ECOFLIGHT

Preserving eco-design and circular economy principles in aviation technology development

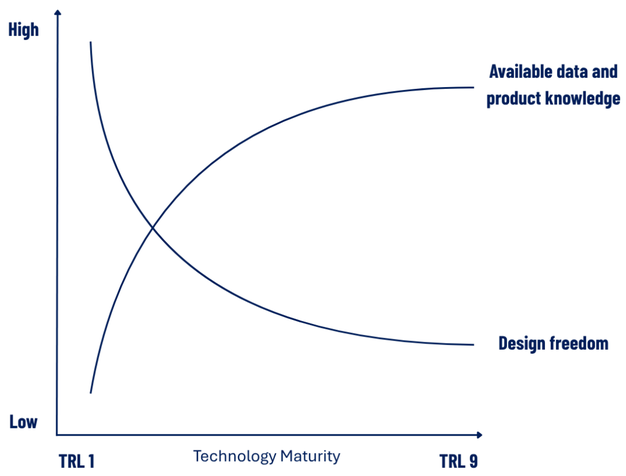
RESEARCH & PROBLEM

Environmental ambitions are displaced, not lost

Aviation must lower it's environmental footprint while demand grows, and the cabin interior, replaced often, high in material waste, is an emerging domain where eco-design and circular economy principles design can be help achieve this. But development projcets were never structured to preserve environmental criteria: **Technology Readiness Levels** run on safety, weight, and cost, and sustainability sits structurally outside that logic.

The eco-design paradox

Combining that with the eco-design paradox, where design freedom is highest at the very start, when almost nothing is known, and where this freedom lowers significantly as a technology matures, a challenging environment is created.



Eco-design paradox in technology development, derived from Poudelet et al., 2012

Existing tools, such as lifecycle assessments or sustainability screening methods, were never built for this timing gap. Combining that the characteristics of the aviation ecosystem, where certification requirements and gate logic built around technical performance and weight dominate, preserving eco-design and circular economy principles becomes a real challenge. This resulted in the following research question.

RESEARCH QUESTION

How can eco-design and circular economy principles be preserved in TRL-based aviation technology development?

RESULTS

A framework of 20 barriers, in four categories

Seventeen expert interviews across the aviation value chain **validated and extended** the existing literature and findings into a structured framework of the barriers and conditions that push eco-design and circular economy principles out of the gate process.

17 INTERVIEWS → **20** BARRIERS → **4** CATEGORIES

COMMERCIAL
No business case for sustainability at a decision moment; environmental value needs to carry a commercial argument.

ORGANIZATIONAL
Silos and handovers between design and downstream teams erase ownership and information availability.

REGULATORY
Certification and airworthiness rules dominate; sustainability sits outside what compliance requires.

INFORMATIONAL
Environmental data is missing or immature at the moments it matters.

These barriers and conditions informed how a potential solution could enable practitioners in actually preserving their environmental ambitions.

RESEARCH	DESIGN OUTCOME
Environmental ambitions are displaced, not accidentally lost.	Map the barriers and conditions so practitioners see what is coming.
Commercial barriers are the most dominant, and need to be synergized with environmental ambitions.	Surface the commercial justification that lets environmental criteria survive the process.
TRL processes were never built to insert environmental criteria.	Sequence methods so the evidence is ready when it matters.

This is what EcoFlight operationalizes: the solution explained below.

THE SOLUTION

It does not tell you what to design. It tells you which barriers to expect, which methods to use, and how to justify environmental ambitions in the language decision-makers respond to. All across three phases.

Try it → ecoflight.pages.dev

PHASE 01 — AWARENESS

01 BARRIERS & CONDITIONS

Map the barriers that cause eco-design and circularity to be deprioritized in your project.

20 BARRIERS & CONDITIONS
Across all four categories, each translated into commercial language.

FILTER
By category or TRL stage to surface what is most active in your context.

AI SELECTOR
Describe your project, get a shortlist of the 3–5 most relevant barriers.

PHASE 02 — OPERATIONALIZE

02 METHODS & TOOLS

Thirteen methods that translate circular design intent into defensible, gate-ready evidence.

13 METHODS
Mapped to barrier type and TRL stage for the situation you are in.

SEQUENCE
Early-stage methods feed and unlock the later ones.

GATE-READY
Outputs are gate-review inputs, not standalone reports.

PHASE 03 — JUSTIFY

03 REFRAME & COMMERCIALIZE

Seven structural conditions under which environmental ambitions survive aviation gate decisions.

7 CONDITIONS
Observed patterns from real aviation cabin development projects.

IDENTIFY
Recognize which conditions are present or achievable in your project.

REFRAME
Frame sustainability as cost reduction, supply-chain resilience, or regulatory risk.

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