Decarbonisation in aviation

No silver bullet

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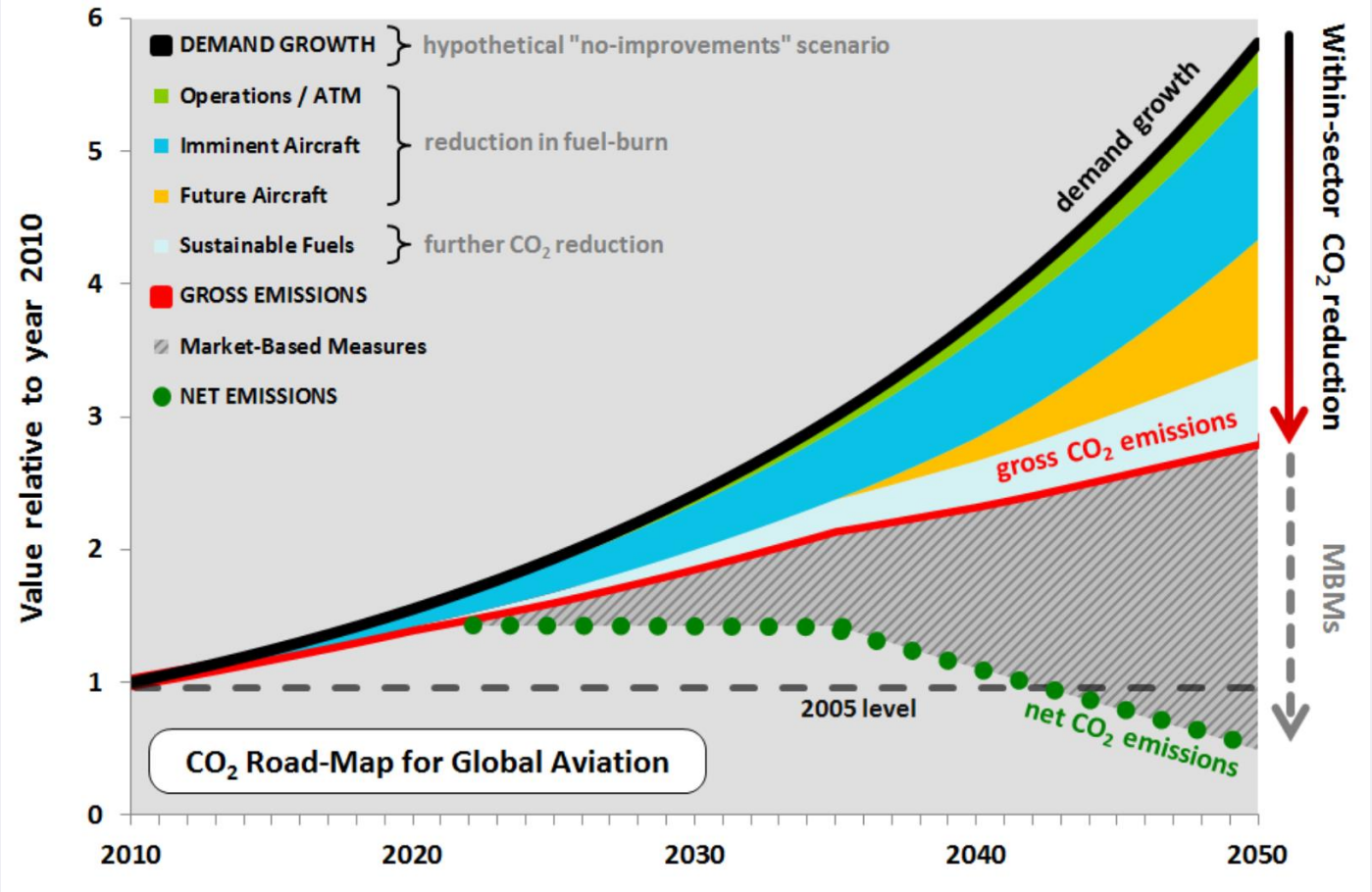
No silver bullet exists

Concerted effort on a number of fronts is required



Source: Sustainable Aviation

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Key areas of focus in Civil Aerospace

All closely inter-connected and being developed in parallel.

All have a role to play in the decarbonisation of our industry.

Continue to improve the gas turbine

Collaborate on drop-in SAFs

Develop radical alternatives such as electrification, hydrogen

Enhanced integration at platform level

Manufacturing, Digital and Services technologies

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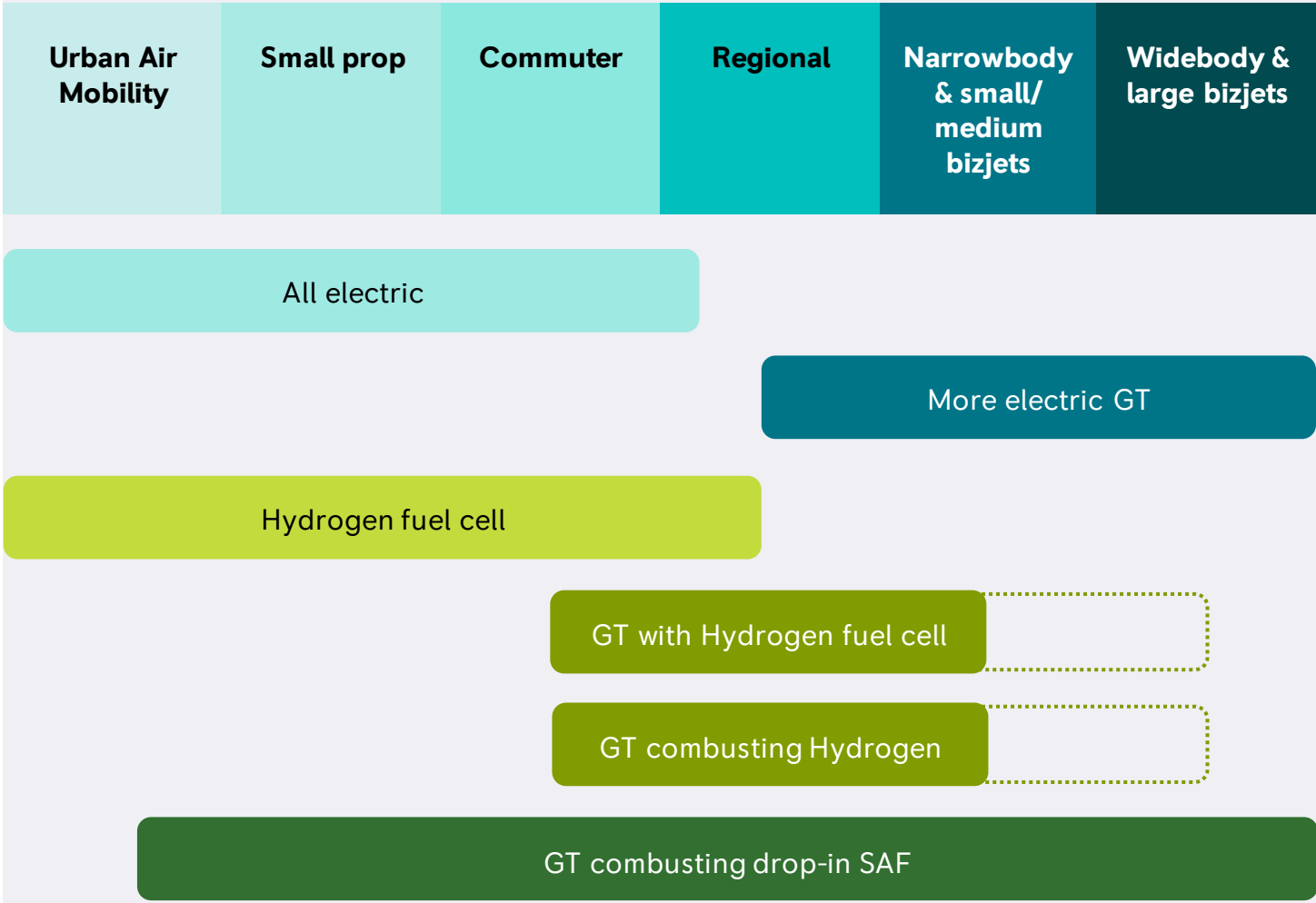
Parallel pathways for decarbonisation solutions

Electric-powered aircraft are already a reality and market is growing rapidly

Small hydrogen-powered aircraft could materialise in 2020s, Regional mid-2030s and Narrow body mid-late 2030s

SAF and GT (gas turbine) will be required to power most applications, particularly larger, longer-range aircraft, without more radical designs



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Sustainable Aviation Fuels (SAF)

Suitability	Sustainability	Scalability
		
Energy density Fuel specification	CO_2 benefit Food / water	Mass production Global distribution

Already successfully completed ground and flight tests using blended SAF
Latest Trent engines and business jet engines can already run on SAF
Plan to test a 100% SAF in a Trent engine next year.

Working closely with fuel producers, operators, airports, environmental organisations and government agencies to bring these fuels into widespread aviation use by 2050

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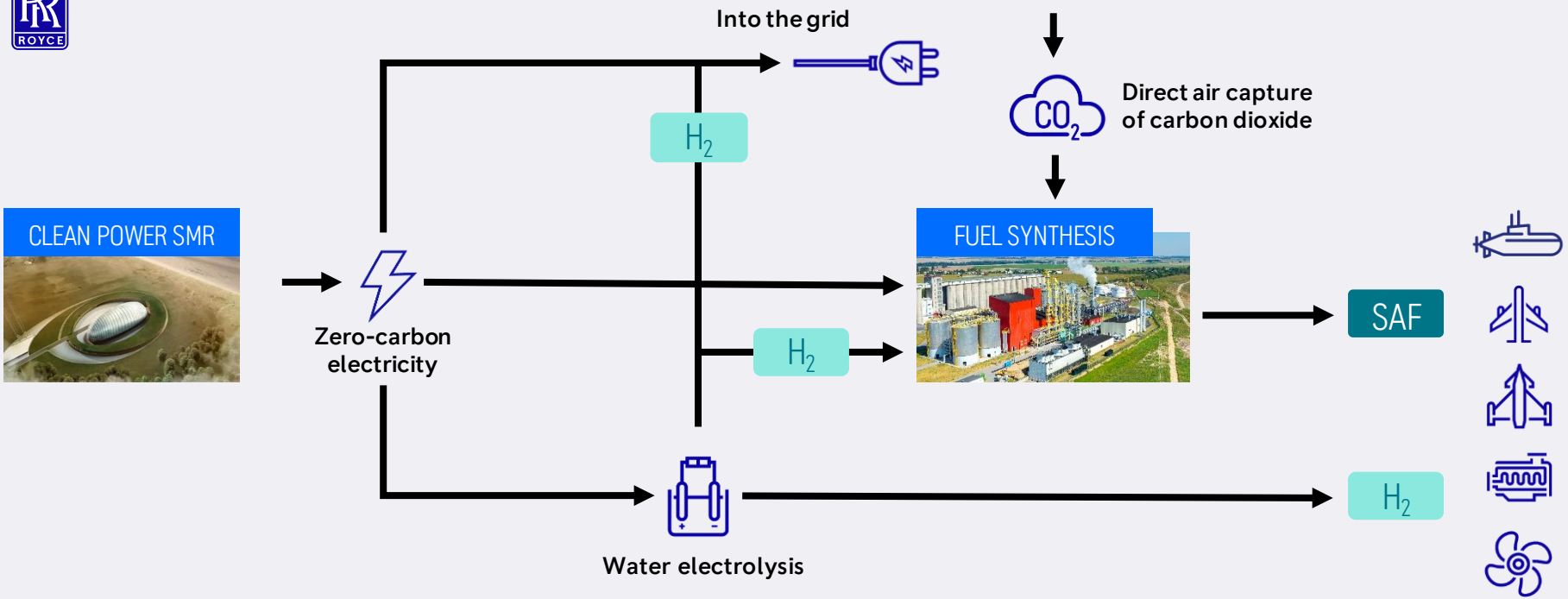

Many new or improved technologies needed for carbon neutral fuel

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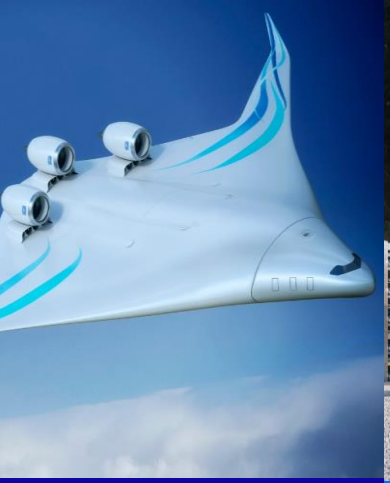
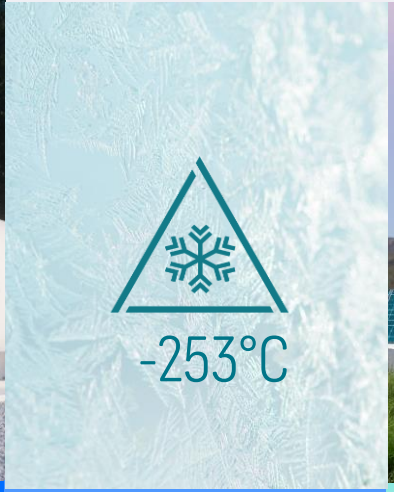


3x the energy density but occupies

4x the volume of kerosene

GH2

requires specialist pressurised (700 bar) heavyweight storage tanks



LH2

requires complex pressure and thermal management

Certification & Safety for flight

Operational implications, e.g. increase in aircraft turnaround times

Technical challenges and considerations of flying hydrogen

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Thank you