The Assessment and Comparison Tool (ACT)

Simplified, space-specific, prospective LCA

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19/09/2025

Some background

ESA FLPP identified the need for a space-specific ecodesign tool

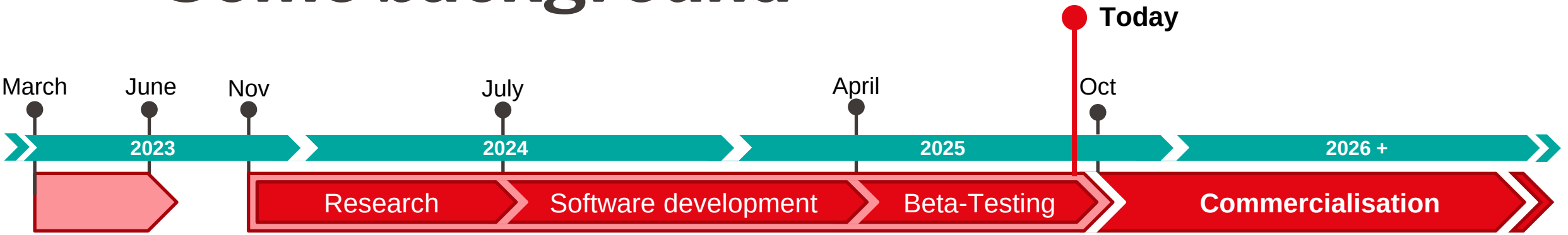
EPFL Space Center was chosen for its expertise in space sustainability

Goal is to make a tool that is used by the industry, after the ESA project

The Assessment and Comparison Tool

- ✓ **Space-specific** scopes, inventories, and methods
- ✓ From **simplified** to full LCAs
- ✓ Data quality rating and impact contribution analysis
- ✓ Iterative assessment thanks to compatibility with Excel and BrightWay
- ✓ Safe by design (no data stored on servers)
- ✓ Easy to use

Some background



Phase 1: Development of ACT v1.

Phase 2: Development of ACT v2.

Phase 3: Operations

Key focus:

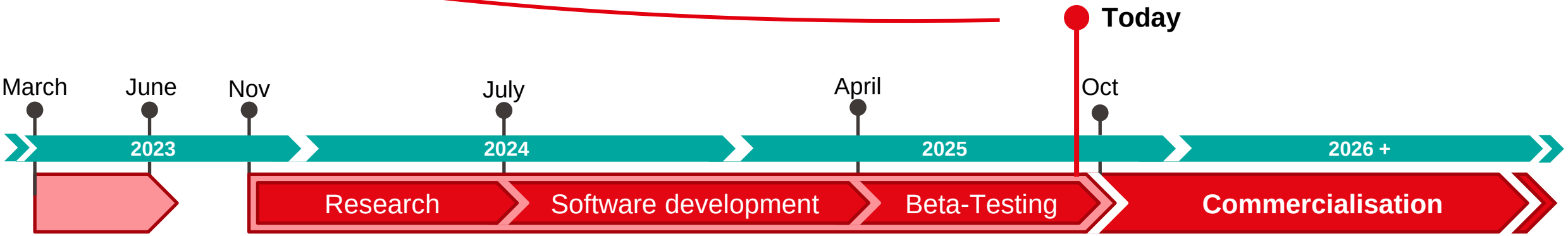
- Align ACT with (future) industry needs
- Integrate ever-evolving LCA methodology changes (PEFCR, ESA guidelines, etc.)
- Improve user experience and simplicity

- End of ESA project
- Start of ACT's implementation with industry
- Continued alignment with industry needs

Some background

- ACT v2 is in its finalisation stage
- A public demo planned on 19 Nov
- The team is looking ahead, after ESA project

We'll get back to this at the end...



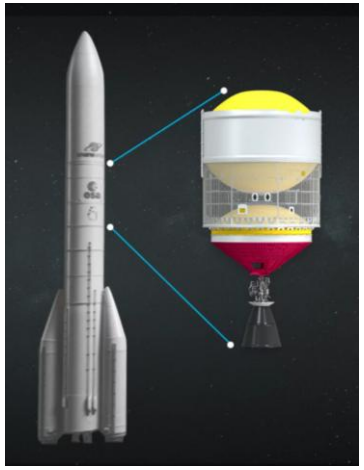
Phase 1: Development of ACT v1.

Phase 2: Development of ACT v2.

Phase 3: Operations

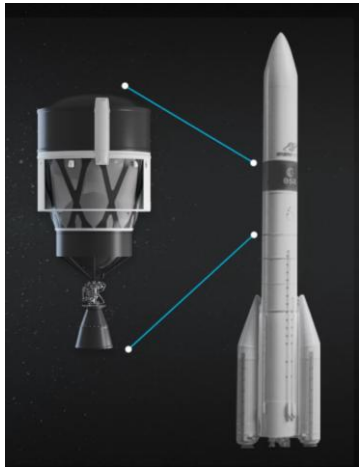
The Assessment and Comparison Tool

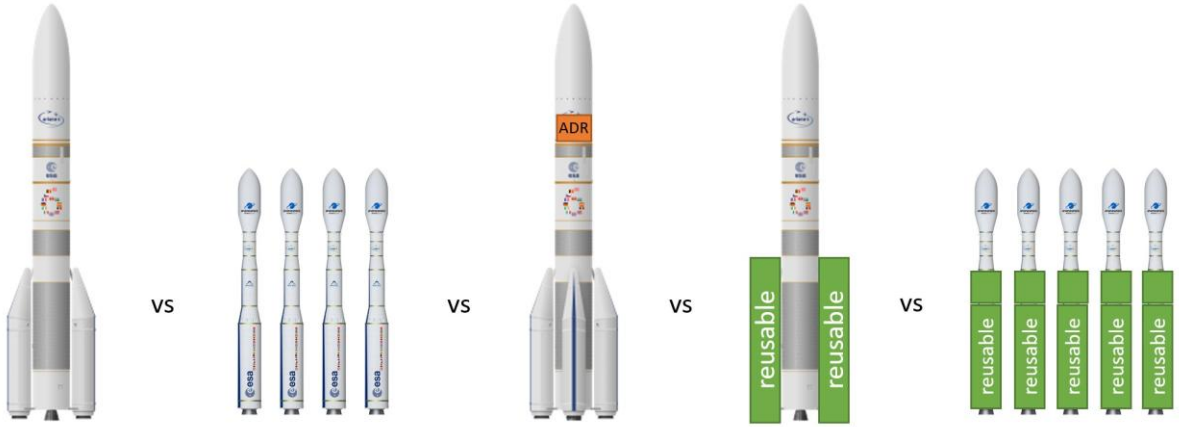
ACT is ***space-specific*** tool for ***simplified*** and ***prospective*** *(screening)* LCA in the space sector to give (visualised) *guidance* on ecodesign and decisions-making



<u>More or less</u>:
Performance ?
Cost ?
Availability ?

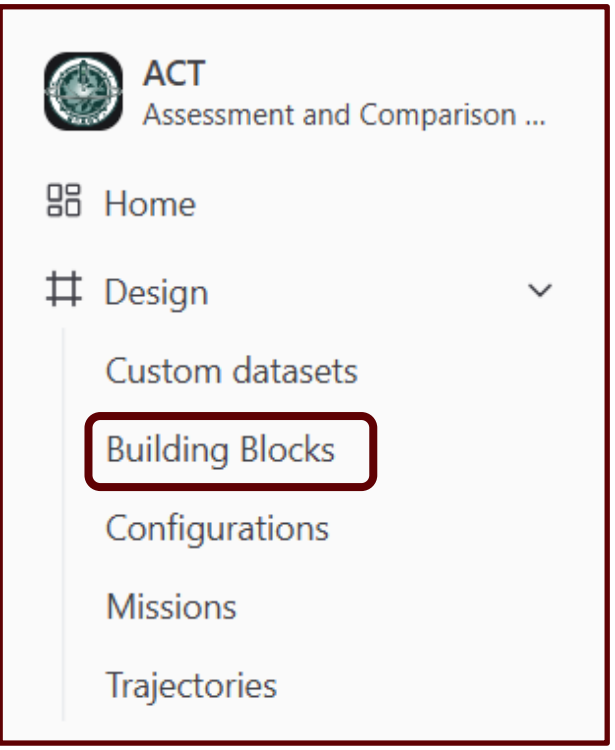
Risks ?
Environmental impacts ?

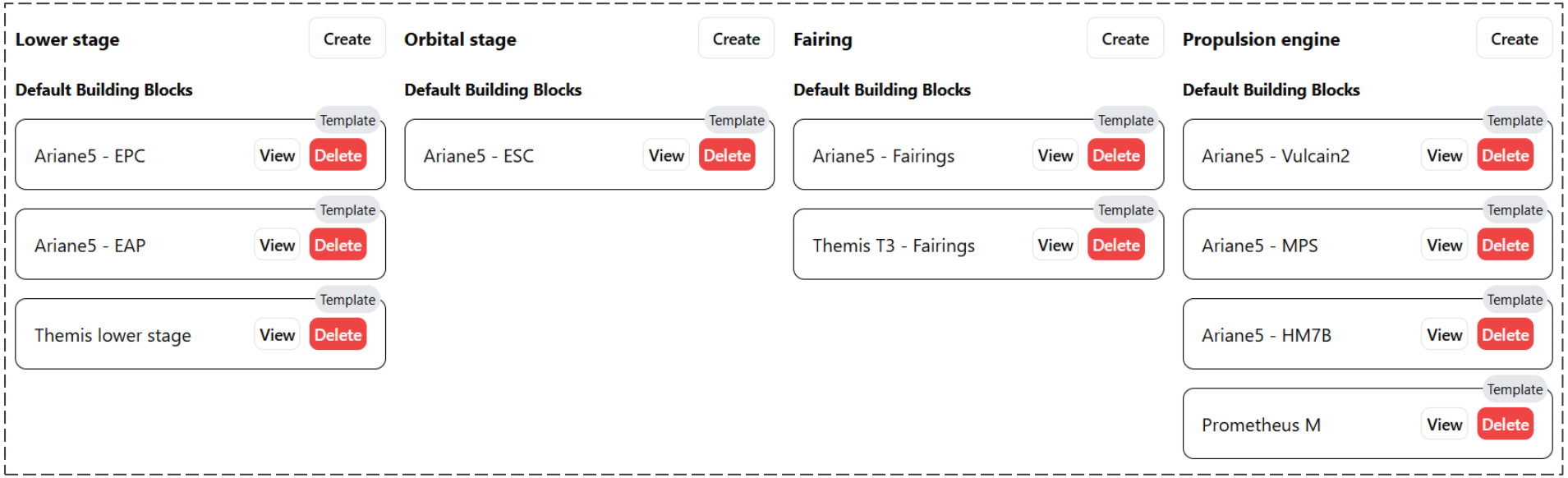




Figures: ArianeGroup, Phoebus article, 2022

ACT models – building blocks

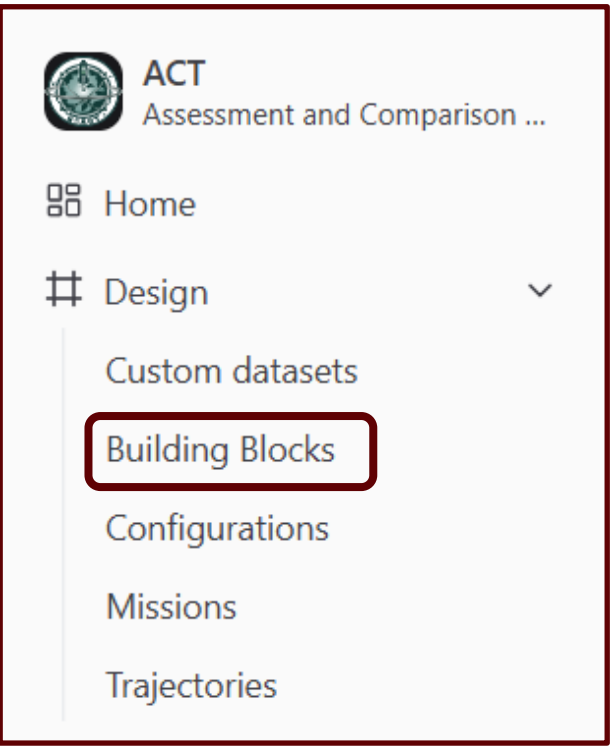


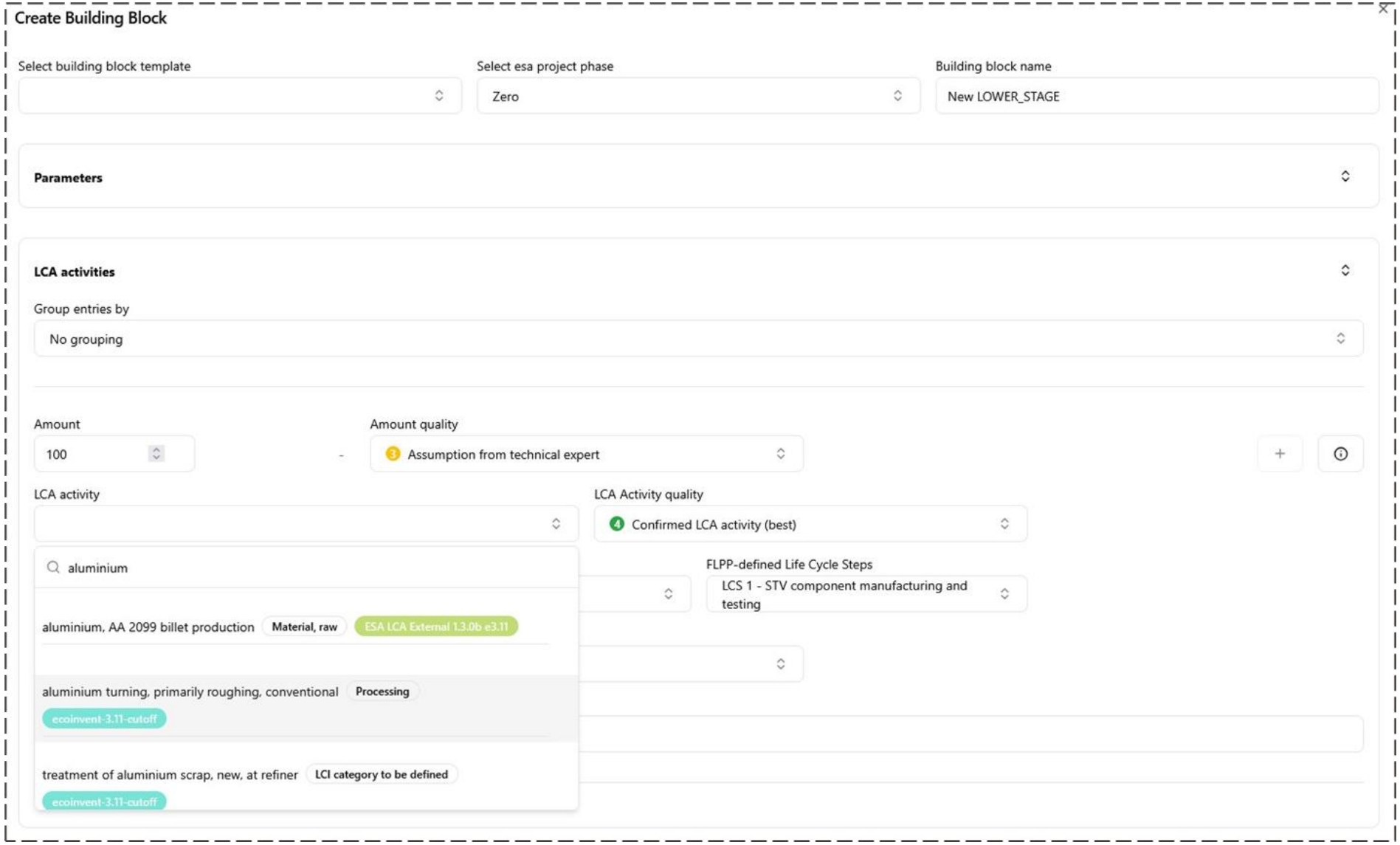


Building blocks specific to space systems

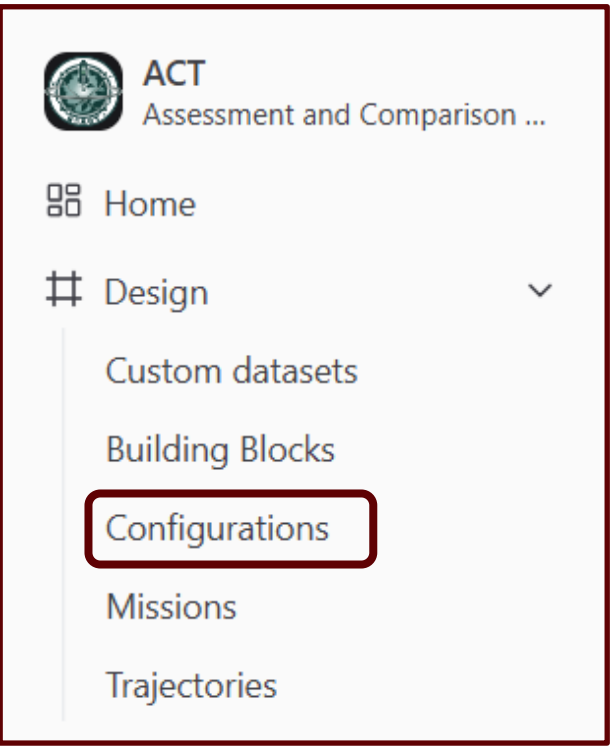
→ More straightforward system modelling

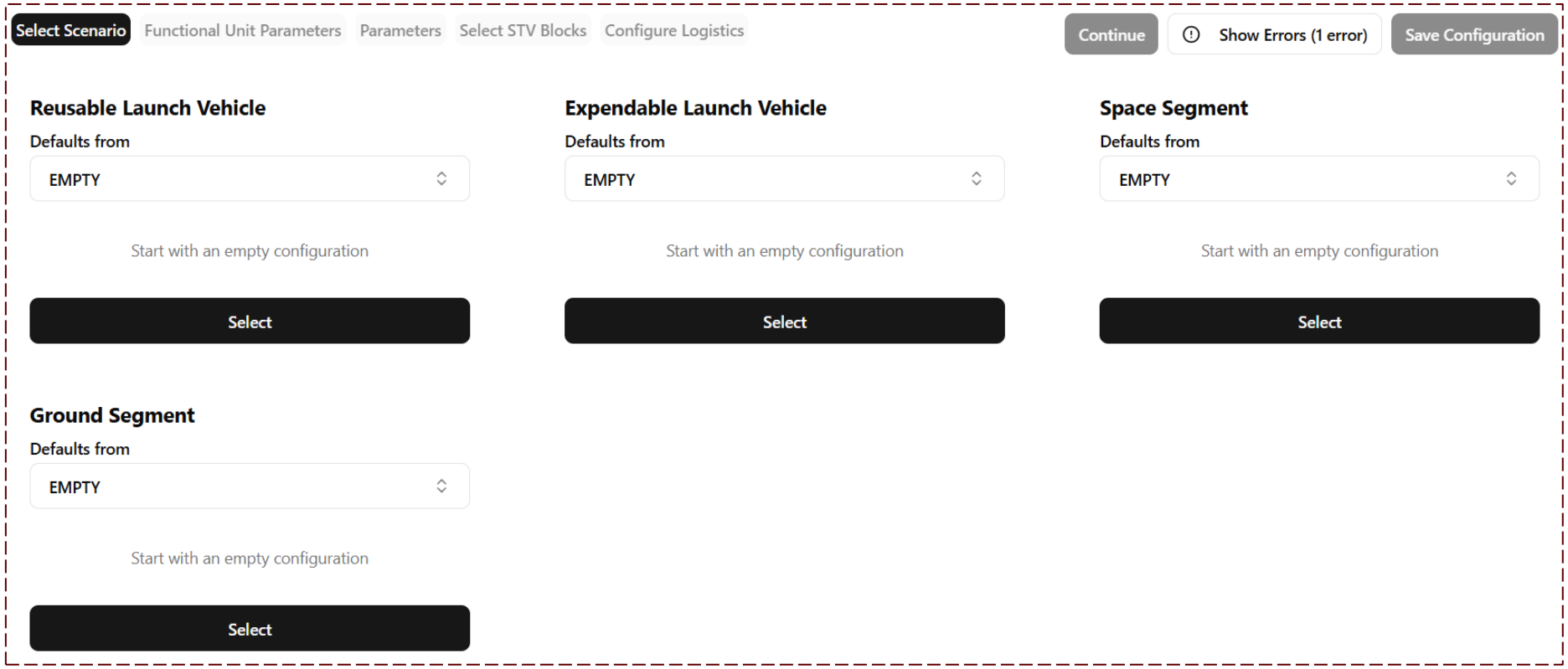
ACT models – building blocks





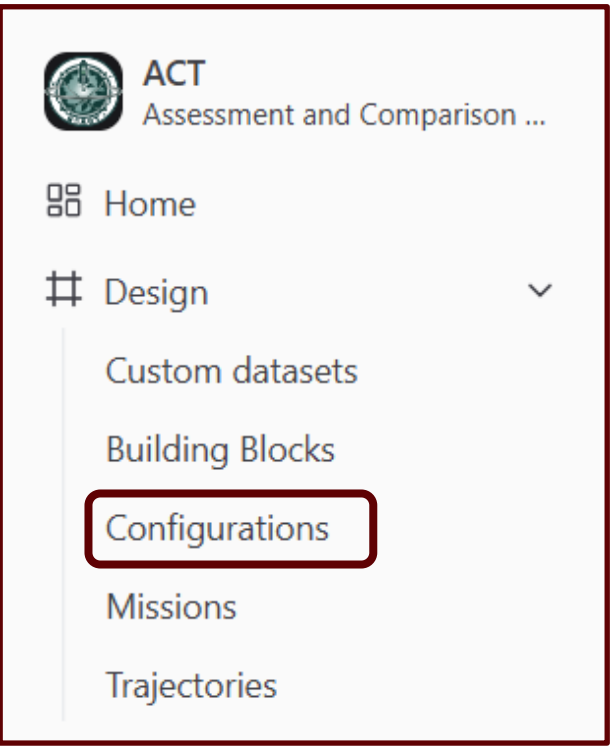
ACT models – configurations

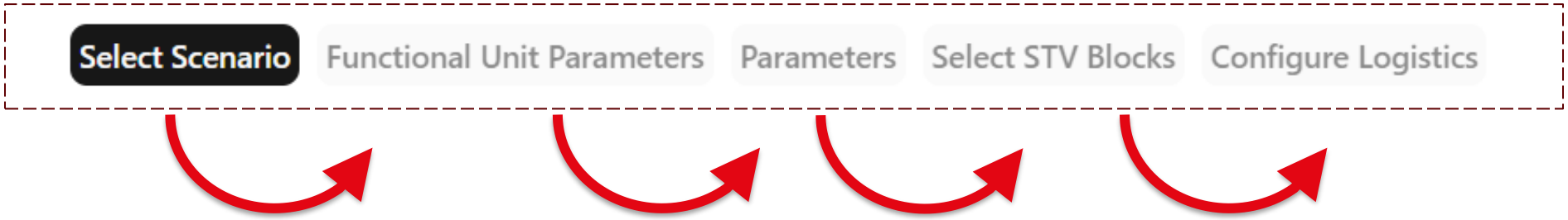




Full space mission configurations
(space, launch, ground segments)

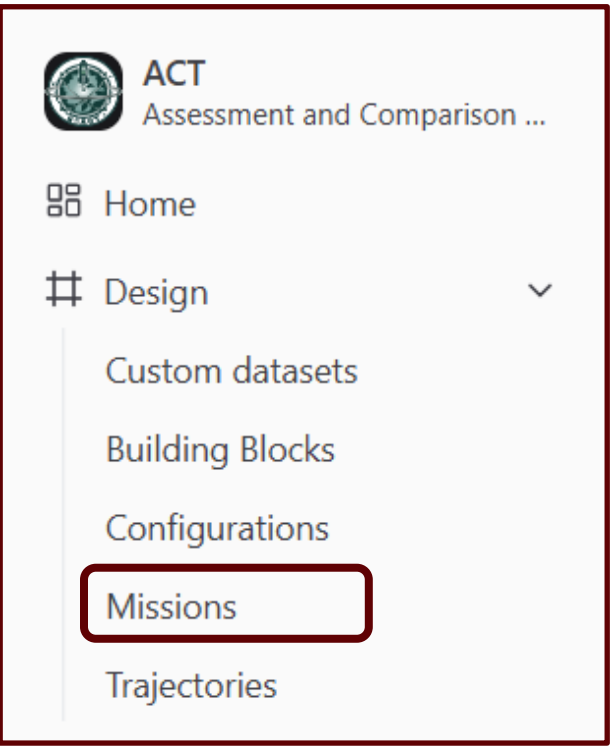
ACT models – configurations

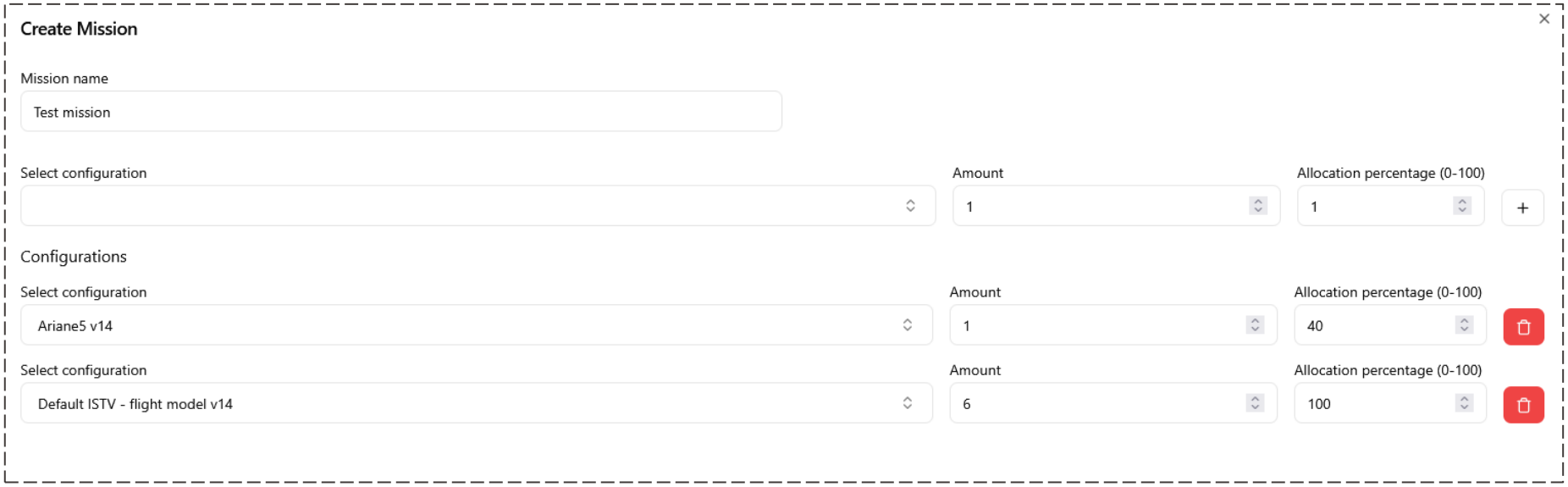




Guided LCA steps

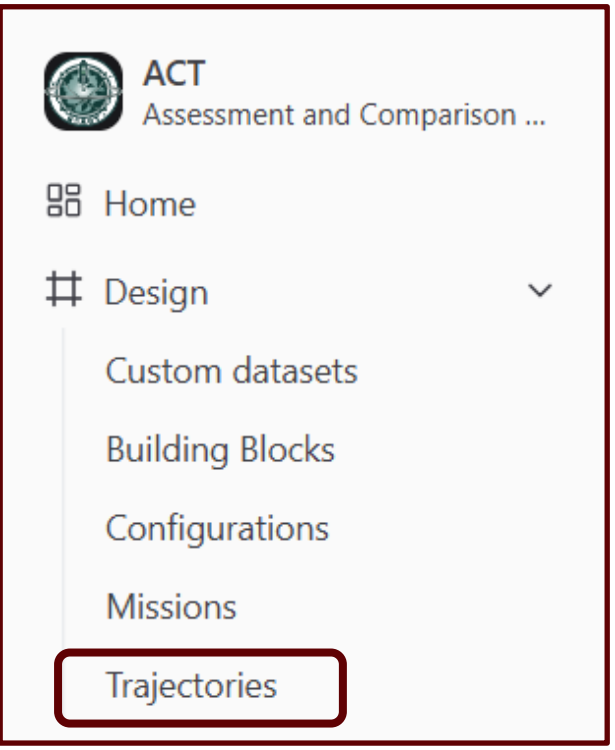
ACT models – space missions

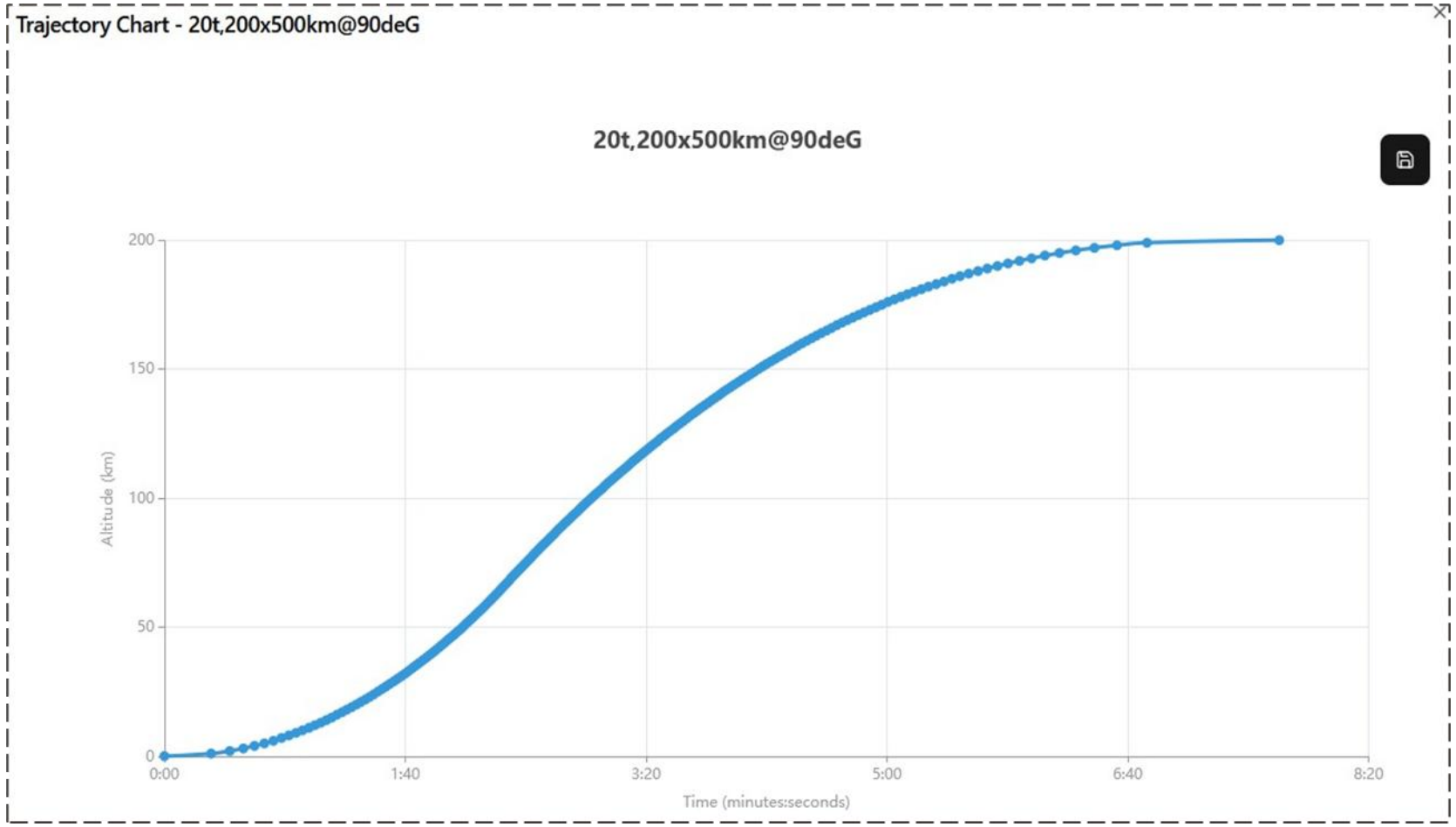




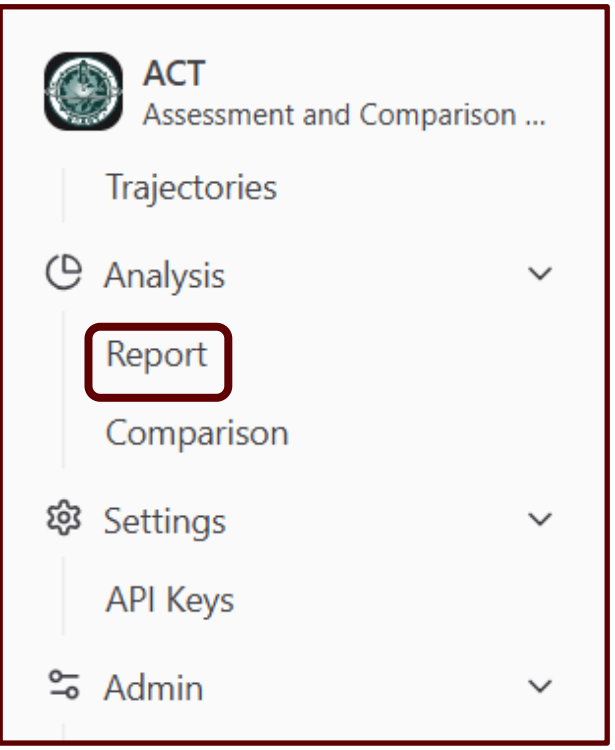
To combine and allocate impacts of several configurations

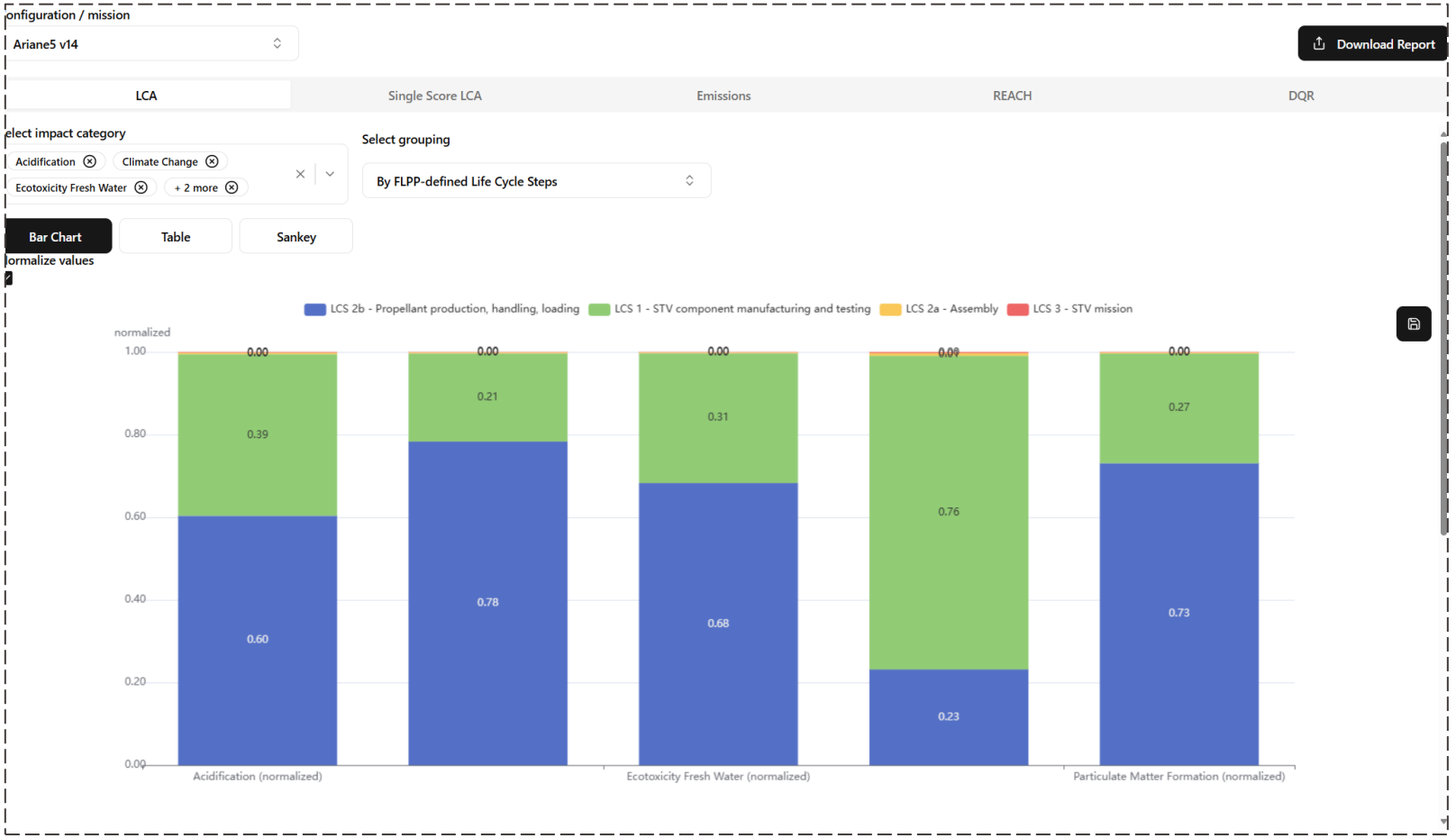
ACT models – trajectories





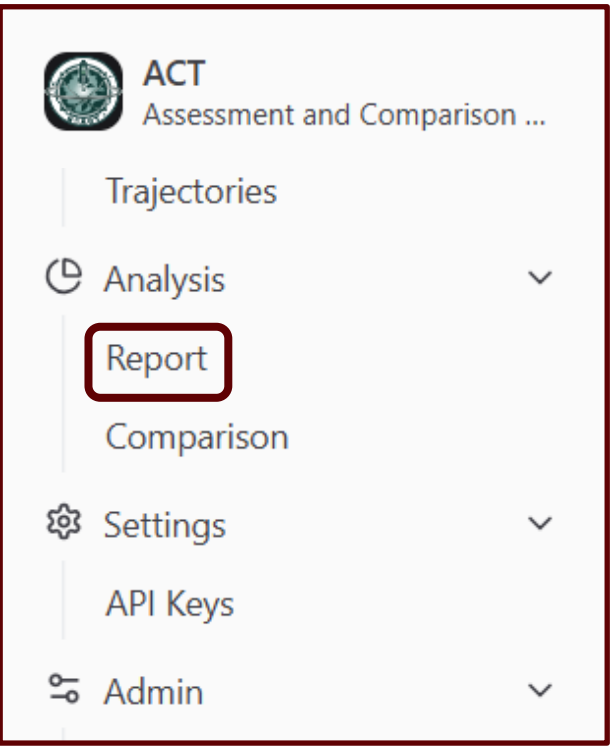
ACT outputs – LCIA bar charts





Note: these are example results and should not be considered as real LCA conclusions for the Ariane 5

ACT outputs – table



Configuration / mission

Ariane5 v14

Download Report

LCA | Single Score LCA | Emissions | REACH | DQR

Select impact category

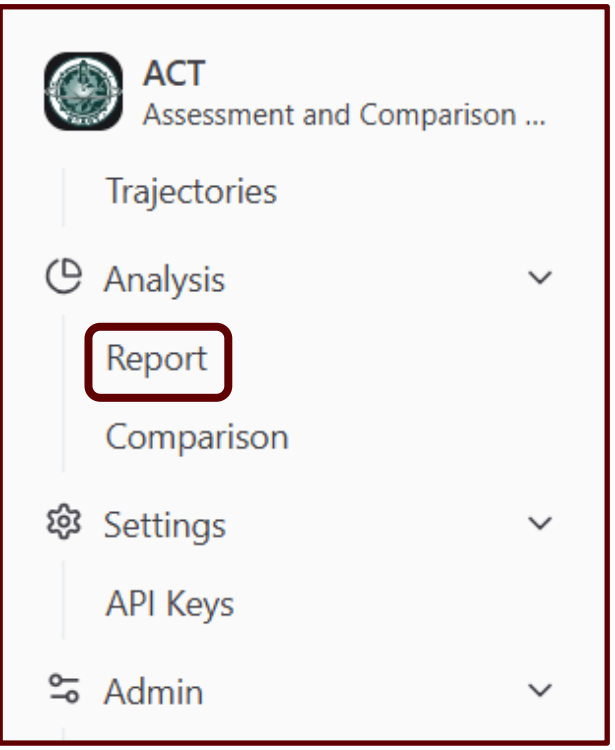
Select options

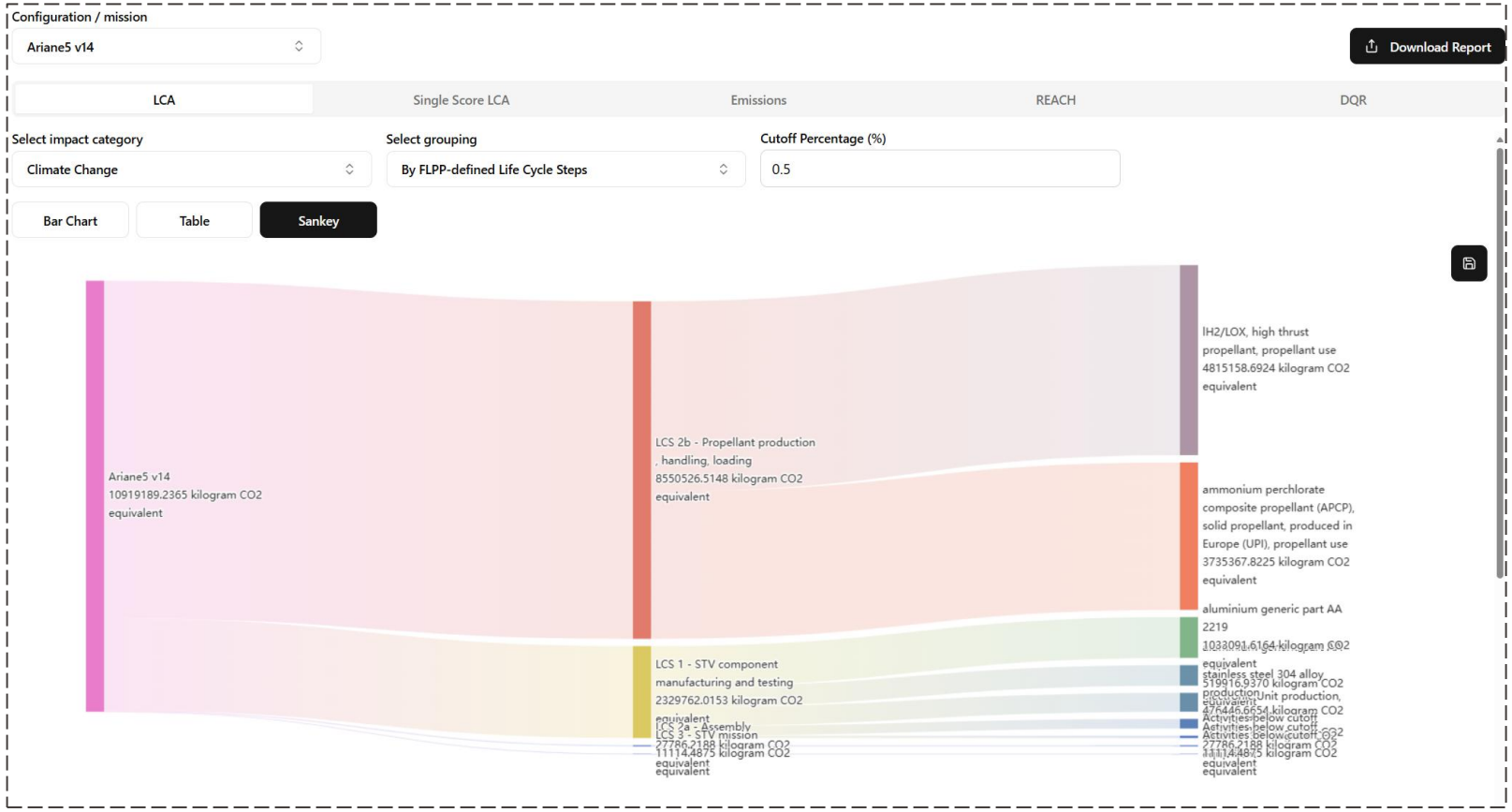
Bar Chart | Table | Sankey

LCA Activity Name	Amount	ESA project phase	ESA input type	FLPP-defined Life Cycl...	Path	Climate Change (kilog...
Filter ...	Filter ...	All	All	All	Filter ...	Filter ...
lH2/LOX, high thrust propellan...	170000	E1	Others	LCS 2b - Propellant production...	Ariane5 v14,Ariane5 - EPC,lH2/...	**4427133.4651**
aluminium generic part AA 7075	6250	C	Raw Materials and lower level i...	LCS 1 - STV component manuf...	Ariane5 v14,Ariane5 - EPC,alu...	**317022.5226**
aluminium generic part AA 2219	7150	C	Raw Materials and lower level i...	LCS 1 - STV component manuf...	Ariane5 v14,Ariane5 - EPC,alu...	**397342.9294**
harnessing production	0	D	Raw Materials and lower level i...	LCS 1 - STV component manuf...	Ariane5 v14,Ariane5 - EPC,harn...	**0.0000**
stainless steel 440b (X 90 CrM...	100	C	Raw Materials and lower level i...	LCS 1 - STV component manuf...	Ariane5 v14,Ariane5 - EPC,stai...	**910.2383**
aluminium generic part AA 2219	100	E1	Raw Materials and lower level i...	LCS 2a - Assembly	Ariane5 v14,Ariane5 - EPC,alu...	**5557.2438**
electronic Unit production, Hig...	200	C	Raw Materials and lower level i...	LCS 1 - STV component manuf...	Ariane5 v14,Ariane5 - EAP,elec...	**120884.2913**
stainless steel 304 alloy produ...	22000	D	Raw Materials and lower level i...	LCS 1 - STV component manuf...	Ariane5 v14,Ariane5 - EAP,stai...	**238223.3327**
aluminium generic part AA 2219	100	D	Raw Materials and lower level i...	LCS 2a - Assembly	Ariane5 v14,Ariane5 - EAP,alu...	**5557.2438**
aluminium generic part AA 7075	2000	C	Raw Materials and lower level i...	LCS 1 - STV component manuf...	Ariane5 v14,Ariane5 - EAP,alu...	**101447.2072**
ammonium perchlorate comp...	240000	E1	Others	LCS 2b - Propellant production...	Ariane5 v14,Ariane5 - EAP,am...	**1867683.9112**

Note: these are example results and should not be considered as real LCA conclusions for the Ariane 5

ACT outputs – Sankey





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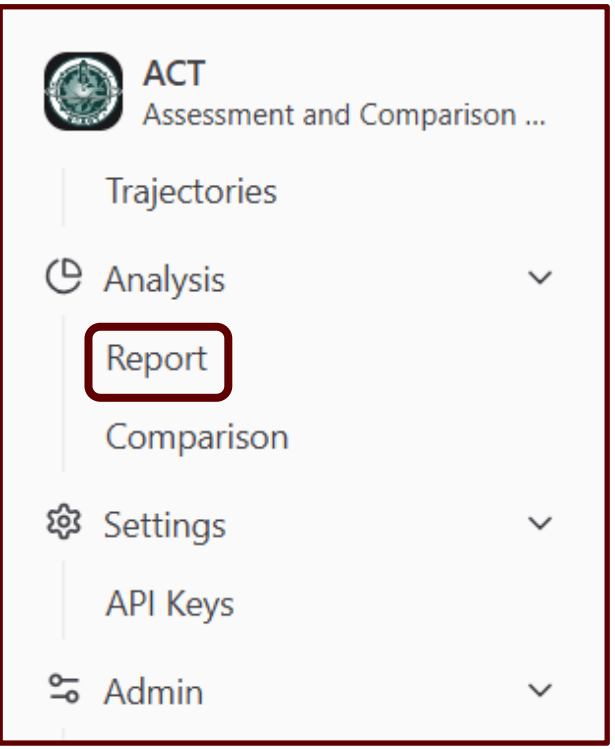
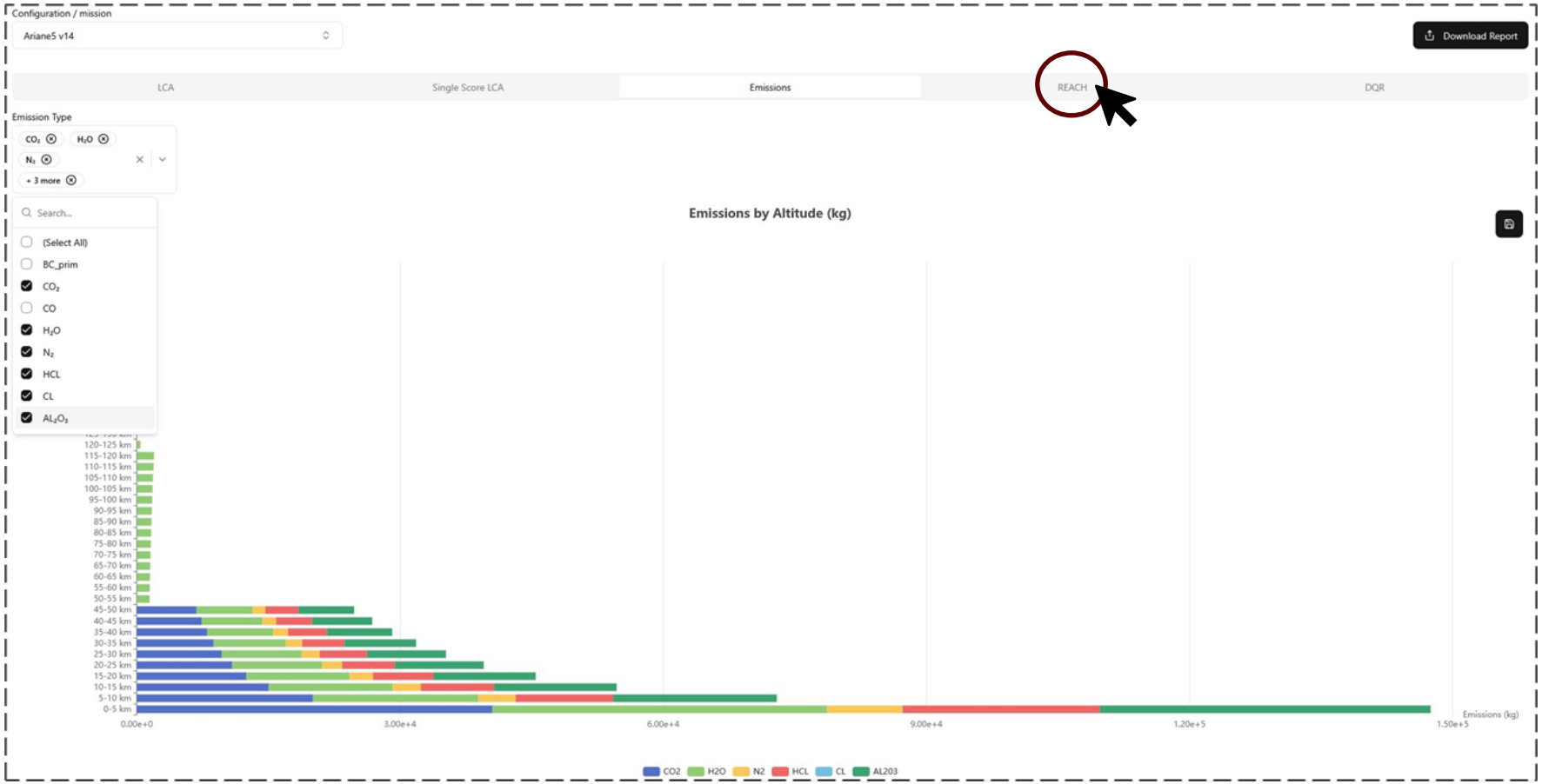
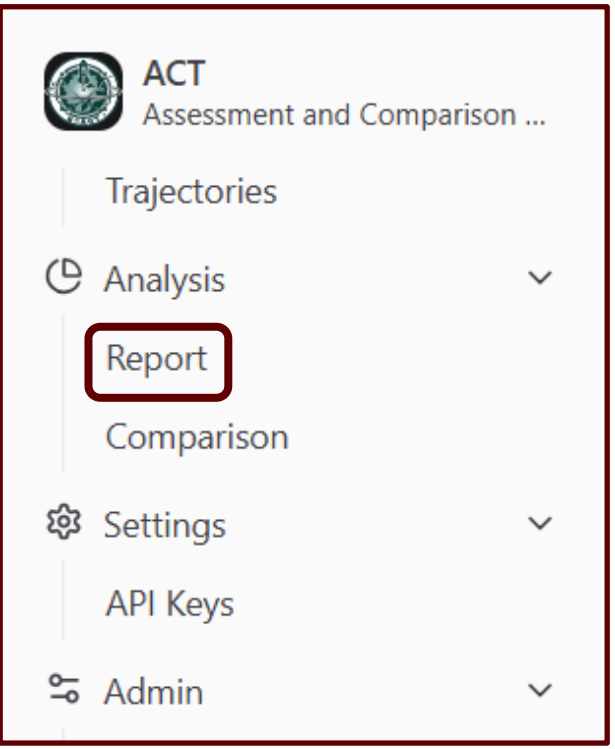
ACT outputs – launch emissions

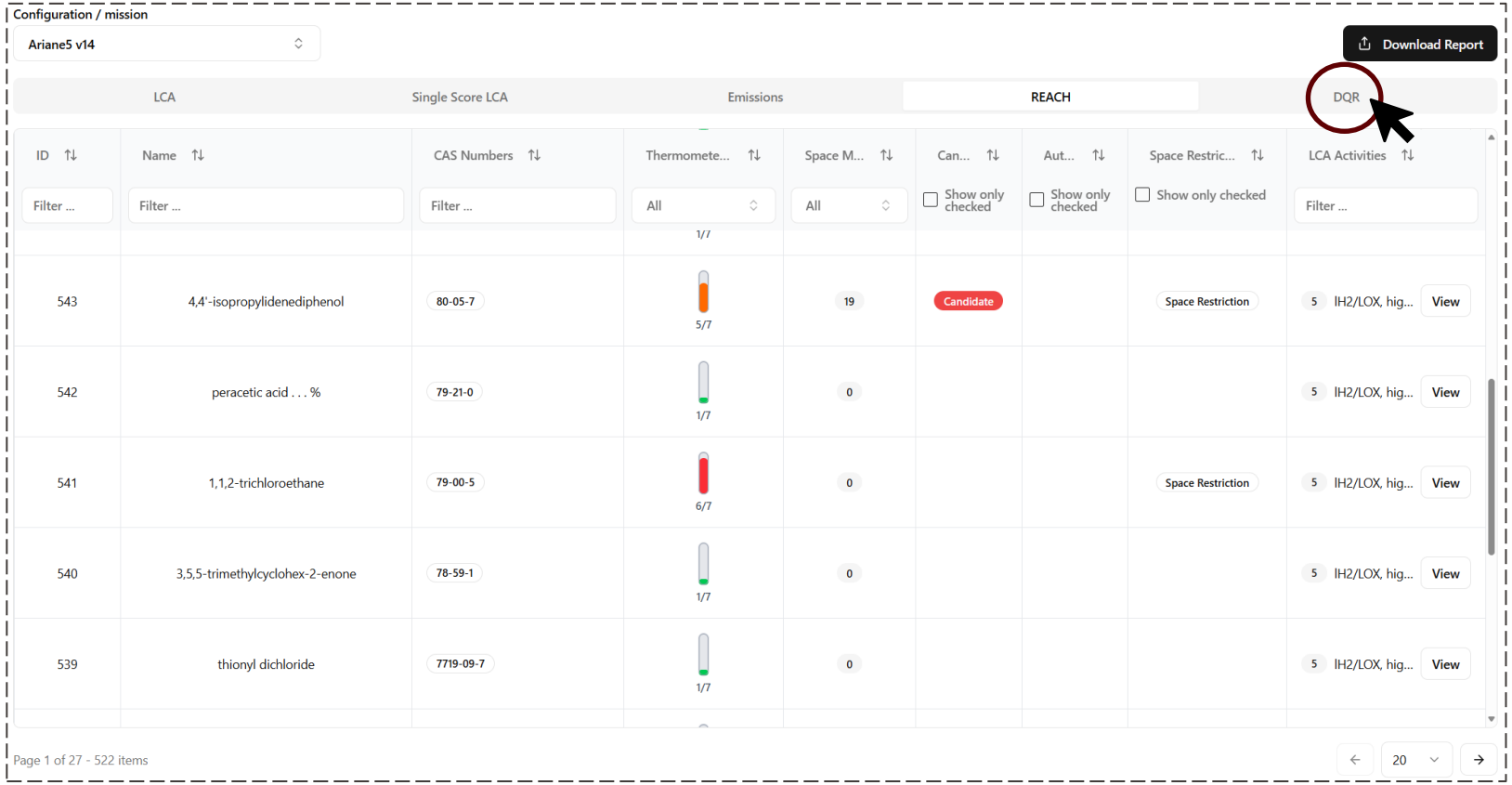




Note: these are example results and should not be considered as real LCA conclusions for the Ariane 5

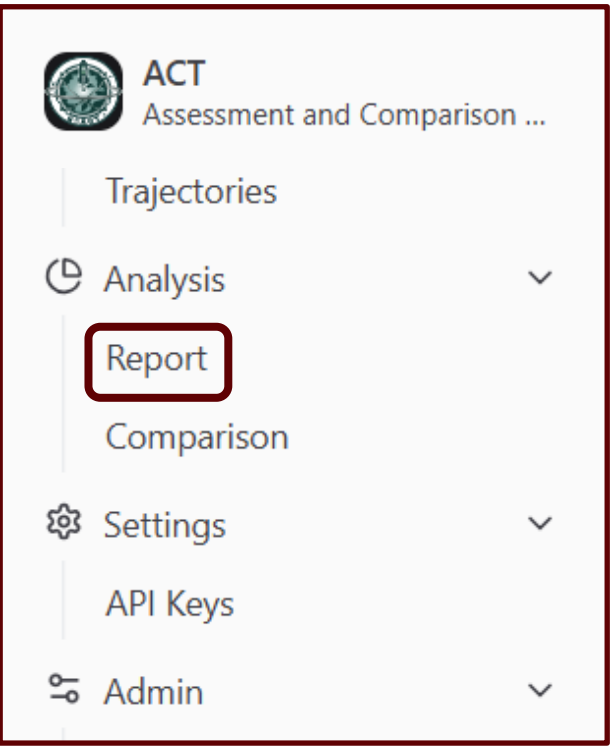
ACT outputs – REACH risks





Note: these are example results and should not be considered as real LCA conclusions for the Ariane 5

ACT outputs – data quality rating



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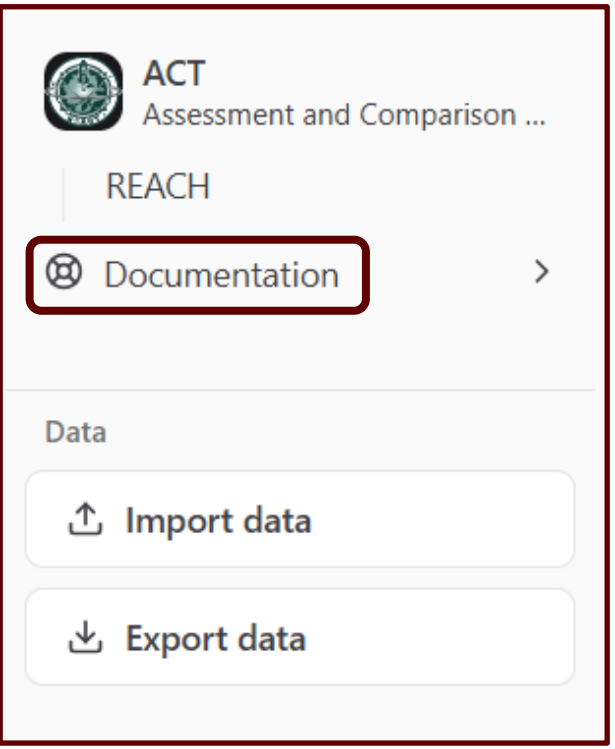
ACT documentation



Welcome to the Assessment and Comparison Tool documentation

Welcome to the ACT documentation!

Download Documentation as PDF

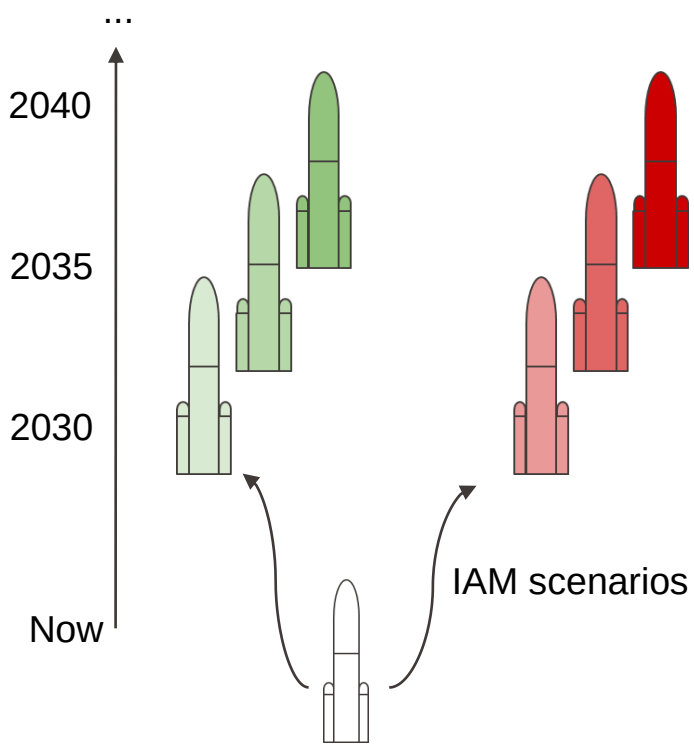
The writing of the documentation was done in parallel with the development of the Assement and Comparion Tool (ACT). It organises knowledge accumulated during the ESA FLPP-funded ReACT project (2023-2025) and its deliverables (Technical Notes TN 1, TN 2, TN 3). It was also used to produce the User Manual - UM deliverable (ACT User manual ESA Class 2 document).

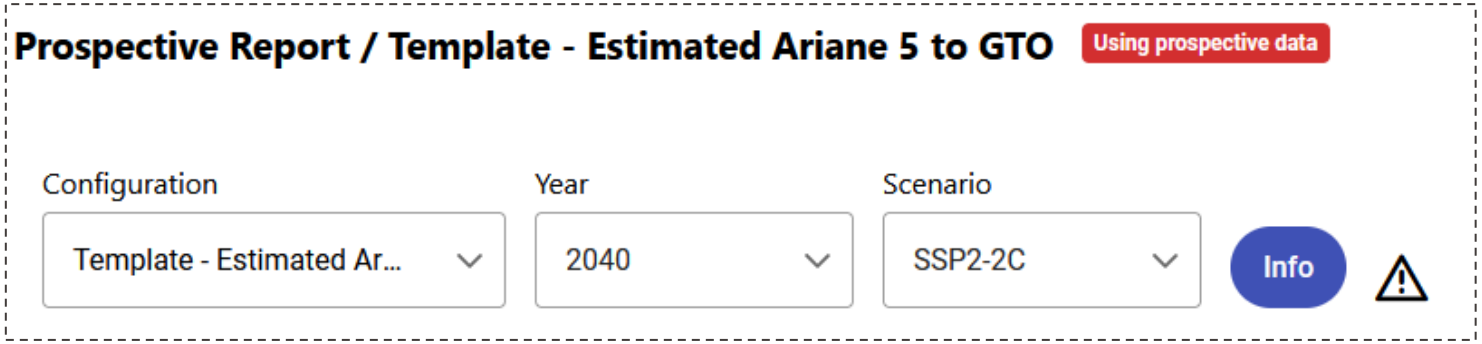
Quick documentation navigation

1. Getting Started
2. ACT glossary
3. Step by step user manual
4. Simplified LCA in more details
5. External Tools
6. LCA results interpretation
7. Examples of the methodology applied to space systems
8. User manual for administrators

ACT advanced features

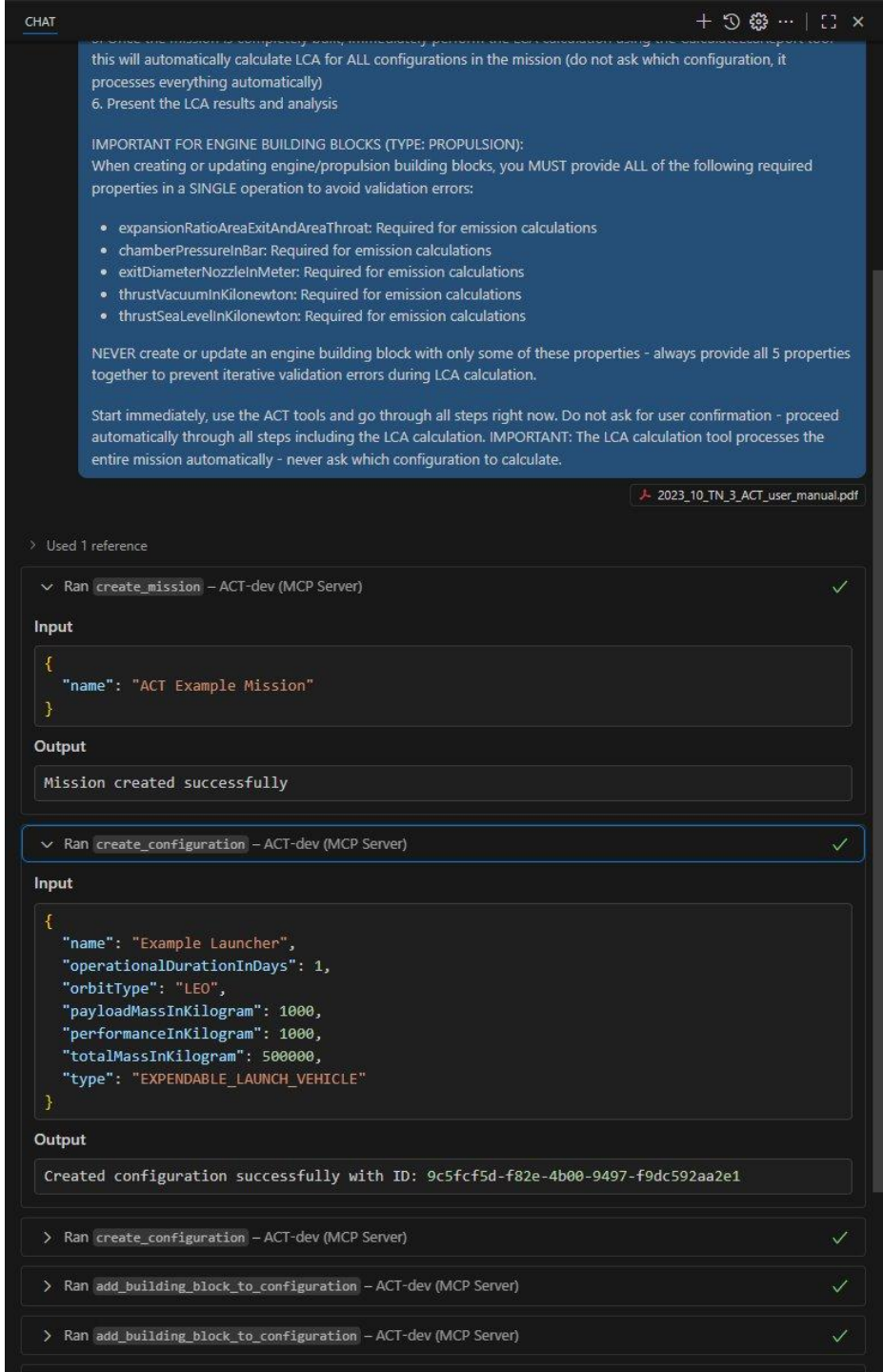
- Prospective databases (years and scenarios) – future proof





ACT advanced features

- Model Context Protocol (Open protocol for LLMs) = "USB-C port for AI apps"
- An interface between ACT **functions** and user **data** (context)
- Predefined **prompts** to create configurations and compute LCIA
- You can choose the (local) model you trust, so your data stays **safe**

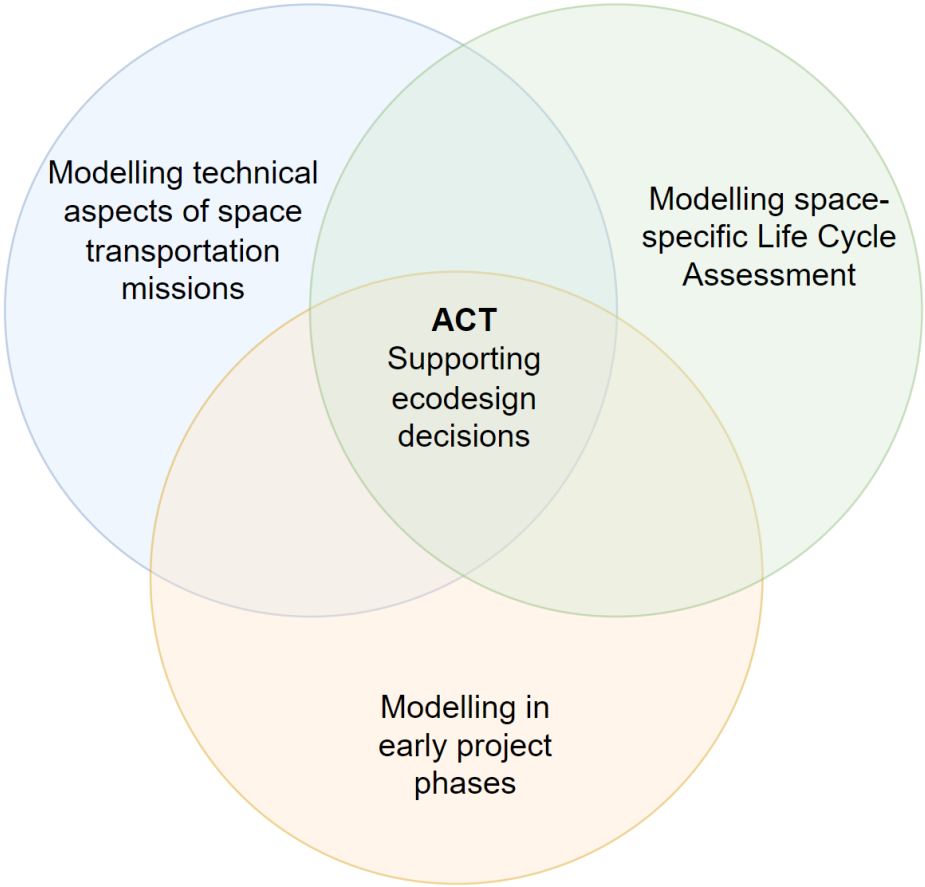


Next steps

Extensive testing ongoing

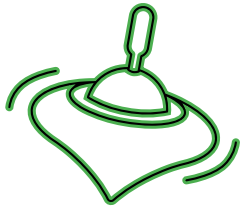
Finishing the FLPP project in November

Public Final Presentation on November 19th

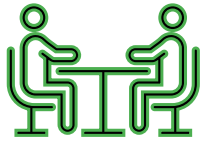


And, what about after the ESA Project?

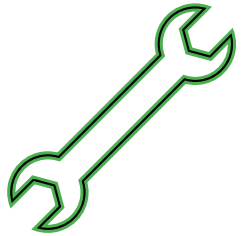
Future plans – EcoΔV



Spin out from EPFL and Stuttgart University



Provide tool-based consultancy **services**



Refine ACT further, matching industry needs

More info & get in touch:
www.ecodeltav.com

EcoΔV

EcoΔV – the team

Jan-Steffen Fischer
The avid climber and launcher impacts expert

Mathieu Udriot
The dutiful firefighter and systems engineer

Marnix Verkammen
The enthusiastic paraglider and ecodesign consultant

Emmanuelle David
The motivated trail runner and advisor

EcoΔV

EPFL

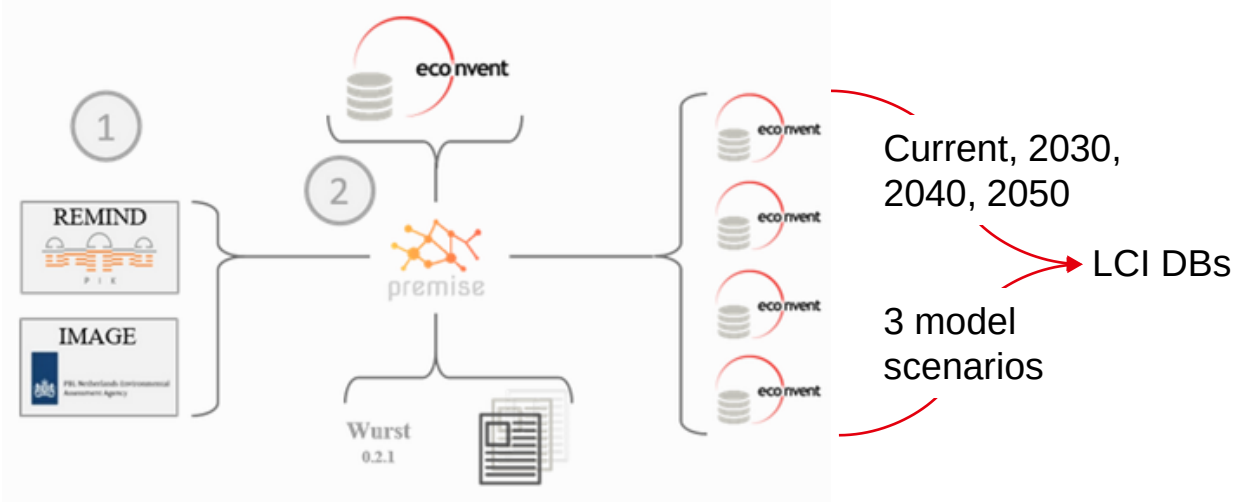
Thank you for your atten

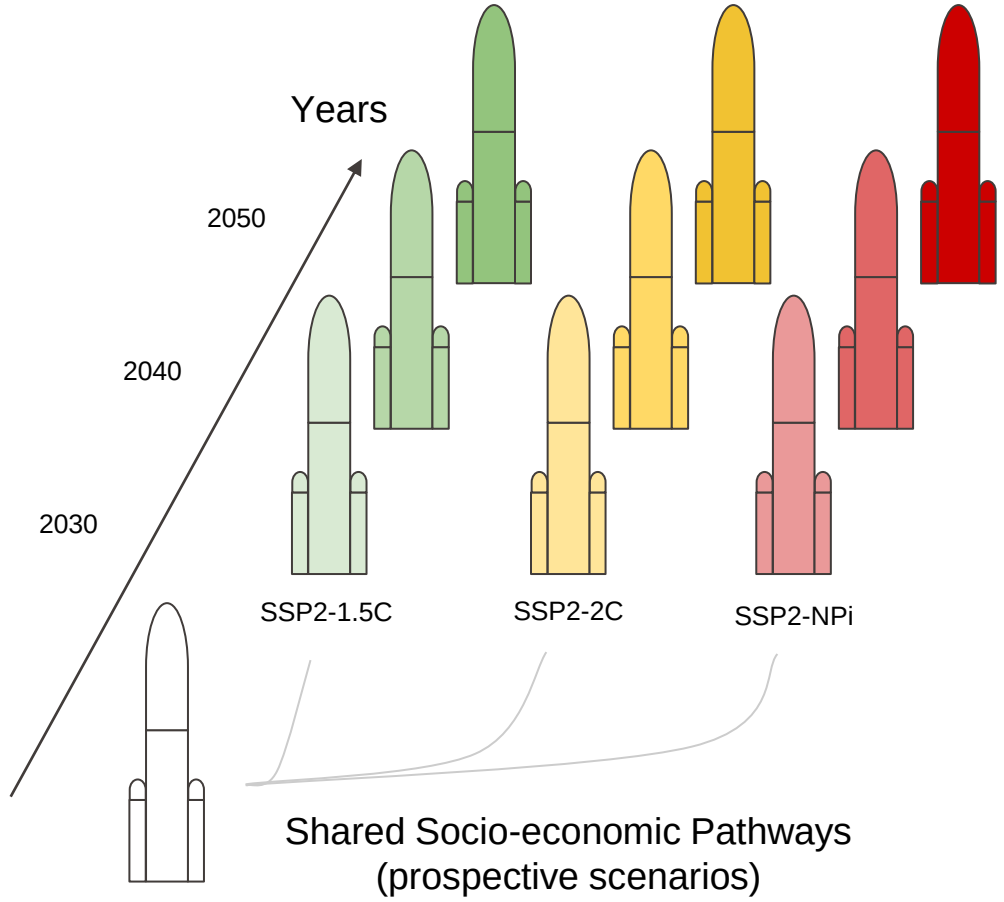
ACT Demo: 19th Nov

EcoΔV

Consistent prospective background LCI

The open software python package «Premise" couples the IAM with ecoinvent and the ESA database (**background**).



Sacchi, R., et al. (2022). PRospective EnvironMental Impact asSEment (premise): A streamlined approach to producing databases for prospective life cycle assessment using integrated assessment models. *Renewable and Sustainable Energy Reviews*, *160* (April 2021), 112311. https://doi.org/10.1016/j.rser.2022.112311

- IAMs present a potential future world situation depending on policies to limit global warming (used in the IPCC reports)
- Historically focusing on sectors influencing climate change (energy, steel, etc.), but now starting to concentrate on raw materials use, ozone depletion etc.