



ARIANEWORKS

**THEMIS A PATHFINDER
TO NEW PERFORMANCES INTEGRATION**



ESA CLEANSPACE INDUSTRIAL DAYS

22ND SEPTEMBER 2021

ONGOING ARIANEWORKS INTERNSHIP

JUNE/NOV 2021

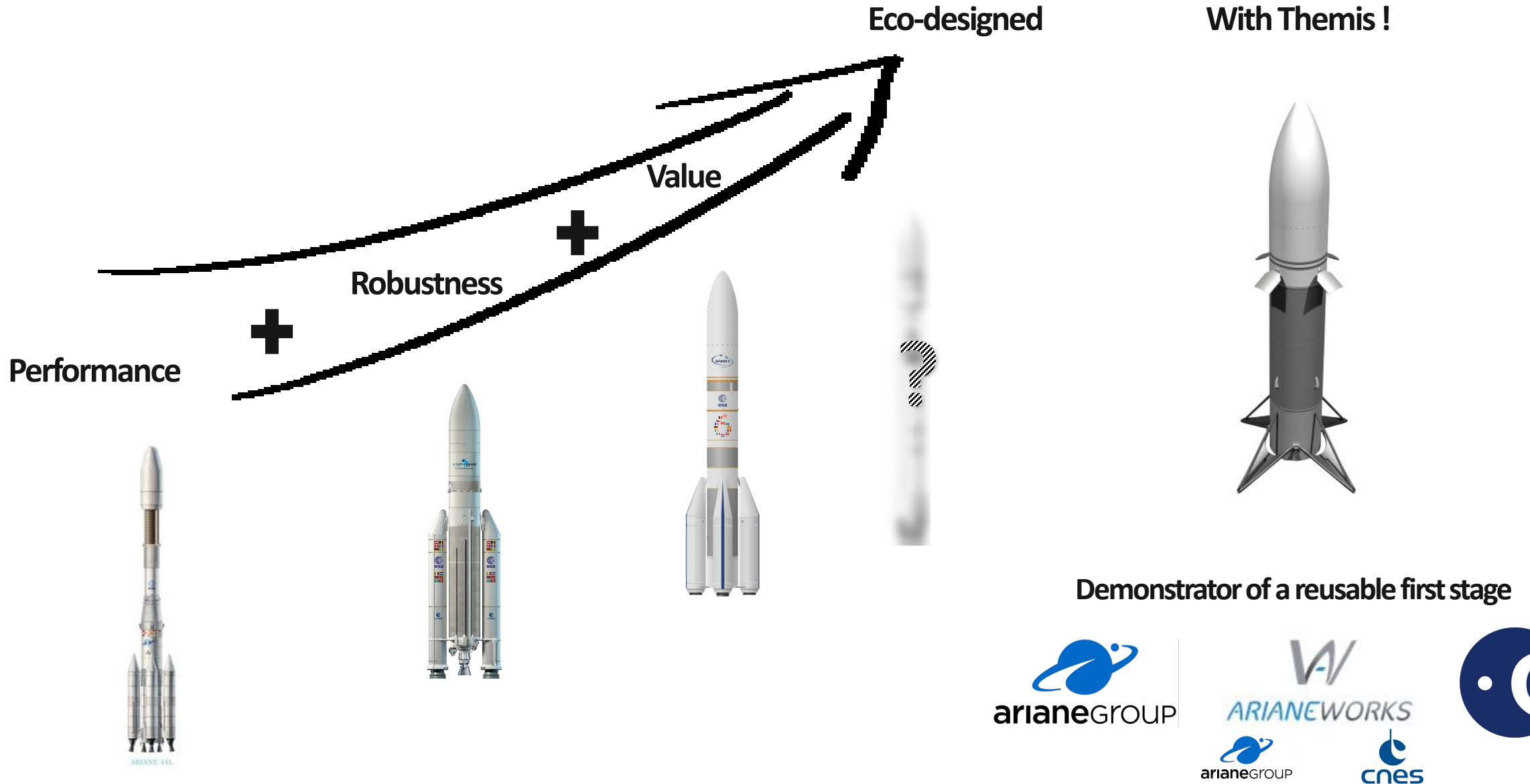
INTERN : LOÏS MIRAUX



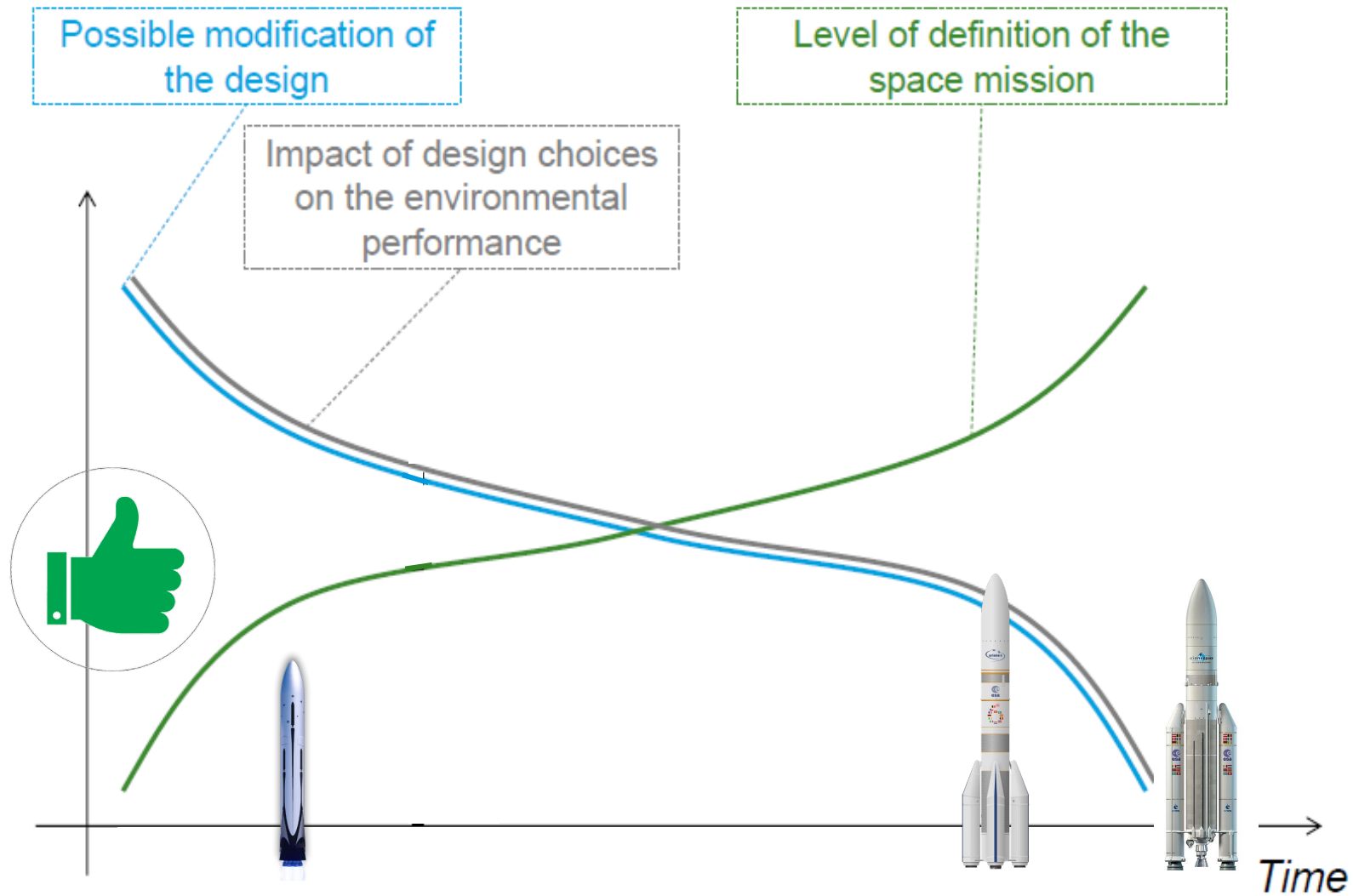
TUTOR : LÉONARD PINEAU



THEMIS a pathway to integrate new performances at early phase of development



Anticipation is the key



Adapted from
Chanoine, A. (2015)

An operational launch system as a use-case for eco-design



Themis T3

Market hypothesis



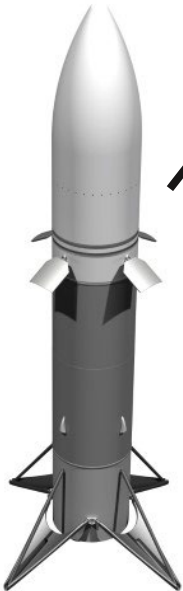
Launch system based on Themis

Scaling approaches

- Propellant loading
- Demonstrator versus Operational system
- Additional components
- Industrial organization hypotheses



(Most of) data collection



Extrapolation



LCA

Ecodesign

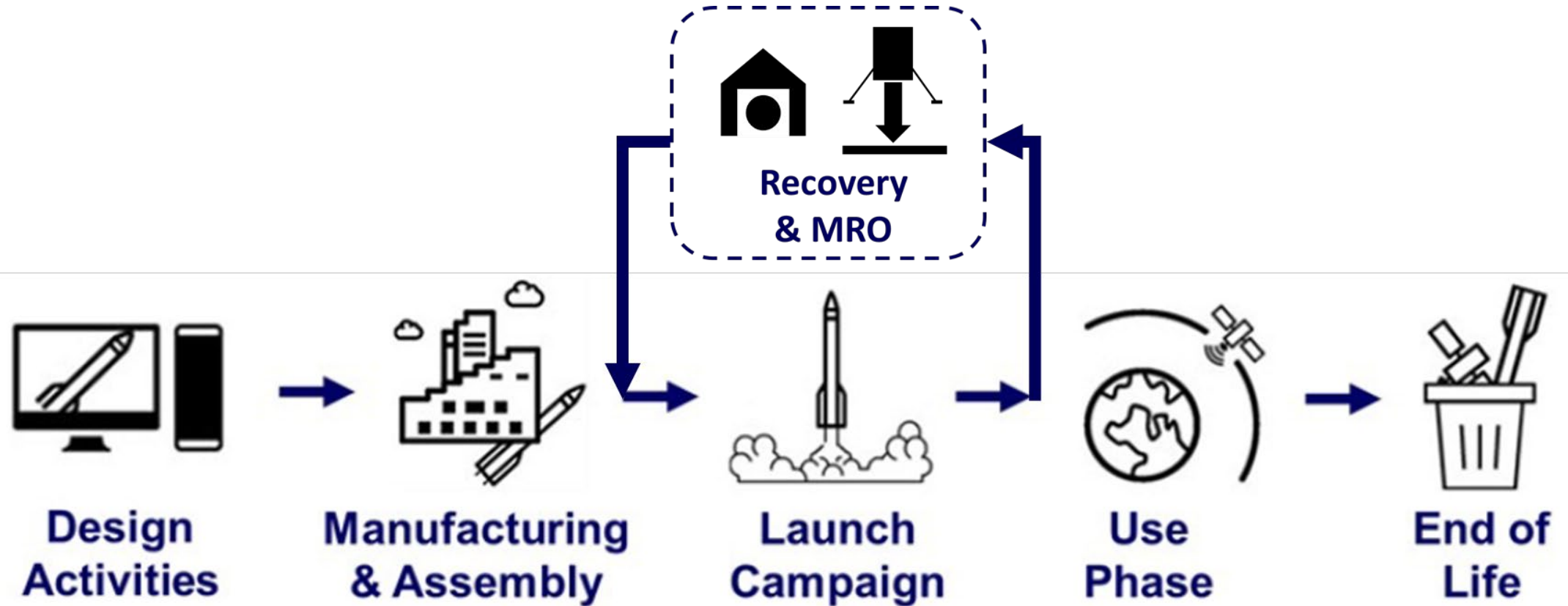


Functional unit
“To place a payload of one ton into SSO over one year of operations”

Inclusion of reusability in the life cycle of a space system



- ❖ R&D, infrastructure and activities related to payload are out of scope
- ❖ Some phases are not fully addressed yet : testing and logistic
- ❖ Some impacts are not well known : launch event and impact on ocean



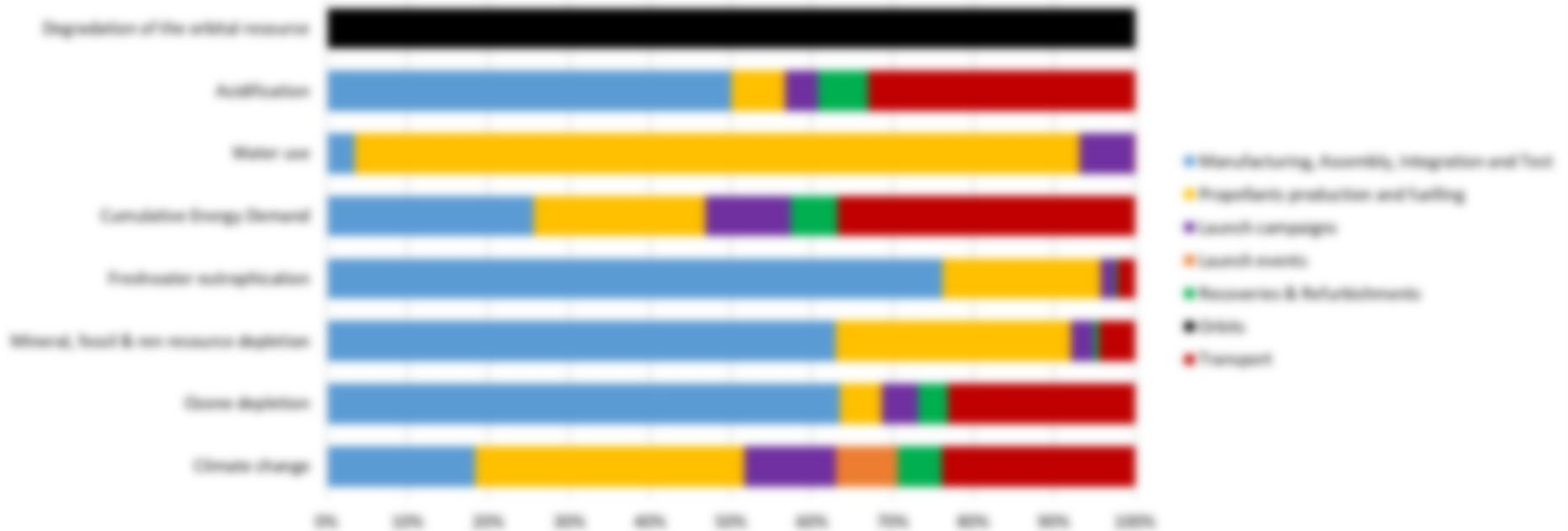
LCA results for one year of operations



Ongoing studies

Preliminary results on a reference scenario

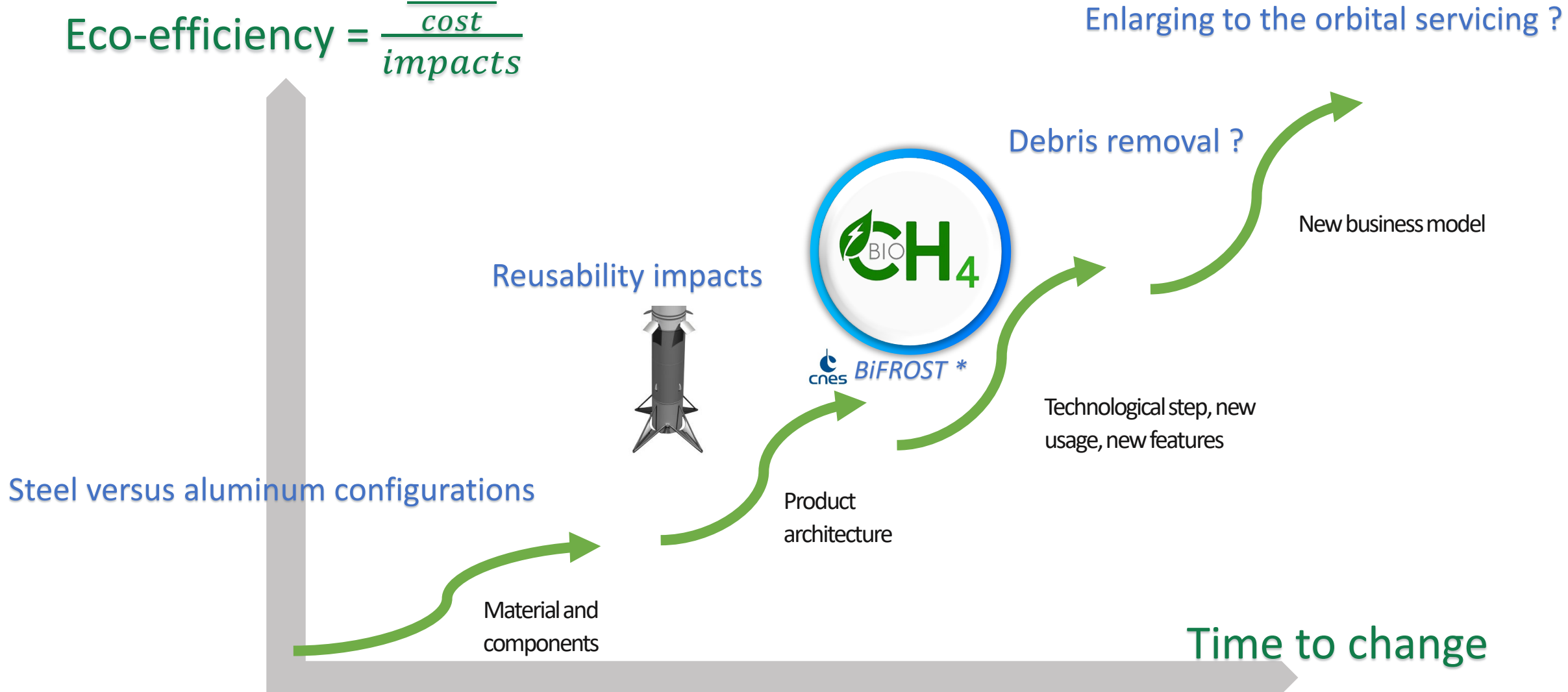
% highly depends on market scenario



Different levers to explore and question - examples



$$\text{Eco-efficiency} = \frac{\frac{\text{Value}}{\text{cost}}}{\text{impacts}}$$



* <https://cnes.fr/fr/lanceurs-vers-une-filiere-biomethane-en-guyane>

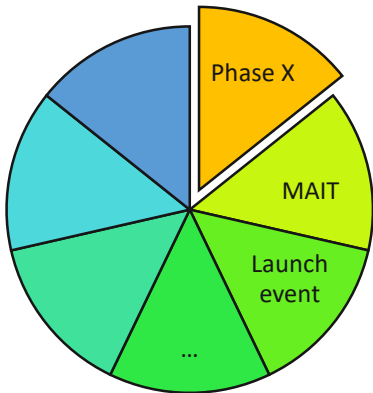
How do we innovate and eco-design with Themis



Supporting Trade-off



Sensitivity analysis and specification



Diagnostic (LCA)



Eco-innovation



Business Strategy



Externalities identification

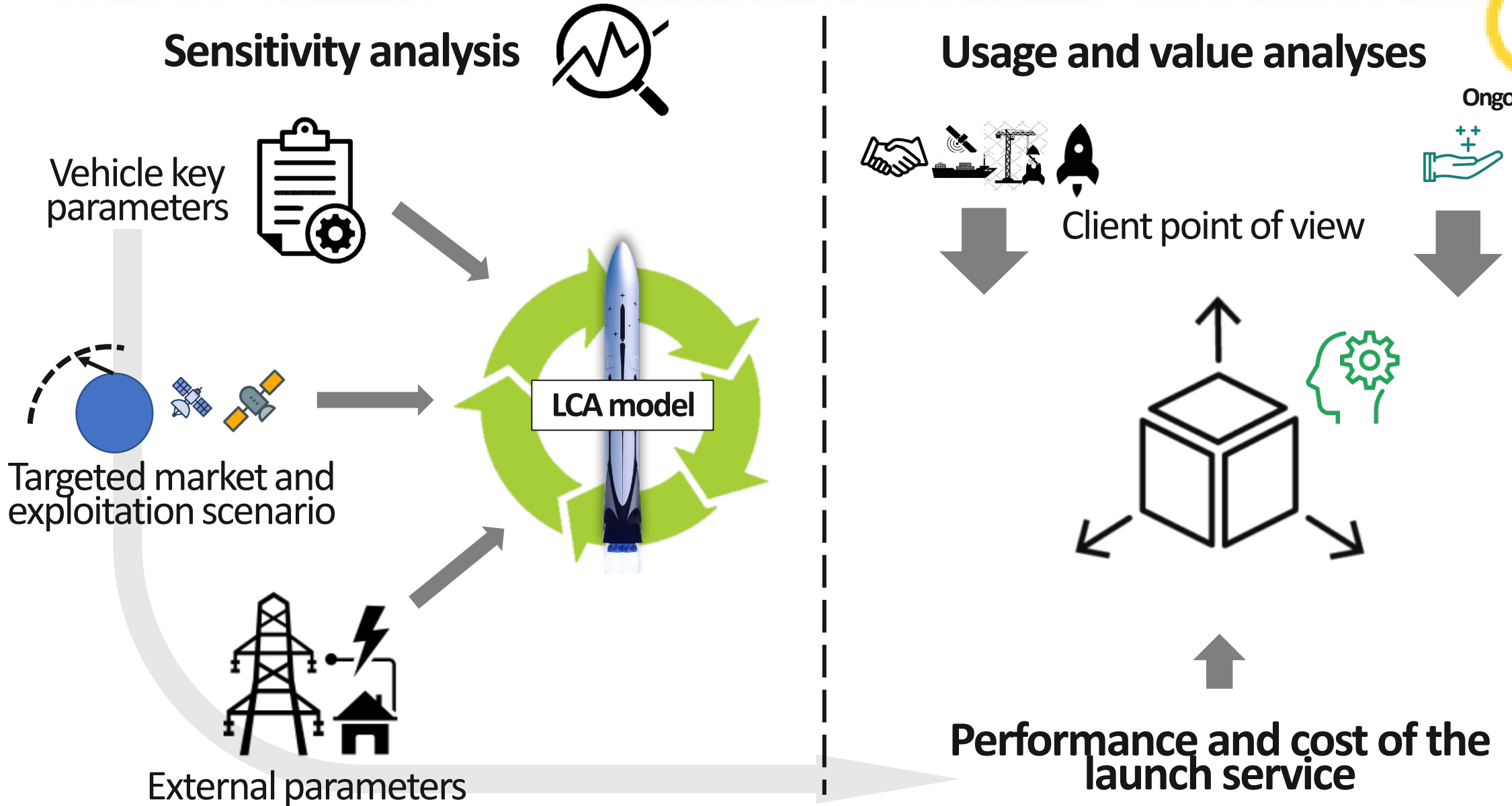


Value, social and usage analyses

Identification of main ecodesign levers



Ongoing studies



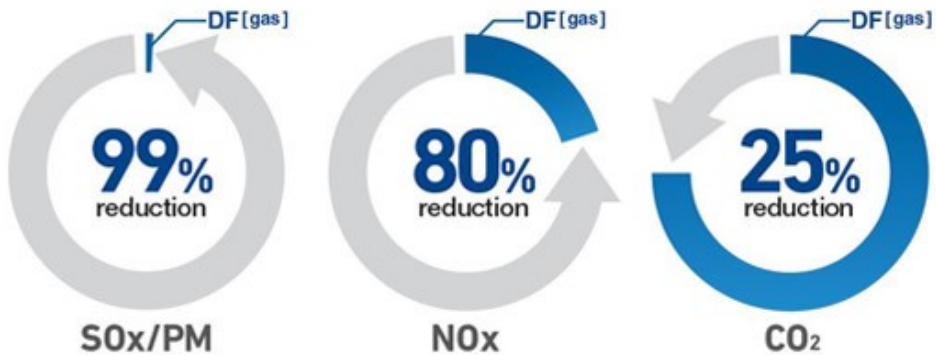
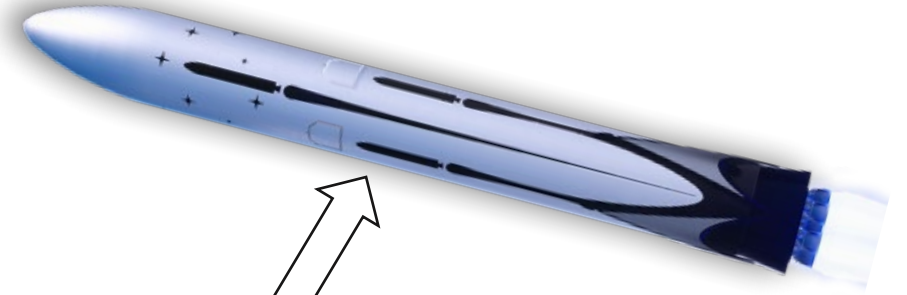
Eco-innovation idea – BioCH4 tugboats for recovery phases



Ongoing studies

Lower emissions

Synergy with LCH4 propellant production

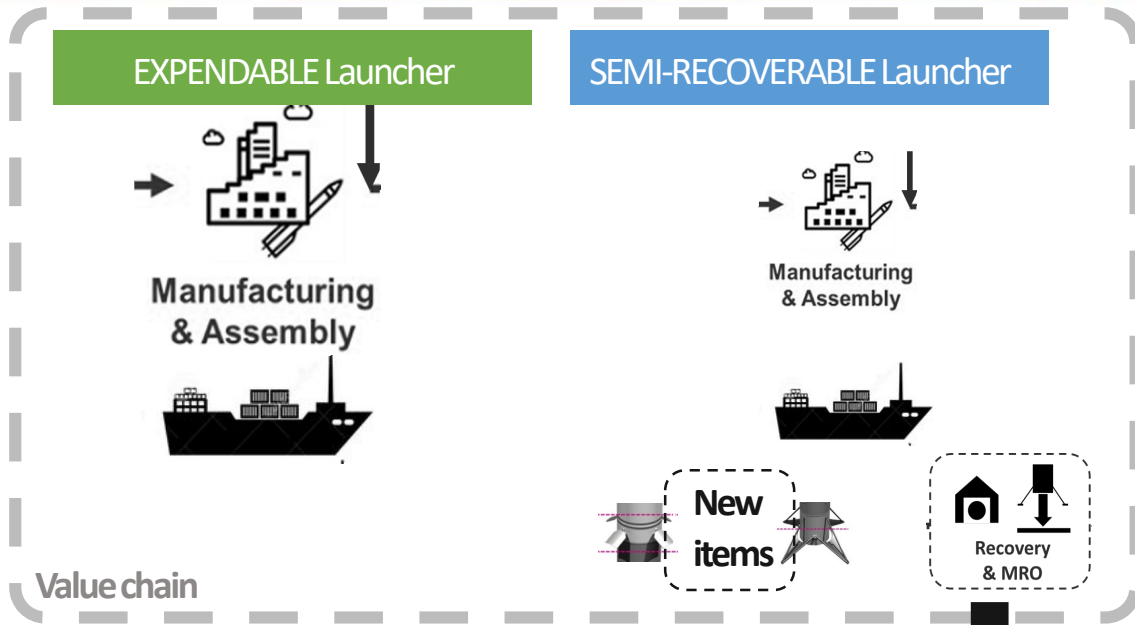


* Where diesel is 100

Impacts/ gains of reusability ...



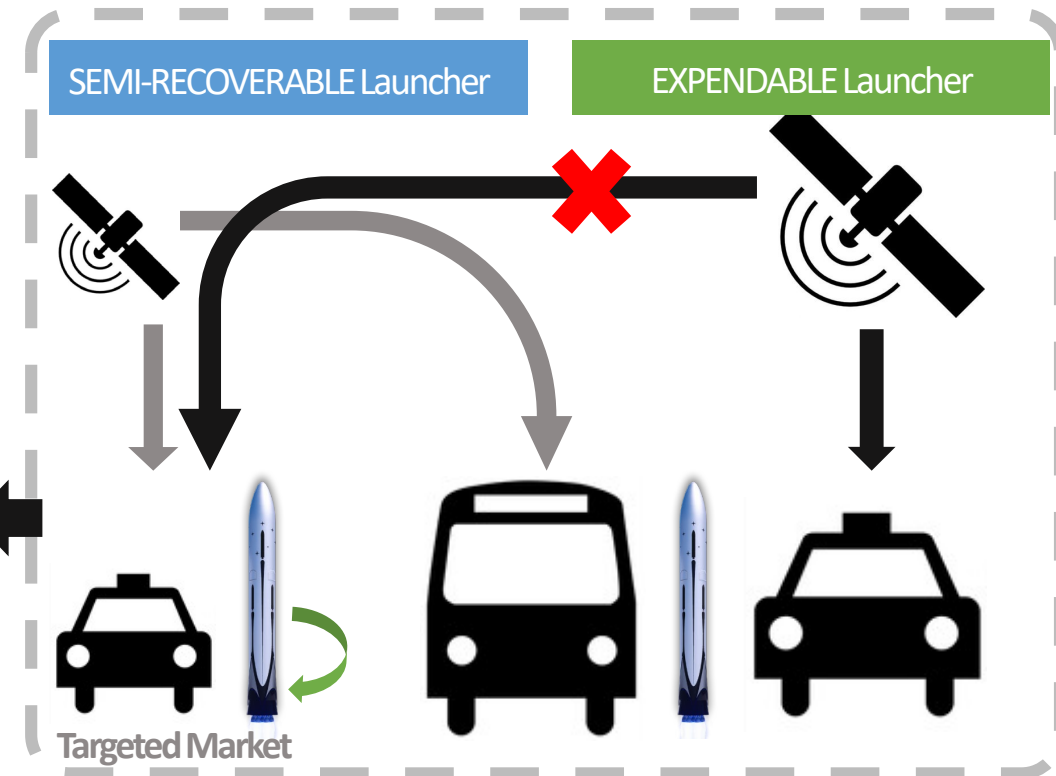
On going studies



... a matter of architecture, launch service offer and market



Environment al impact **Depends on conventions and impact categories**



Thanks for your attention !



THEMIS is a good war-horse to experiment eco-design on access to space !



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to animate eco-design with all Themis stakeholders !