# Future Space Transportation

## Propulsion for Europe’s Next Generation Space Transportation

Industry Space Days

16/09/2026

EUROPEAN SPACE AGENCY

# FLPP

*Assuring future growth of Europe's access to space*

Enable larger payload capacities, launch rates and mission versatility

Foster disruptive technology and innovation

Expand the industrial base and the field of competition

# FLPP
## *Focus on Propulsion*

- FLPP propulsion priorities
- Prometheus
- THRUST!
- Sustainable storable propulsion
- FIRST! Propulsion

# FLPP Propulsion
## *Priorities*

### 🔥 High-thrust liquid propulsion

→ Mandatory enabler of larger competitive access to space

→ N.B. Test facilities are an important aspect for high-thrust engine development and production

### 🔥 Deep transversal technical fields

with huge potential on industrial productivity, piloted by **AI**

→ Computational engineering

→ Additive manufacturing

→ Measurement data processing (tests, product assurance, acceptance, etc.)

# FLPP Propulsion
## *Priorities*

### Sustainable storable propulsion

→ Replacing existing liquid storable propellants with more sustainable (and cost-efficient) alternatives

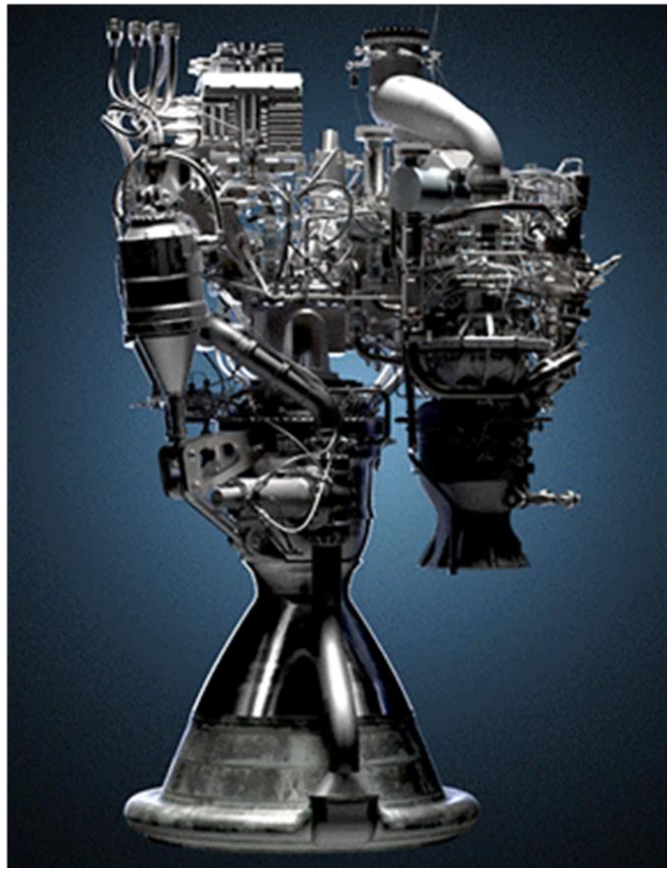
### Propulsion Technology

→ High-risk high-gain propulsion technology identification and maturation through the FIRST! initiative

→ Specific themes of interest identified by FLPP but entities can propose any technology that is justified in terms of application and market potential

**OVERALL -> Growth of engine prime and subsystem industrial networks**

# Prometheus



Prometheus is the first **cost-effective** 100-tonne class LOX/LCH4 reusable engine in the FLPP programme ahead of THRUST! Engines

- Design-to-cost, design-to-reusability, design-to-manufacturing
- 4 engines produced
- 3 hot-fire test campaigns → Operating thrust from 30% - 100%
  → Multiple reignitions!
- Industrial demonstration through a Production Pilot Unit for achieving cost-effective and high-rate production (50 per year)
  → Additive manufacturing extensively used (LBM, Cold Gas Spray)

CGS Cabin (for TCA production)

# Prometheus

# FLPP

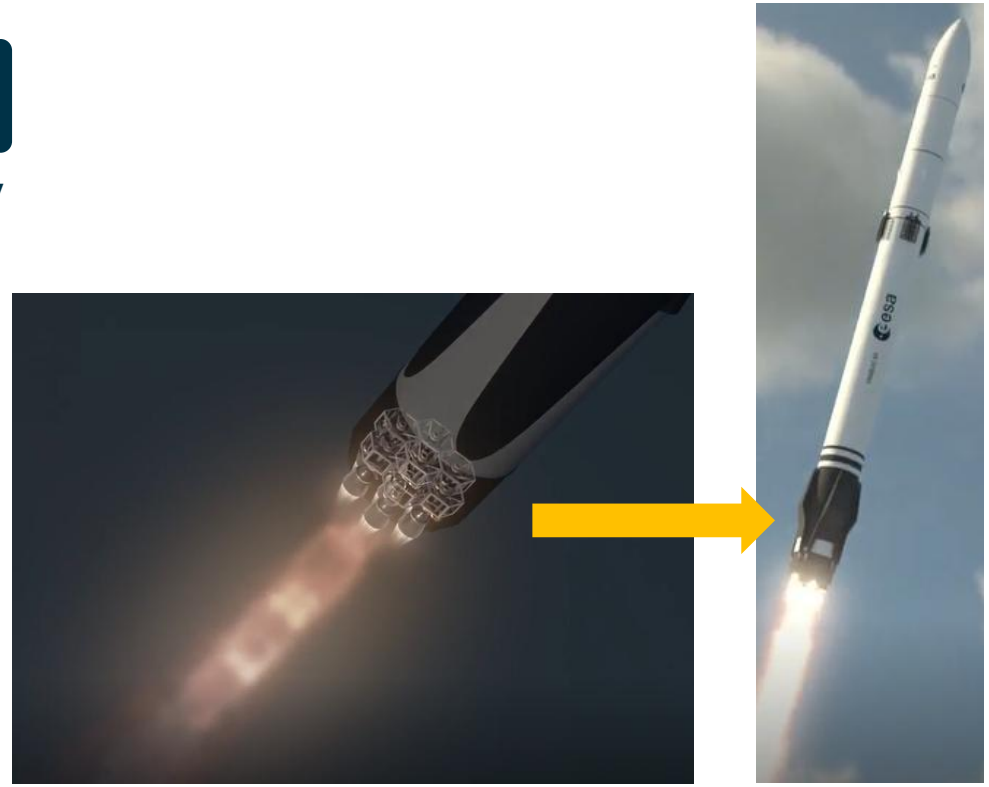
## *THRUST! Technology Call*

## Technologies for High-Thrust Re-Usable Transportation

Mature staged combustion engines and related technologies in Europe

### Staged Combustion Engines

- Increase technology maturity
- Improve performance & compactness
- Enable reusable high-lift launchers





### THRUST! Open Call 2024

Two parallel contracts now running

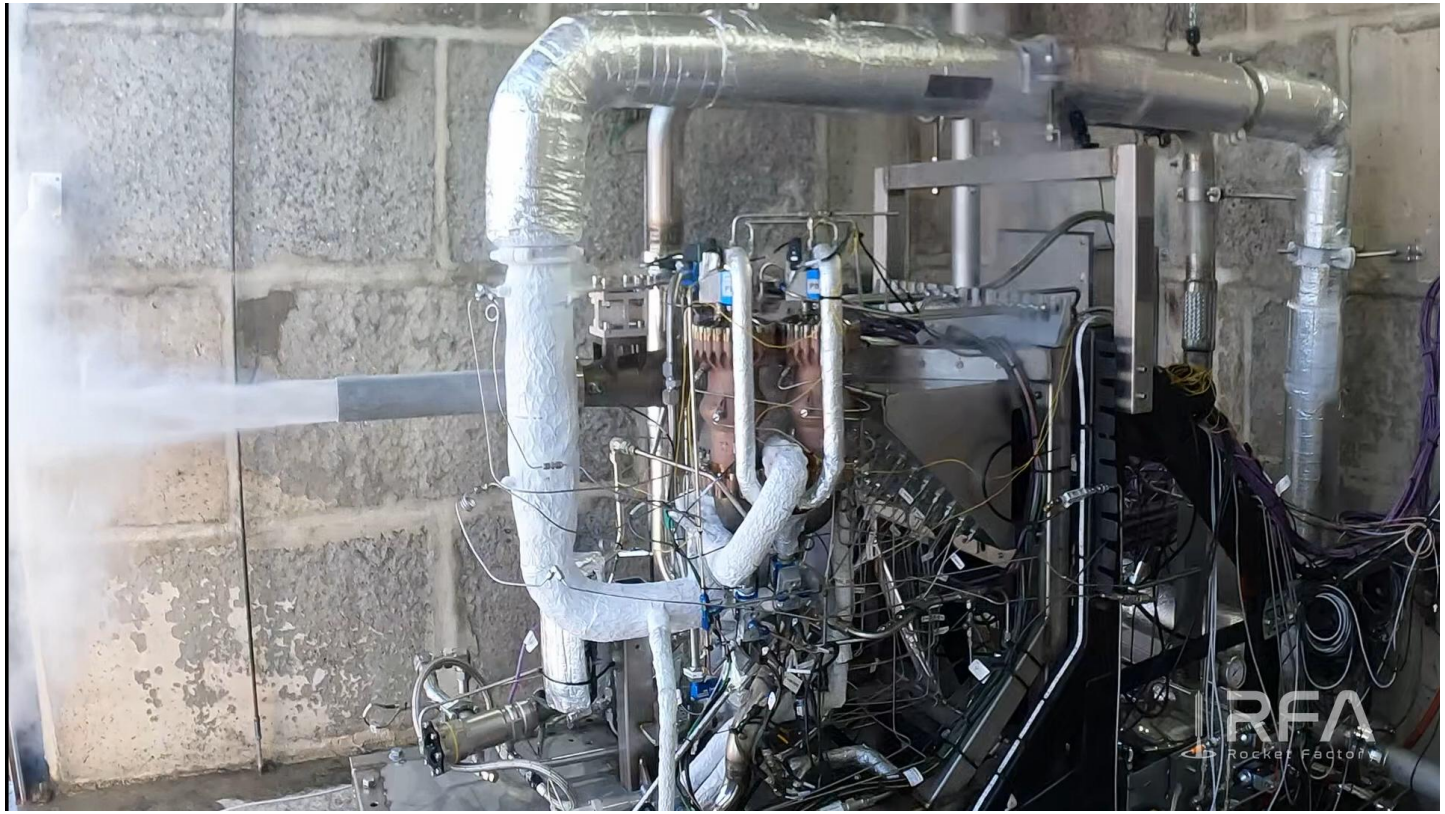
COMING SOON

### THRUST! 2 ITT 2026

Proposals for full-scale component production and testing will be requested

Intended

# HELIX Engine




## Key Technologies to derisk

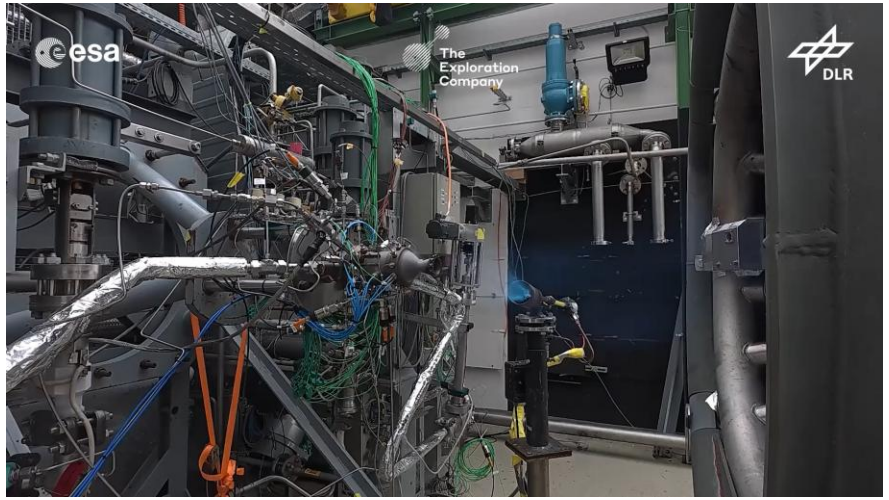
- Build on HELIX heritage
- Increase combustion chamber pressure & mass flow
- Maximize preburner efficiency
- Demonstrate world-leading TPU efficiency
- Achieve maximum thrust within mass & packaging constraints

# Storm Engine

The Exploration Company

## Key Technologies to derisk

- Functional activities
- Combustion Devices research
- Ignition Systems
- Pre-Burners
- TCA + Pre-Burners
- Regulation Valves
- Fuel Turbopump



# Key take-aways for THRUST! / THRUST!2

**THRUST!2 Online Pitch Day**

→ ***8th October***

# FLPP
## *Propulsion Demonstrator Projects*

## ***Green-Storable Propellant Demonstrator***

98% Hydrogen Peroxide (H2O2) - *Oxidiser*

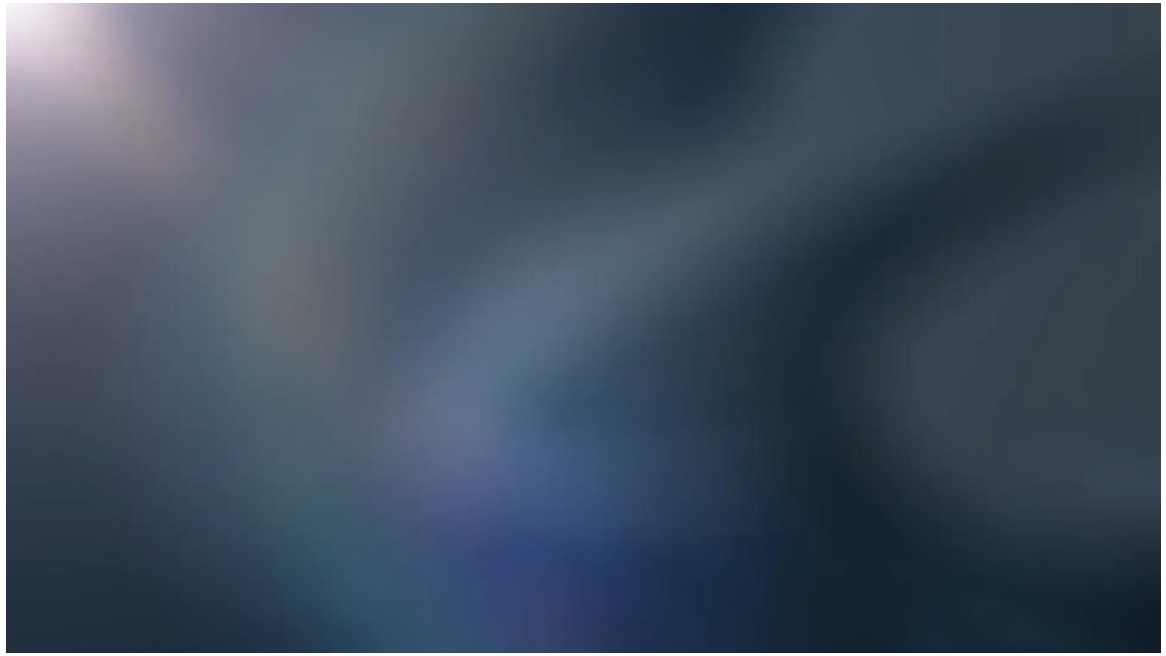
Ethanol - *Fuel*

*Regenerative cooling*

5kN thrust at sea level

*Modular design* for first demonstrator

Main contractor: Ariane Group GmbH (DE)
Now working with LRN-IoA (PL), InPraise (CZ) and SAB (BE)



*GRETA demonstrator engine undergoing hot-fire testing. Copyright AGG OTN*

COMING SOON → **Complete engine demonstrator**
(test planned for 2027)

# GRETA - GREENER PROPULSION SPACE TRANSPORTATION ENGINE

## ABOUT THIS PROJECT

GRETA enables the use of greener propellants instead of hydrazine, reducing potential impacts on human health and the environment.

Focus on GRETA, a greener propulsion engine for kick stage space transportation, which is currently a demonstrator produced by ArianeGroup.

## KEY LEARNINGS

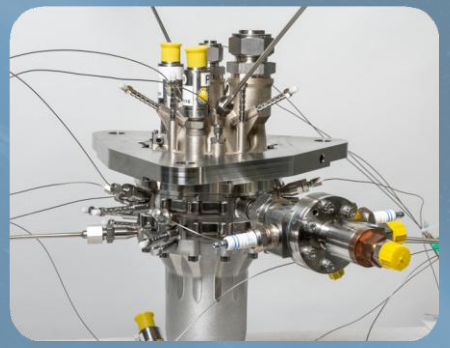
Potential reduced impact on **climate change** due to the use of ethanol as an alternative propellant.

Potential reduction in **human toxicity** by avoiding the use of monomethylhydrazine (MMH).

Potential increased impact on **water depletion**, due to the water-intensive ethanol production.

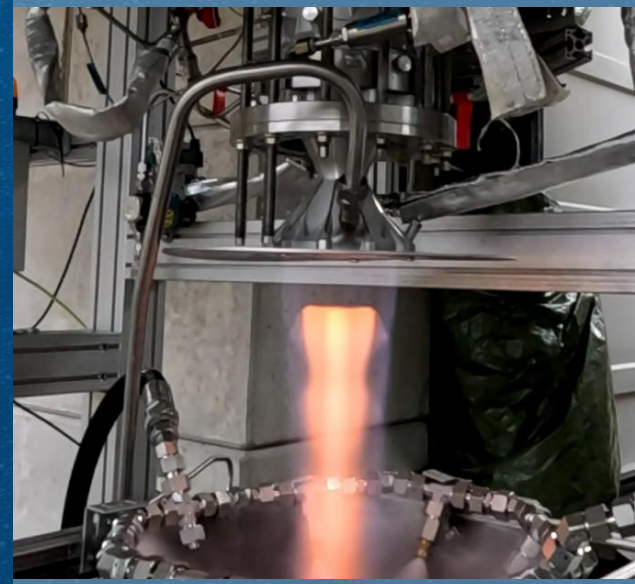
## KEY RECOMMENDATIONS

- Optimise water use by optimising additive layer manufacturing processes.
- Explore a higher degree of recycling during manufacturing to recover and reuse materials and reduce waste.



Directorate of Space Transportation (STS)

Programme: **Future Launchers Preparatory Programme (FLPP)**



The ESA Green Agenda supports the preparation and execution of space projects and activities by minimising their environmental impacts. This case study was evaluated through a qualitative and quantitative sustainability assessment, focusing on a preliminary life cycle assessment (LCA).

**Contributor**

ARIANEGROUP

# ***Throttleable Liquid Propulsion Demonstrator***

98% Hydrogen Peroxide (H2O2) - *Oxidiser*

Ethanol - *Fuel*

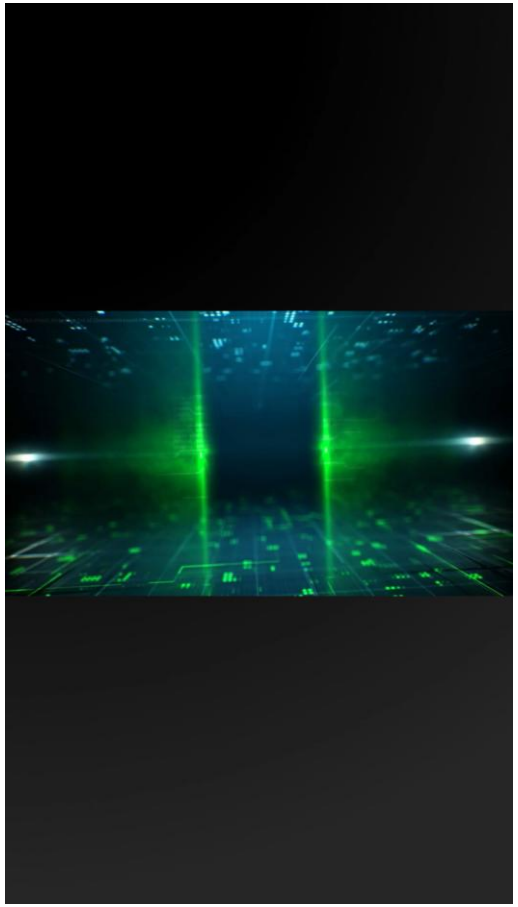
Between *10 and 110% thrust range*, 5kN thrst at sea level

*2026:* First demonstrator *hot fire test campaign*

*Now ongoing:* flight-like design including lessons learned from test campaigns

Main contractor: Łukasiewicz Research Network, Institute of Aviation (PL)

Łukasiewicz
Institute of Aviation

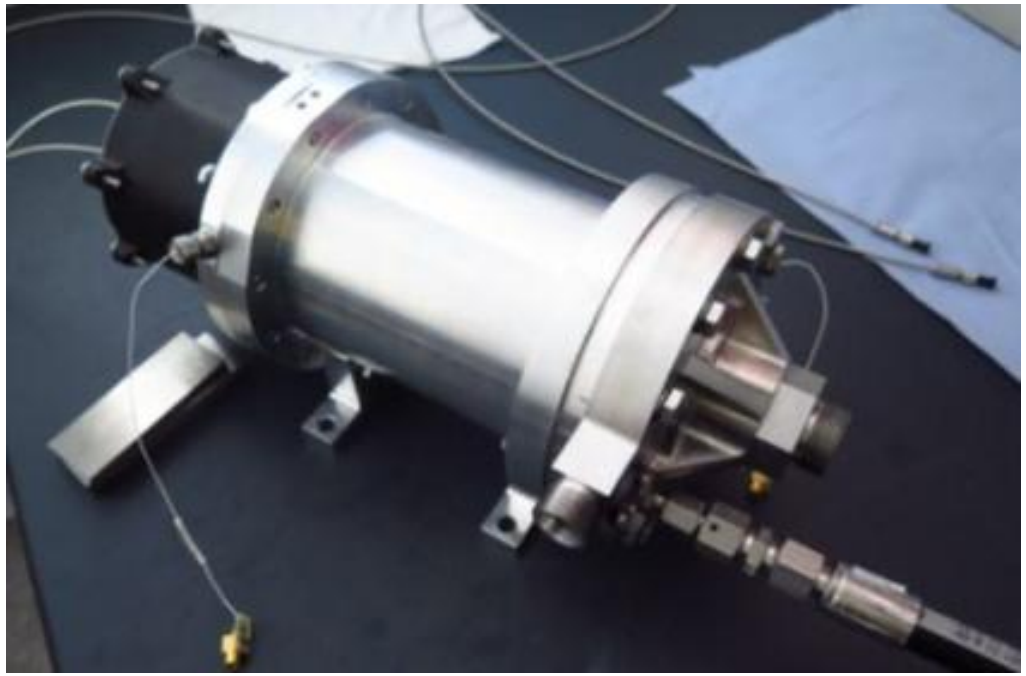


# *Green Storable Electric Pump (GSEP)*

Main contractor: InPraise Systems (CZ)

Provides mass flow of H2O2/ethanol propellants at the required pressure head

Performance benefits for in-space missions



*Hydrogen Peroxide electric pump breadboard. Copyright InPraise*

***CURRENTLY*** → **Successful water-based validation of the design, project in the production phase ahead of propellant testing**

# FLPP
## *Technology Scouting*

FLPP supports ***"Coopetition"***

Start-ups + Legacy companies = Innovative and disruptive technologies

Cooperation Competition

System-pull

OR

Techno-push

→ Technology database → Technology roadmaps and activities

# Future Innovation and Research in Space Transportation

De-risking key technologies for ESA space transportation roadmaps in open competition through:

→ Rapid prototyping

→ High risk / High gain

→ Commercial applications

# FLPP
## *FIRST! Technology Call*

1 Call for ideas (including pitch day)

2 Competitive ESA Invitation To Tender (ITT)

**Identify**

- Key players for future European Space Transportation
- Space transportation service providers and industrial primes interested in technology disruptions
- Prime's needs and preferences
- Potential investors for technology providers

COMING SOON

**FIRST! Avionics & GNC → ITT 2026**

*NEXT CALL FOR IDEAS*

**FIRST! Propulsion → January 2027**

# FLPP
## *FIRST! Propulsion Projects*

New materials and processes for launcher and in-space liquid propulsion

### CRESCENTT
Lightweight thrust chambers development made from Arceon's C/C-SiC material - Carbeon

### SPARK
Explores Refractory High-Entropy Alloys as a disruptive alternative for Monel K500

### AMMLO
De-risking the AM manufacturing process of a newly selected powder, selected for its characteristics in high-temperature, high-pressure, ox-rich environments; i.e. for use in a preburner of a staged combustion engine

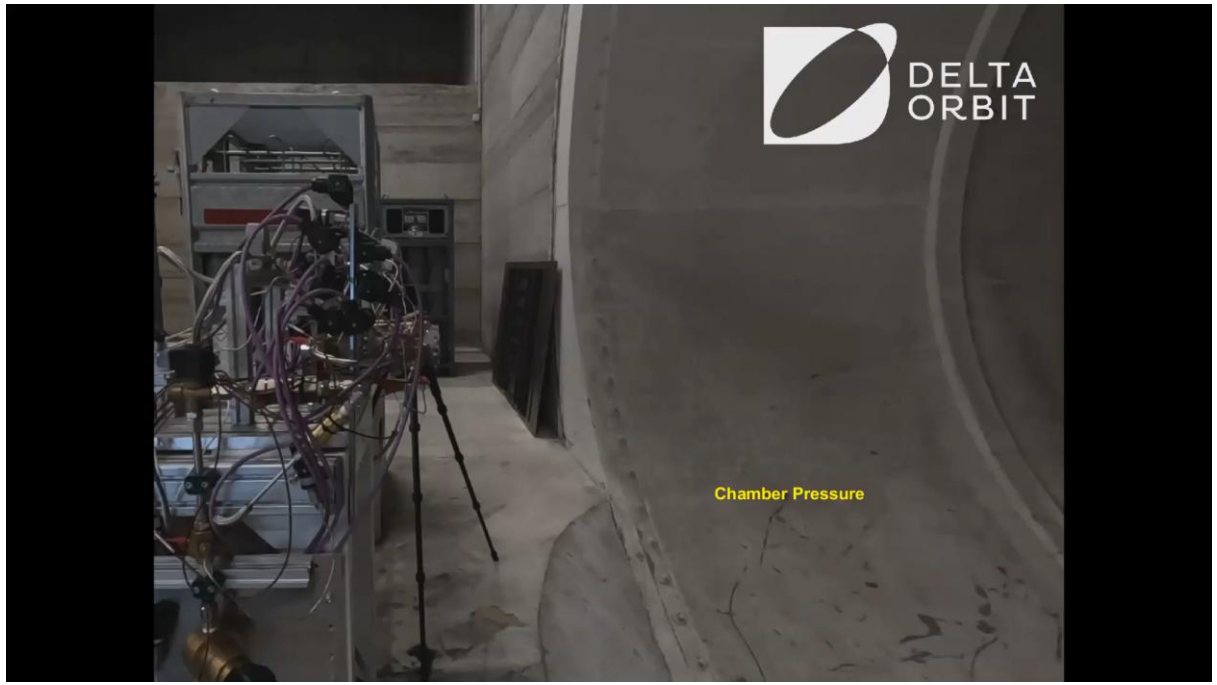
*Breadboard AM manufacturing parts. Copyright AVIO*

# FLPP
## *FIRST! Propulsion Projects*

Launcher and in-space liquid propulsion engine components design and technologies

### STREAM
Next-generation electrically driven gear pump for pressure-fed chemical propulsion systems for small-to medium-class spacecraft

### HyRiMO
Development of a monolithic, quasi-hypergolic MethaLOx injector enabled by DeltaOrbit's patented resonance ignition technology




*Resonance Ignited Engine in Pulsed-Mode. Copyright DeltaOrbit.*

# FLPP
## *FIRST! Propulsion Projects*

Launcher and in-space liquid propulsion engine components design and technologies

### CHBS
SiW partnered with BeBlue and Sirius Space Services to de-risk Cryogenic Hydrostatic Bearing Systems for LOX turbopumps

### EVHP
*The Electro-Valve High Pressure* Developing advanced technology for a high-pressure valve. The final product capable of operating at 400 bar; project tested at 300 bar

### PROPEL
Developing two next-generation proportional electromechanical pressure regulators (EPRs) – a novel class of motor-driven, closed-loop pressure control valves designed to replace mechanical and bang-bang

### FAM
Maturating the AM technology for application on a liquid rocket motor igniter

# FLPP
## *FIRST! Propulsion Projects*

Launcher and in-space liquid propulsion engine components design and technologies

### ETP

An electrically-assisted turbopump for a 30kN class MethaLOX rocket engine combines a conventional turbine-driven pump with an electric motor operating in a hybrid regime, where both power sources contribute to the turbopump shaft power

*ETP Models. Copyright InPraise*

### HX3D

The Huracan Heat Exchanger project, led by TEC in partnership with Temisth and EOS - develops a compact, additively manufactured heat exchanger to provide autogenous pressurisation of liquid oxygen for the Huracan MethaLOX engine

*MethaLox Heat Exchanger Prototype. Copyright The Exploration Company.*

# FLPP
## *FIRST! Propulsion Projects*

Launcher and in-space liquid propulsion engine components design and technologies

### HMS
An engine Health Monitoring System, developed to support monitoring and state estimation of RFA's liquid rocket engines

### IMPULSE
The future Commercial Off-The-Shelf (COTS) solution designed to provide a seamless interface for integration and control of propulsion systems from various vendors and propulsion system types for in-space transportation vehicles

# FLPP
## *FIRST! Propulsion Projects*

Hydrogen Peroxide Propulsion / New propellants for launcher and in-space transportation

### NewSTyLE

De-risking activity related to the green, hypergolic HIP_11 propellant. HIP_11 is a pair of hydrogen peroxide and an ionic liquid fuel which was developed at DLR and features hypergolic ignition, similar performance compared to heritage hypergols at significantly lower toxicity

### IDVT

T4i partnered with VUTBR, Avio, and New Horizon aims to develop an innovative vortex-driven combustion chamber for a 3.5kN liquid bipropellant rocket engine using high-concentration hydrogen peroxide (HTP) and Jet-A1

### ASAP

ArianeGroup GmbH works with Technische Universität Berlin on the concept and test of autogenous pressurization for green propellants propulsion systems

# FIRST! Propulsion #2

***COMING JANUARY 2027***

→ *check OSIP*

# FLPP

Keep an eye on **OSIP for FIRST! calls**

Upcoming intended **ITT THRUST! 2**

Regular Networking Events in Paris:

- Future Access to Space Club
- Future Space Transportation Events

***Propulsion is fundamental for continued access to space for Europe***

***-> We are preparing this future with hardware and test rich projects***

*FLPP is investing in technologies with commercial potential, whilst continuing to ensure the transportation necessary for current and future exploration missions.*

EUROPEAN SPACE AGENCY

# THANK YOU!

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