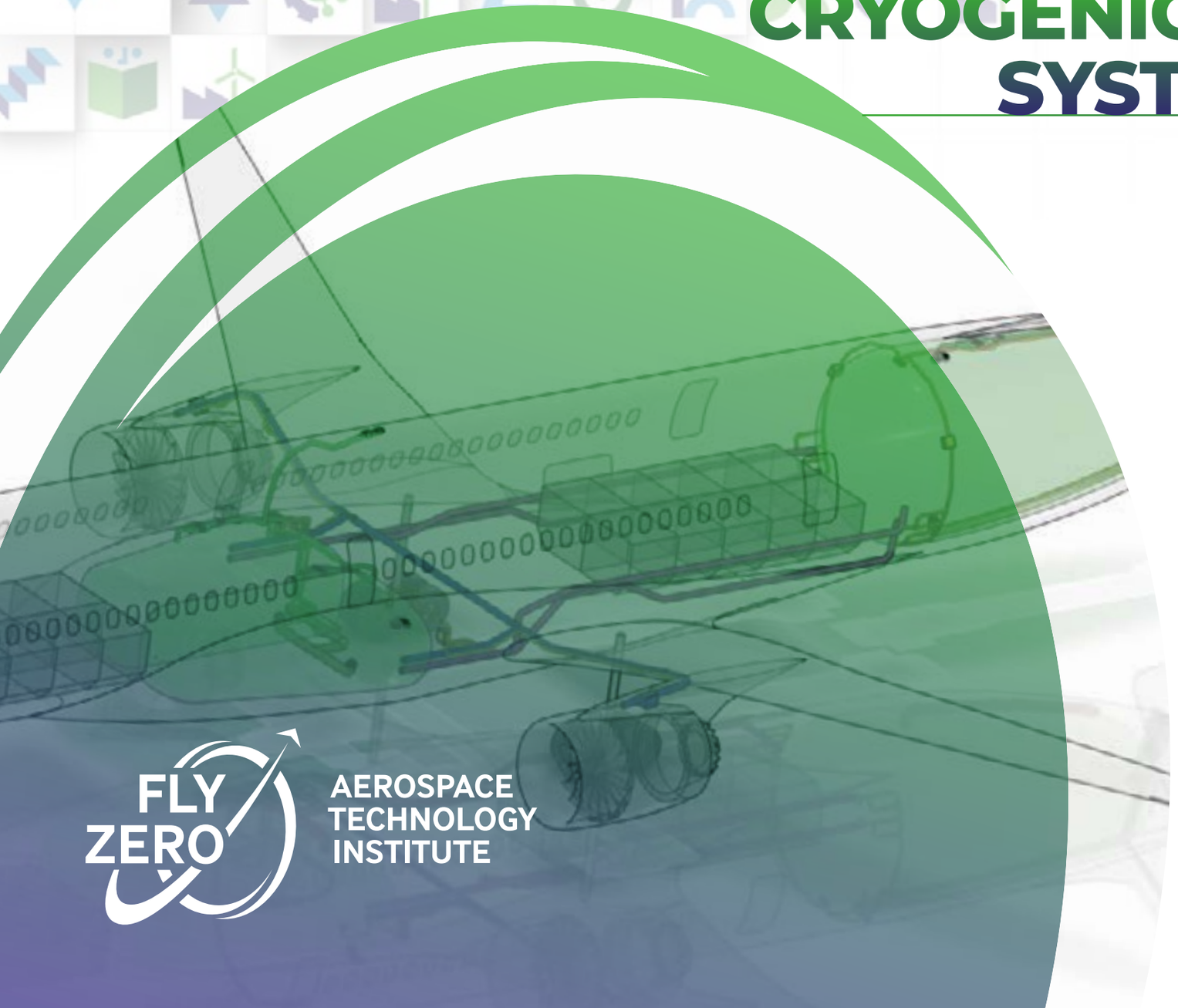
CRYOGENIC HYDROGEN FUEL SYSTEM AND STORAGE

Roadmap



FLY ZERO

AEROSPACE TECHNOLOGY INSTITUTE

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CONTENTS

KEY

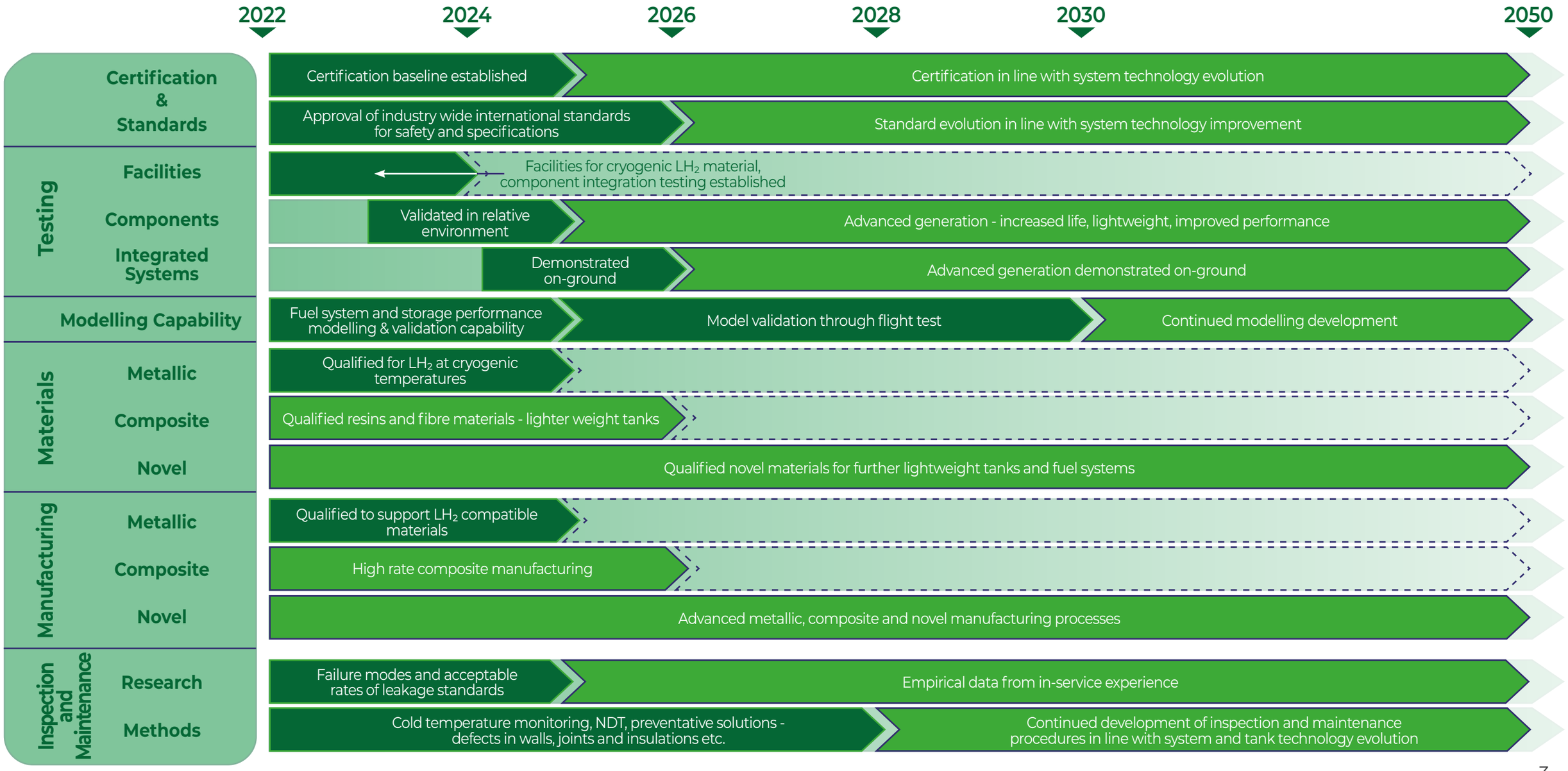
Essential Development	*Development required to bring roadmap technology to market.*
Competitive Development	*Development which delivers performance improvement.*
Technology Mature	*Transition to further integration and production readiness.*
Essential Enabler	*Supporting activity or infrastructure to enable technology development*
Competitive Enabler	*Supporting activity or infrastructure to enable technology development*
Technology Mature	*Transition to further integration and production readiness.*

TRL 1	TRL 2	TRL 3	TRL 4	TRL 5	TRL 6	TRL 7	TRL 8	TRL 9
Basic principles observed and reported.	*Technology concept formulated.*	*Analytical and experimental proof-of-concept.*	*Component validation in laboratory environment.*	*Component validation in relevant environment.*	*Subsystem model or prototype demonstration in relevant environment.*	*System prototype demonstration flown.*	*Flight qualified.*	*Achieved all flight envelope.*

Figure 1 – Technology has been assessed against the NASA Technology Readiness Level (TRL) scale

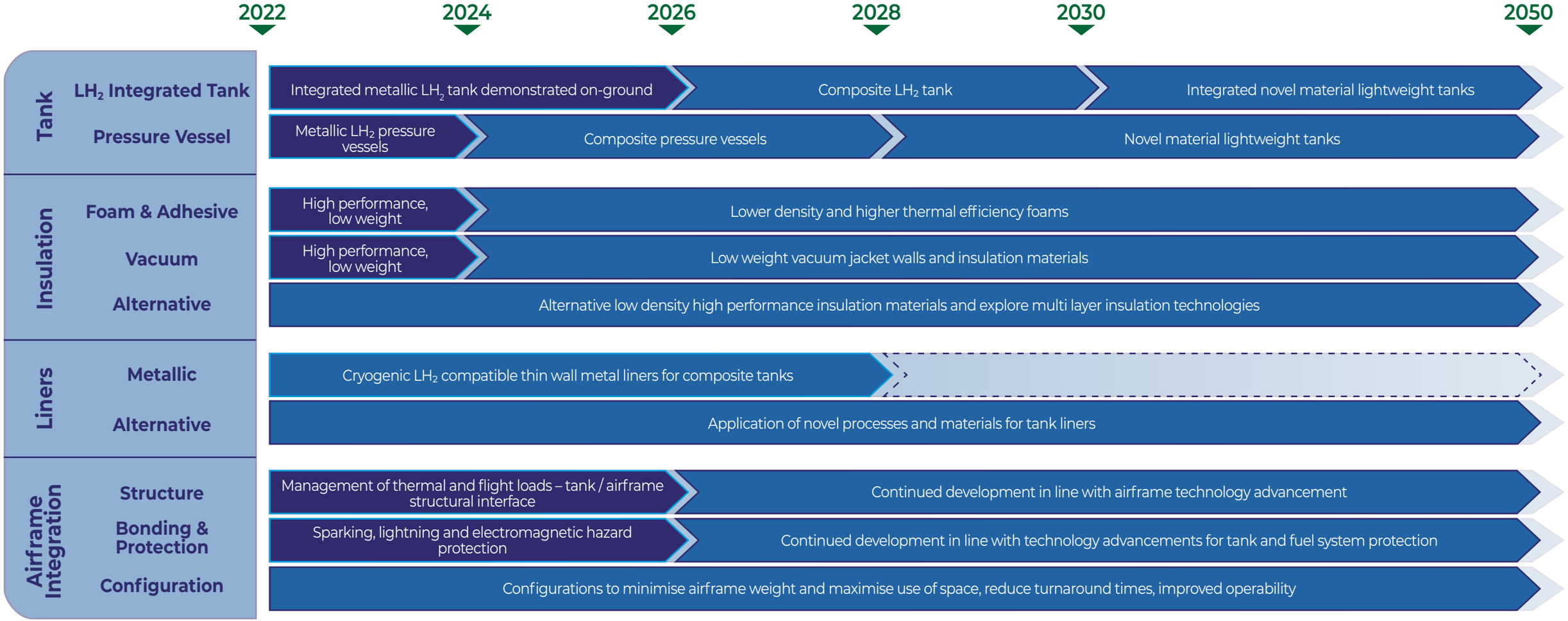
CRYOGENIC HYDROGEN FUEL SYSTEM & STORAGE ROADMAP

Key: Essential Enabler | Competitor Enabler | Technology Mature



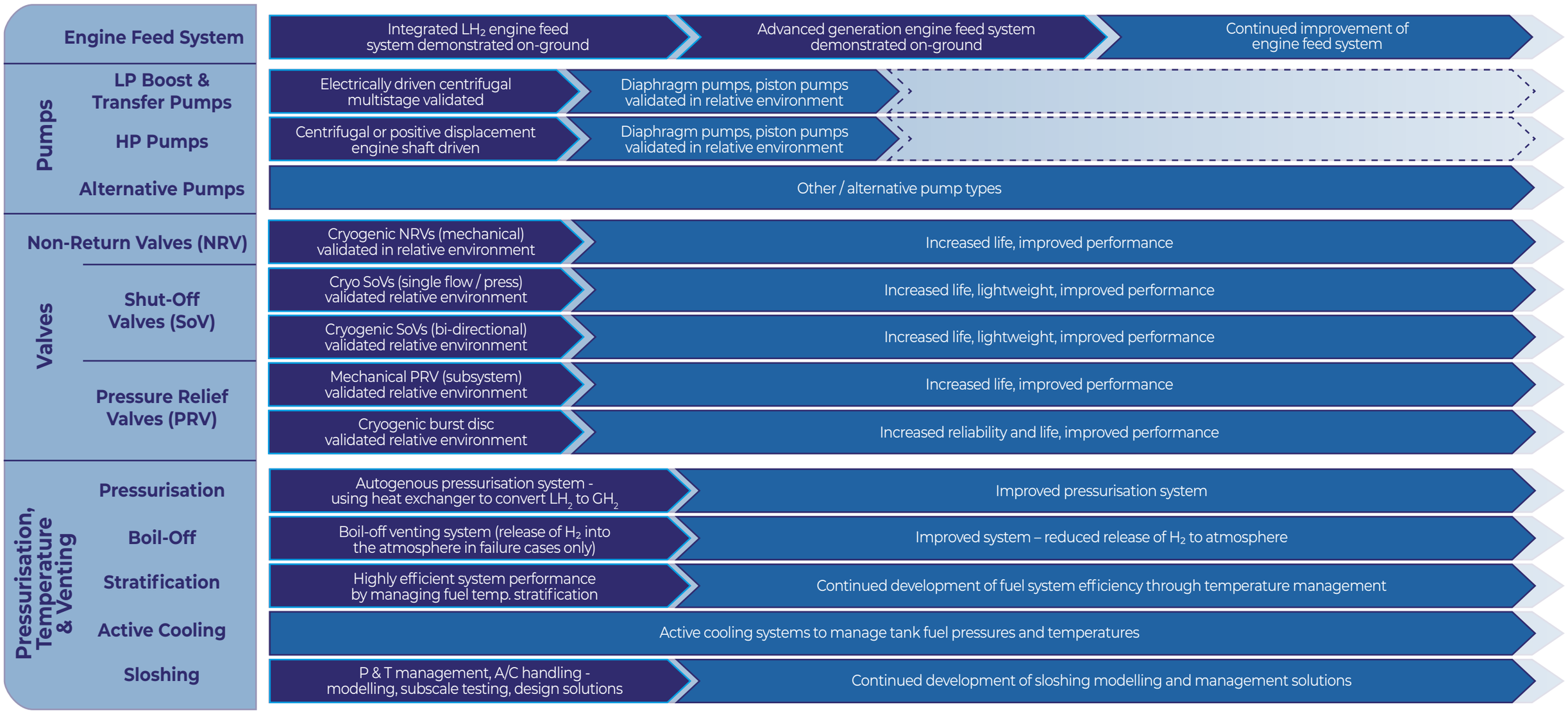
CRYOGENIC HYDROGEN STORAGE ROADMAP

Key: Essential Development | Competitor Development | Technology Mature



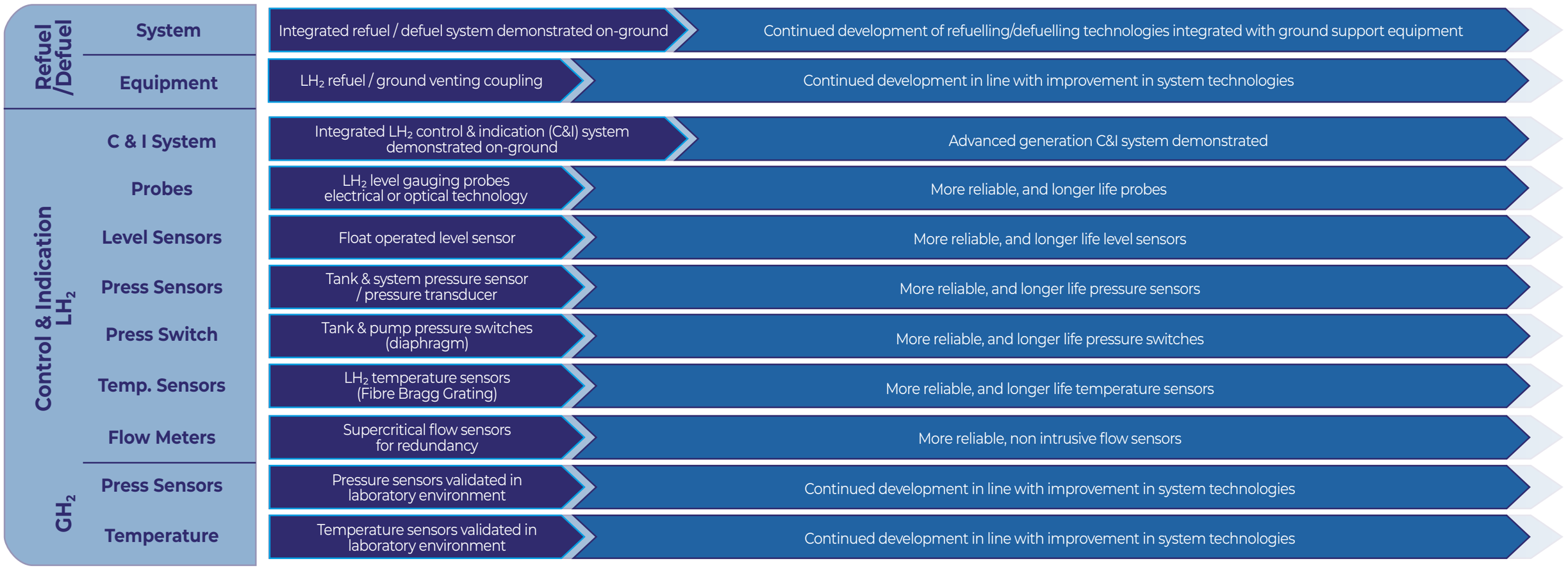
CRYOGENIC HYDROGEN FUEL SYSTEM ROADMAP

Key: Essential Development | Competitor Development | Technology Mature



CRYOGENIC HYDROGEN FUEL SYSTEM ROADMAP

Key: Essential Development | Competitor Development | Technology Mature



CRYOGENIC HYDROGEN FUEL SYSTEM ROADMAP

Key: Essential Development | Competitor Development | Technology Mature

		2022	2024	2026	2028	2030	2050
Leak Detection & Management	System	Leak detection, prevention management system demonstrated on-ground					Advanced generation system demonstrated on-ground
	Fibre Optic	Tank / pipe temperature detection (fibre Bragg grating)					Continued development in line with improvement in system technologies
	GH_2 Sensor	GH_2 concentration detection sensors					Continued development in line with improvement in system technologies
Pipes & Sealing Technology	LH_2 Pipes	Cryogenic insulated stainless-steel pipes					Lighter, more reliable, leak mitigation pipes
	Connectors	Cryogenic LH_2 pipe connectors / flexible joints					Continued development in line with improvement in pipe technologies
	LH_2 Sealing	LH_2 seal technology for aircraft					LH_2 self-sealing breakaway valve
	LH_2 Lubrication	LH_2 lubrication technology for seals & moving parts					Increased service life, reduced maintenance
	GH_2 Pipes	GH_2 pipes					Lighter, more reliable, leak mitigation pipes
	GH_2 Sealing	GH_2 seal technology for aircraft					GH_2 self-sealing breakaway valve
	GH_2 Lubrication	GH_2 lubrication technology for seals & moving parts					Increased service life, reduced maintenance

ABOUT FLYZERO

Led by the Aerospace Technology Institute and backed by the UK government, FlyZero began in early 2021 as an intensive research project investigating zero-carbon emission commercial flight. This independent study has brought together experts from across the UK to assess the design challenges, manufacturing demands, operational requirements and market opportunity of potential zero-carbon emission aircraft concepts.

FlyZero has concluded that green liquid hydrogen is the most viable zero-carbon emission fuel with the potential to scale to larger aircraft utilising fuel cell, gas turbine and hybrid systems. This has guided the focus, conclusions and recommendations of the project.

This report forms part of a suite of FlyZero outputs which will help shape the future of global aviation with the intention of gearing up the UK to stand at the forefront of sustainable flight in design, manufacture, technology and skills for years to come. To discover more and download the FlyZero reports, visit **ati.org.uk**

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These roadmaps have been developed with a view to accelerate zero-carbon technology development and maximise the potential future value for the UK. They are unconstrained by the availability of funding.

Department for Business, Energy & Industrial Strategy

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Roadmap

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