



# The importance of research in hydrogen and other new technology aircraft development

Guy Gratton

Dominique Bovell

17 December 2024

[www.cranfield.ac.uk](http://www.cranfield.ac.uk)



# Hydrogen aircraft – what changes from a regulatory viewpoint?

Crew training

Take off performance  
Cruise performance

Fire / Evacuation / Rescue  
ETOPS clearances

Characterising emissions

Fuel gauging

Engines  
Fuel system  
Fuel tanks  
  
+ Hybridisation?

Materials in  
contact with  
hydrogen

+ Ground infrastructure standardisation & safety, ground staff training, fuel quality control

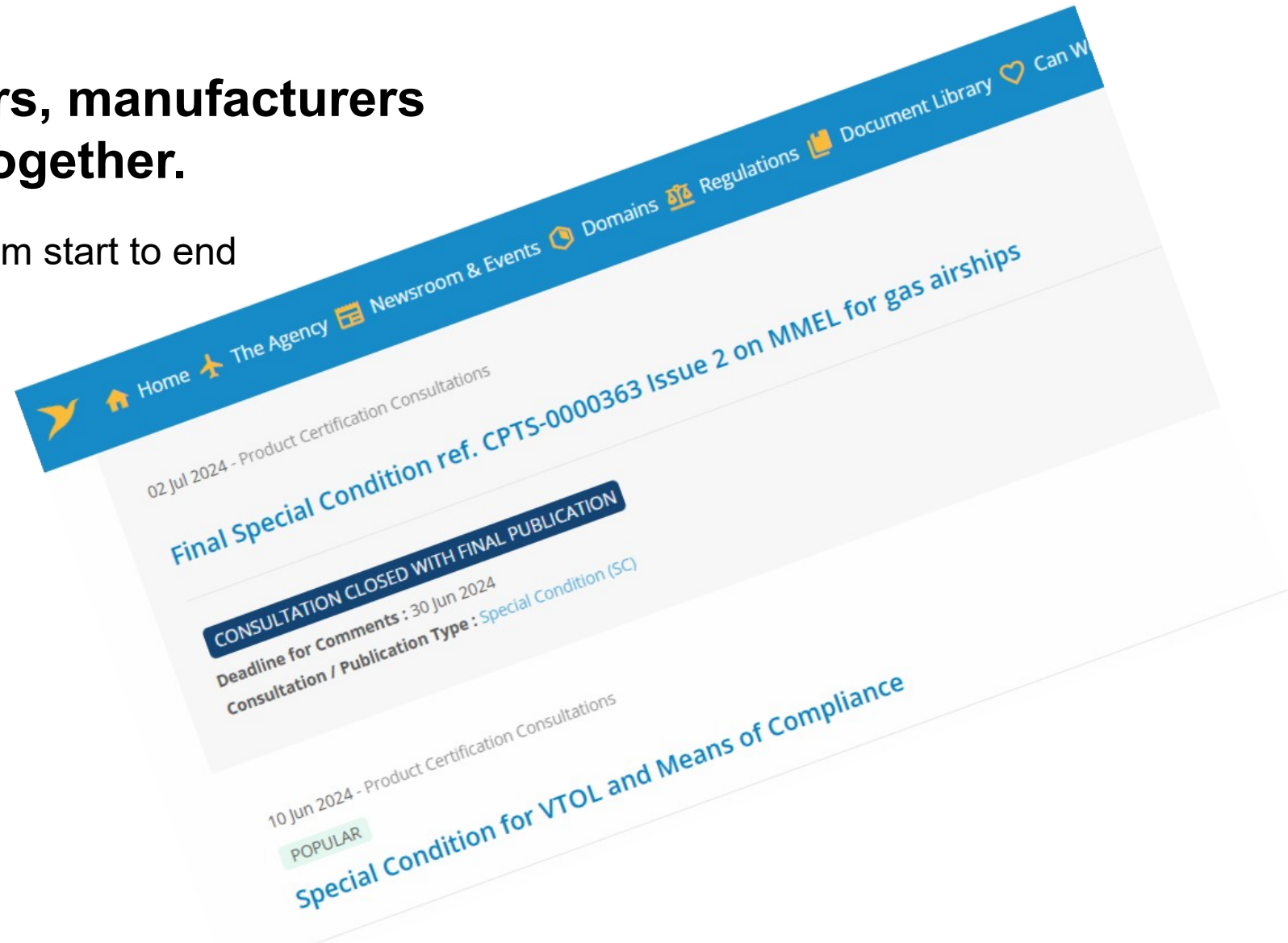




# So the technology programmes, need regulatory programmes

**Which must bring designers, manufacturers and authorities together.**

And throughout every programme – from start to end







# Work in stages

Certification activity needs to shadow the aircraft and/or engine development.

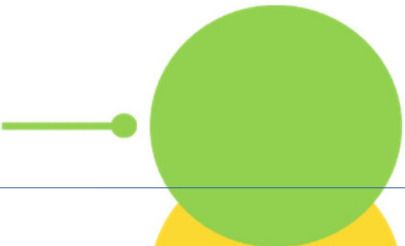


TRL here is standard  
RRL is our proposal  
EASA use CRL – Certification Readiness Level

## Regulatory Readiness Level

Publish requirements

TRL9



Actual system proven in operational environment

Fully freeze certification requirements

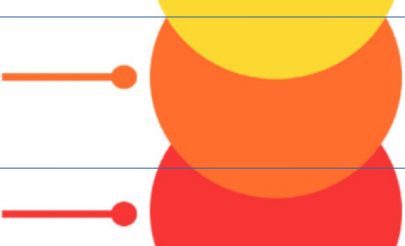
TRL8



System complete and qualified

Requirements NPA process

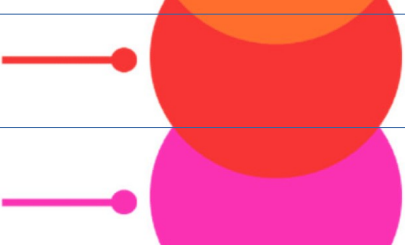
TRL7



System prototype demonstration in operational environment

Internally freeze certification requirements

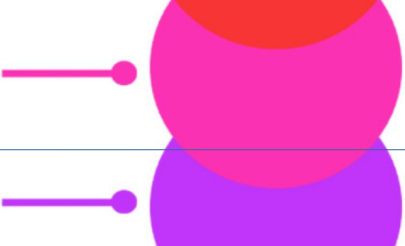
TRL6



Technology demonstrated in relevant environment

In-house trial certification on prototypes

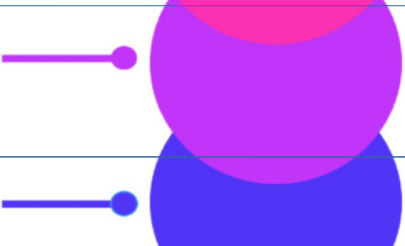
TRL5



Technology validated in relevant environment

Chill Special Conditions structure

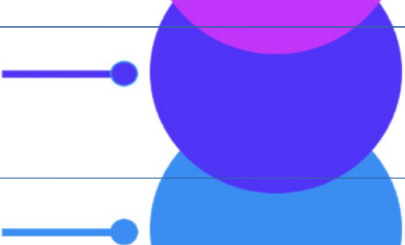
TRL4



Technology validated in laboratory

Start evaluating against testbeds and models

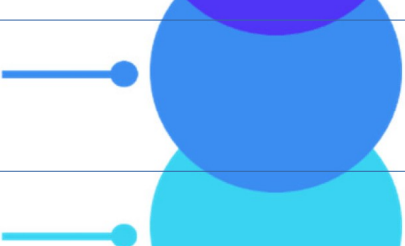
TRL3



Experimental proof of concept

Initial draft Special Conditions

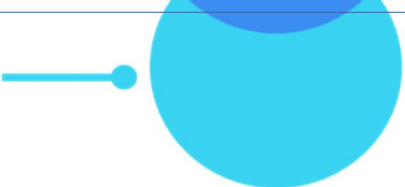
TRL2



Technology concept formulated

Literature Review

TRL1



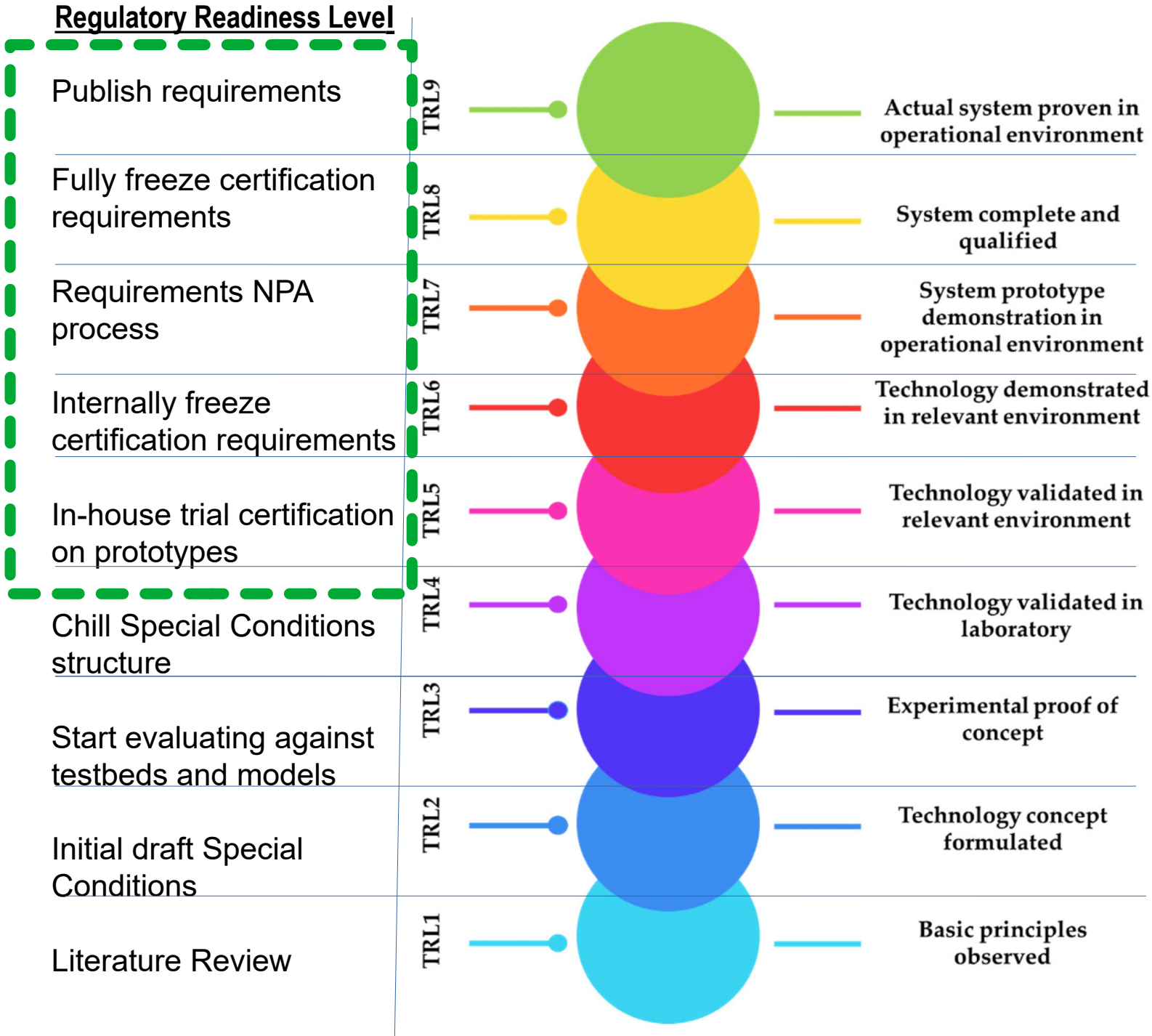
Basic principles observed



# Work in stages

Certification activity needs to shadow the aircraft and/or engine development.

**Main authority involvement**



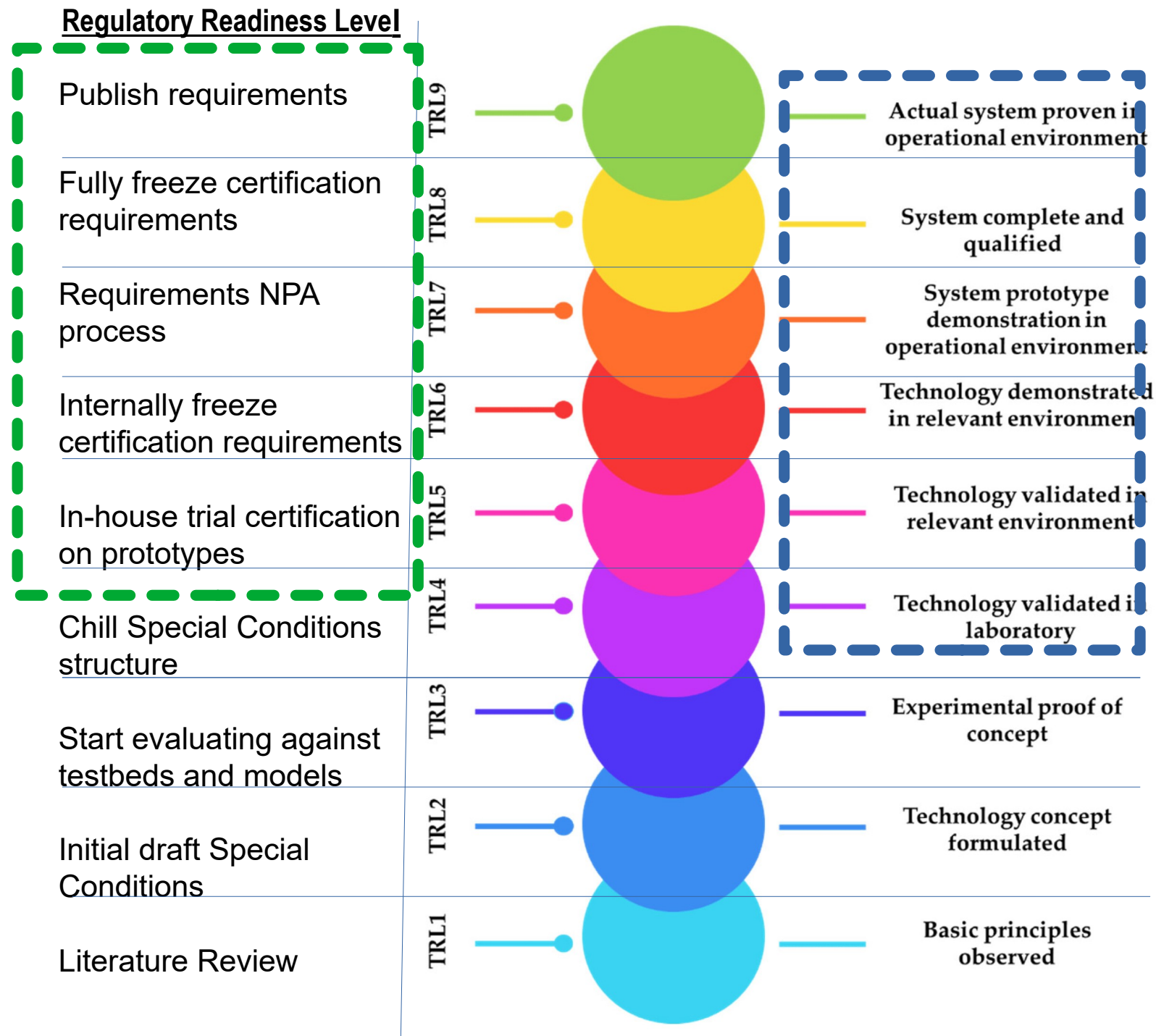


## Work in stages

Certification activity needs to shadow the aircraft and/or engine development.

**Main authority involvement**

**Manufacturer leadership**





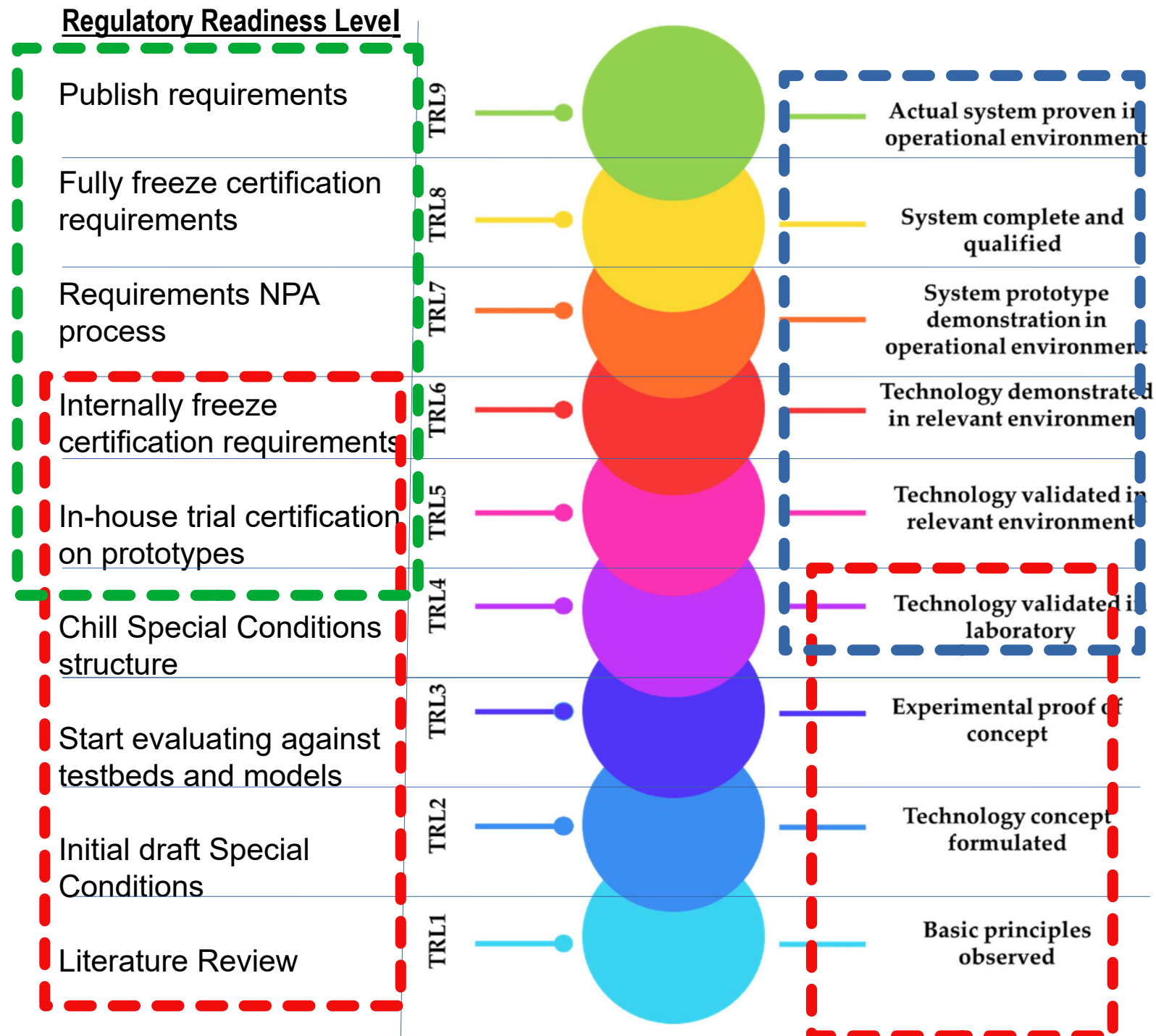
## Work in stages

Certification activity needs to shadow the aircraft and/or engine development.

**Main authority involvement**

**Manufacturer leadership**

**Research organisations  
Greatest added value**







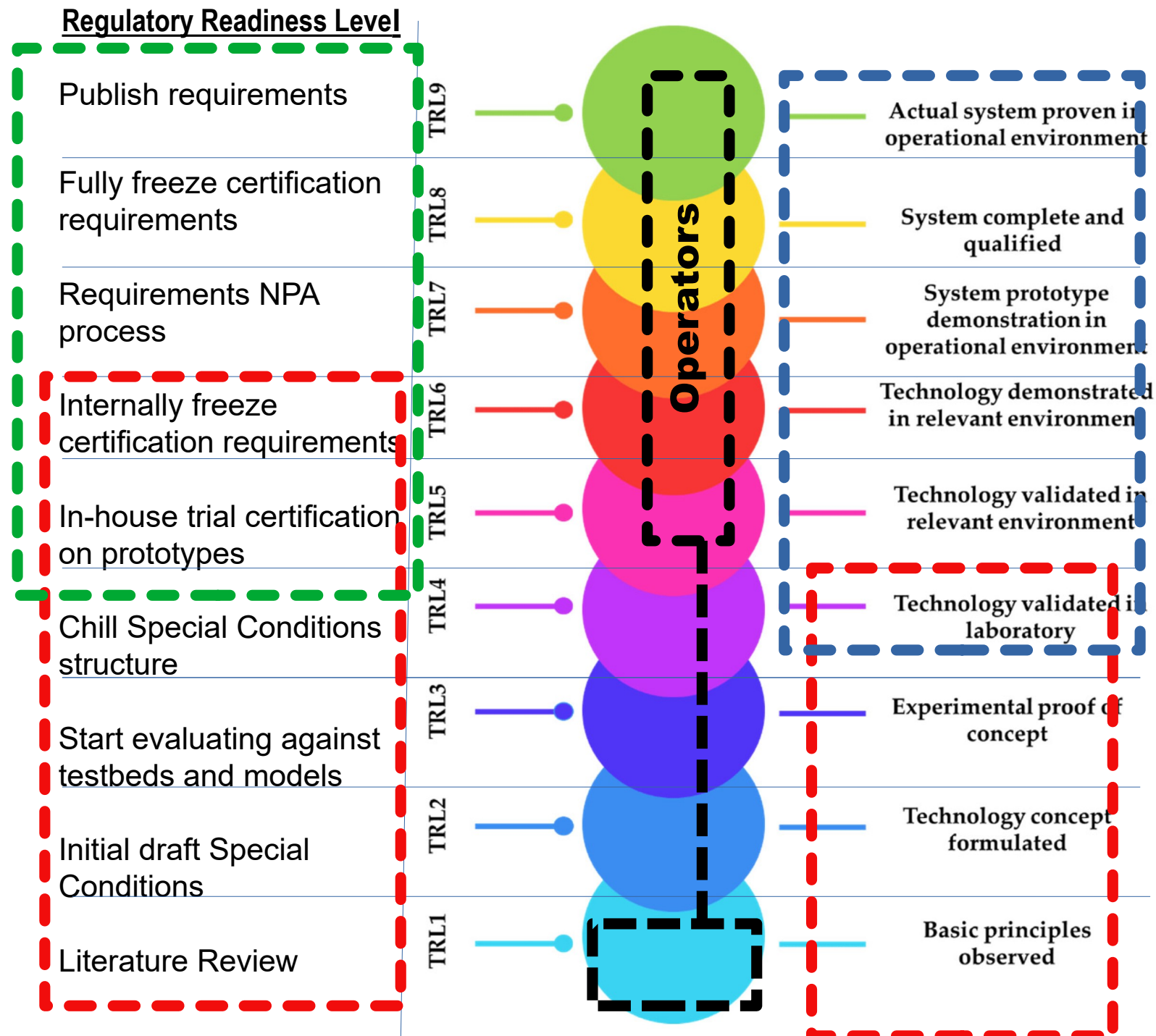
## Work in stages

Certification activity needs to shadow the aircraft and/or engine development.

**Main authority involvement**

**Manufacturer leadership**

**Research organisations  
Greatest added value**







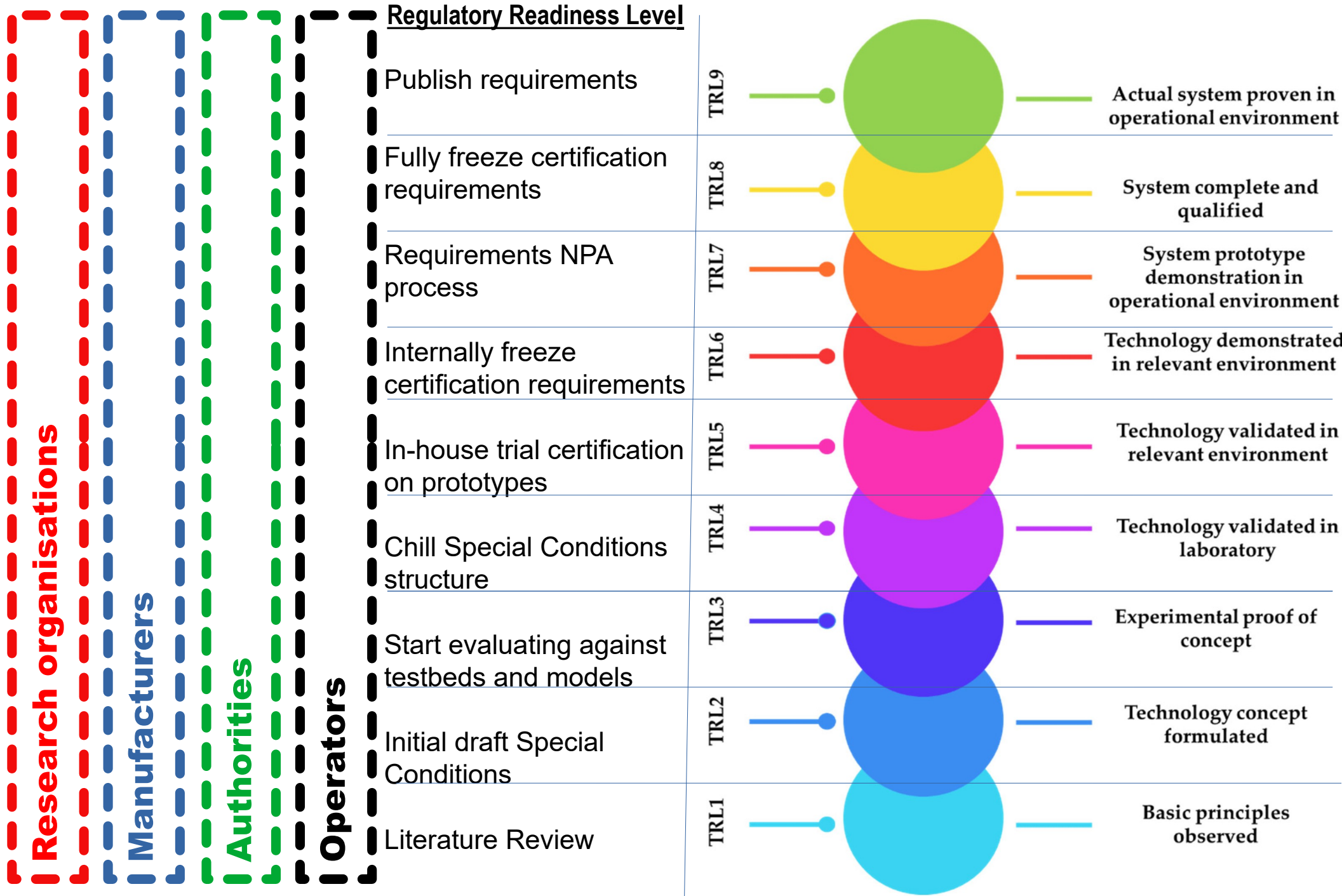
# Integrating designers, authorities, operators and researchers



Everybody in the same tent..... but not equally all at the same time



But don't compromise visibility



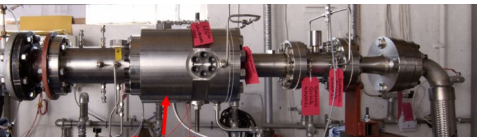


# A few Cranfield Examples

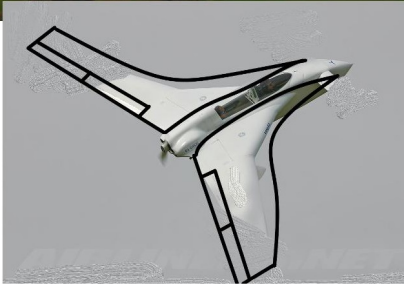
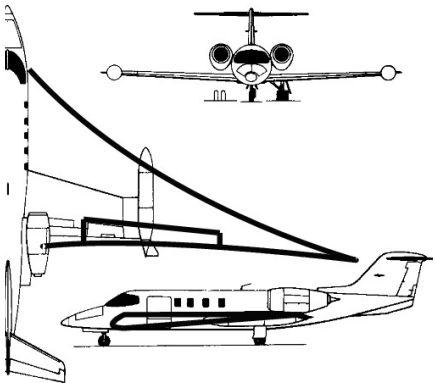
Centre for Doctoral Training  
in Net Zero Aviation



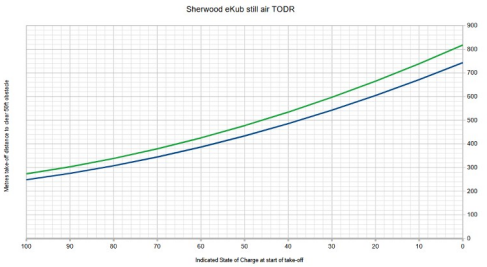
Engineering and  
Physical Sciences  
Research Council



EXAELIA



EnabEI







# Hydrogen and sustainable fuels research at Cranfield

**From 2024: £69 million Cranfield Hydrogen Integration Incubator (CH2i), delivering:**

- Hydrogen labs for research in energy production and end-uses.
- Large-scale test cells for hydrogen in civil aviation.
- Configurable test area for LH2.
- Upgrades to Cranfield Airport for larger and hydrogen-fuelled aircraft.



**Key** Feedstocks and fuel production. Transport, storage, economics, supply chain. End users – aerospace and road vehicles. Policies, economics and markets. • H<sub>2</sub> = Hydrogen • LH<sub>2</sub> = Liquid hydrogen • SAF = Sustainable aviation fuel

For more information, please contact: **Jon Horsley**, Hydrogen and Strategic Projects Manager E: [h2@cranfield.ac.uk](mailto:h2@cranfield.ac.uk)



[www.cranfield.ac.uk](http://www.cranfield.ac.uk)

[guy.gratton@cranfield.ac.uk](mailto:guy.gratton@cranfield.ac.uk)

[dominique.l.bovell@cranfield.ac.uk](mailto:dominique.l.bovell@cranfield.ac.uk)

