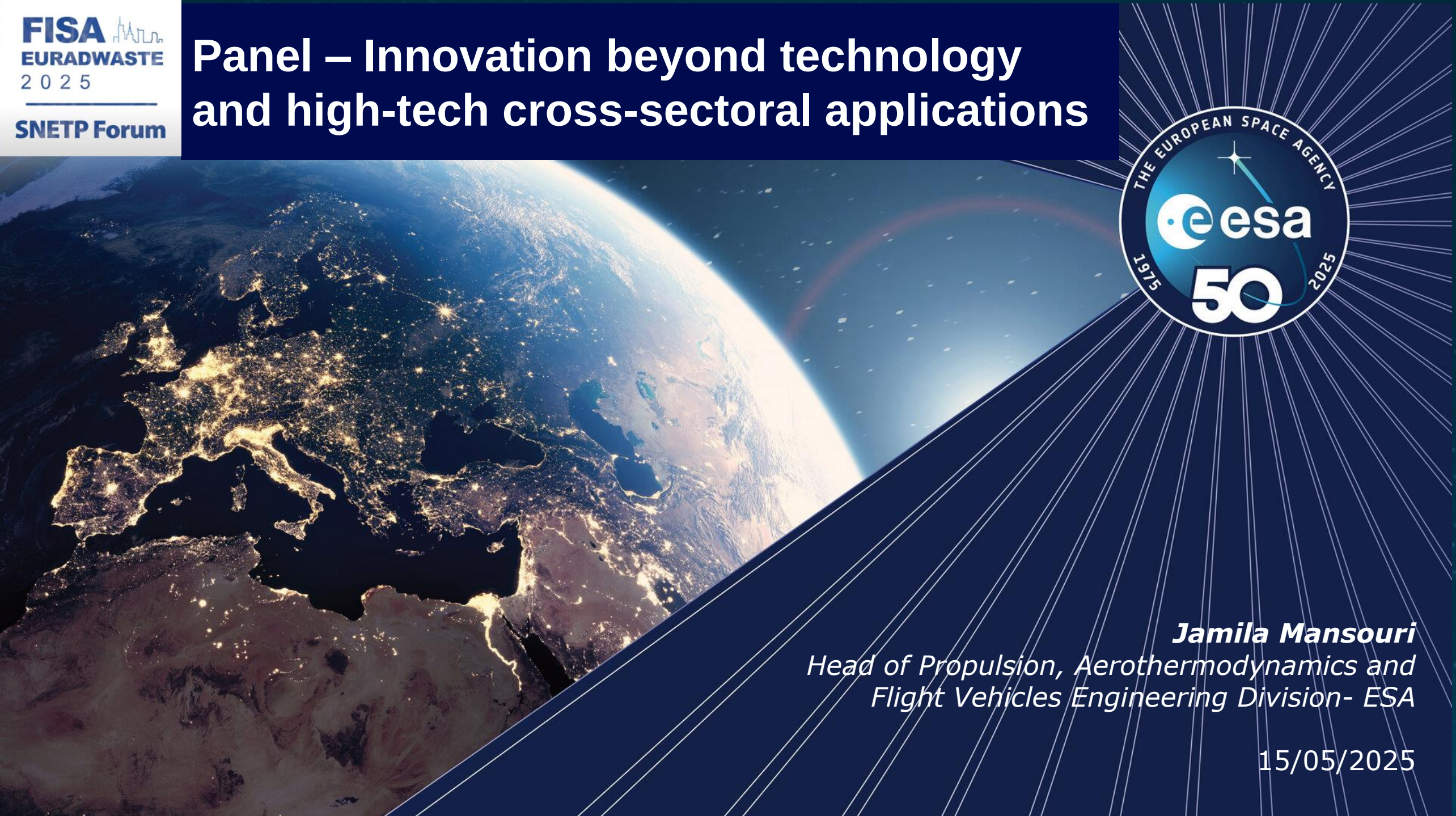
FISA EURADWASTE 2025

SNETP Forum

Panel – Innovation beyond technology and high-tech cross-sectoral applications



Jamila Mansouri

Head of Propulsion, Aerothermodynamics and Flight Vehicles Engineering Division- ESA

15/05/2025

INTRODUCTION

THE EUROPEAN SPACE AGENCY:

SPACE FOR EVERYONE

▼ ESA astronaut Luca Parmitano during AMS-02 spacewalk

Established in 1975, ESA now has 22 Member States, with more than 500 million European citizens. If you're one of them, then we're working for you.

Our mission is the peaceful exploration and use of space for the benefit of everyone

WHY SPACE NUCLEAR POWER AND PROPULSION

"The restriction of ESA missions to non-nuclear sources of power severely limits the ability of the ESA Science Programme to address important scientific goals in more distant and dimly-lit regions of the Solar System […]. The Senior Committee is aware of technology developments within Europe and wish to clearly highlight that the lack of our ability to utilise such power and heat sources on future missions will continue to limit the capacity of ESA's Science Programme."

Final recommendations from the Voyage 2050 Senior Committee,ESA programme

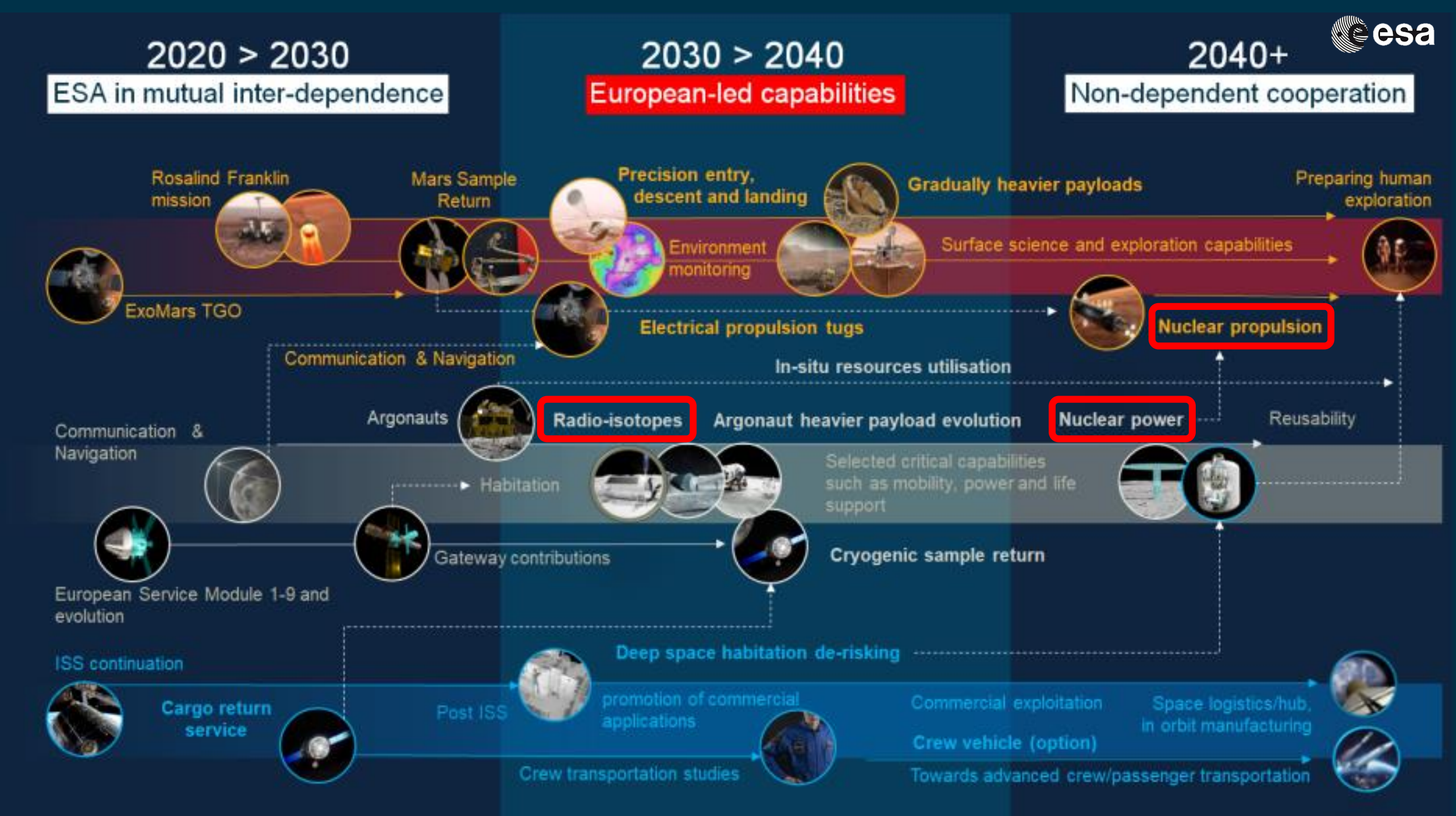
Nuclear electric propulsion, nuclear thermal propulsion, nuclear for space habita are identified as enabling & emerging technologies for human spaceflight & exploration

ESA technology strategy

EUROPEAN NUCLEAR SOCIETY

"The development of European nuclear space capabilities for power and propulsion is an endeavour that will require sustained commitment and substantial investment over at least two decades. Building a robust, resilient and affordable long-term European capability will not be easy but it is crucial".

European Nuclear Society, Position paper


2020 > 2030
ESA in mutual inter-dependence
2030 > 2040
European-led capabilities
2040+
Non-dependent cooperation
esa
Rosalind Franklin mission
Mars Sample Return
Precision entry, descent and landing
Gradually heavier payloads
Preparing human exploration
Environment monitoring
Surface science and exploration capabilities
ExoMars TGO
Electrical propulsion tugs
Nuclear propulsion
Communication & Navigation
In-situ resources utilisation
Argonauts
Radio-isotopes
Argonaut heavier payload evolution
Nuclear power
Reusability
Communication & Navigation
Habitation
Selected critical capabilities such as mobility, power and life support
Gateway contributions
Cryogenic sample return
European Service Module 1-9 and evolution
Deep space habitation de-risking
ISS continuation
Cargo return service
Post ISS
promotion of commercial applications
Commercial exploitation
Space logistics/hub, in orbit manufacturing
Crew vehicle (option)
Crew transportation studies
Towards advanced crew/passenger transportation

KEY ENABLING CAPABILITY FOR SPACE NUCLEAR POWER AND PROPULSION

with strong interdisciplinary collaborations and breakthroughs

MICRO-REACTOR FOR SPACE

with strong interdisciplinary collaborations and breakthroughs

ECO-DESIGN/ Waste Management

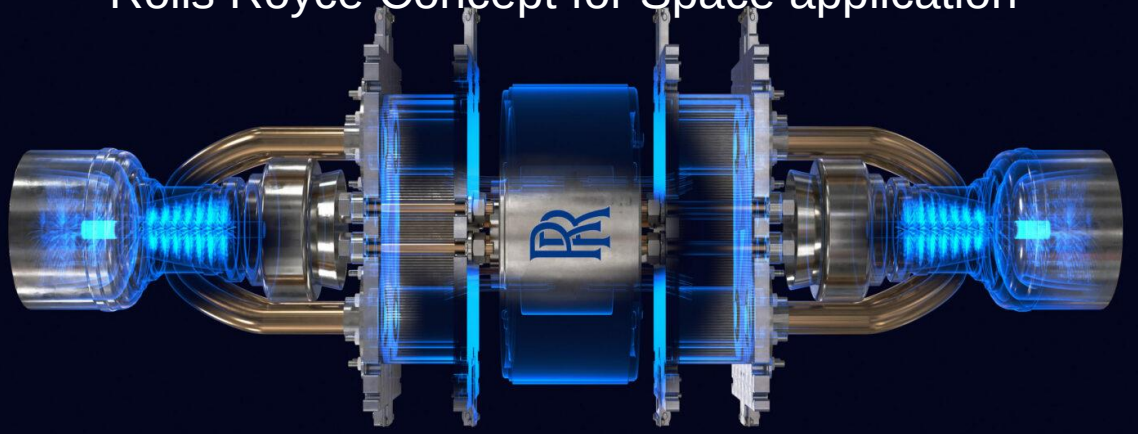
LOGISITICS on Ground and in flights

REGULATORY FRAMEWORK from European countries invovled

TECHNICAL
Concept with cross disciplines:

- Fuel (Physics and chemistry)
- Materials & Processes
- Power conversion
- Thermohydraulics
- Health monitoring
- ….

Example of on going development :
Rolls Royce Concept for Space application



Credit Rolls Royce

Compatible with ground and space SAFETY constraints

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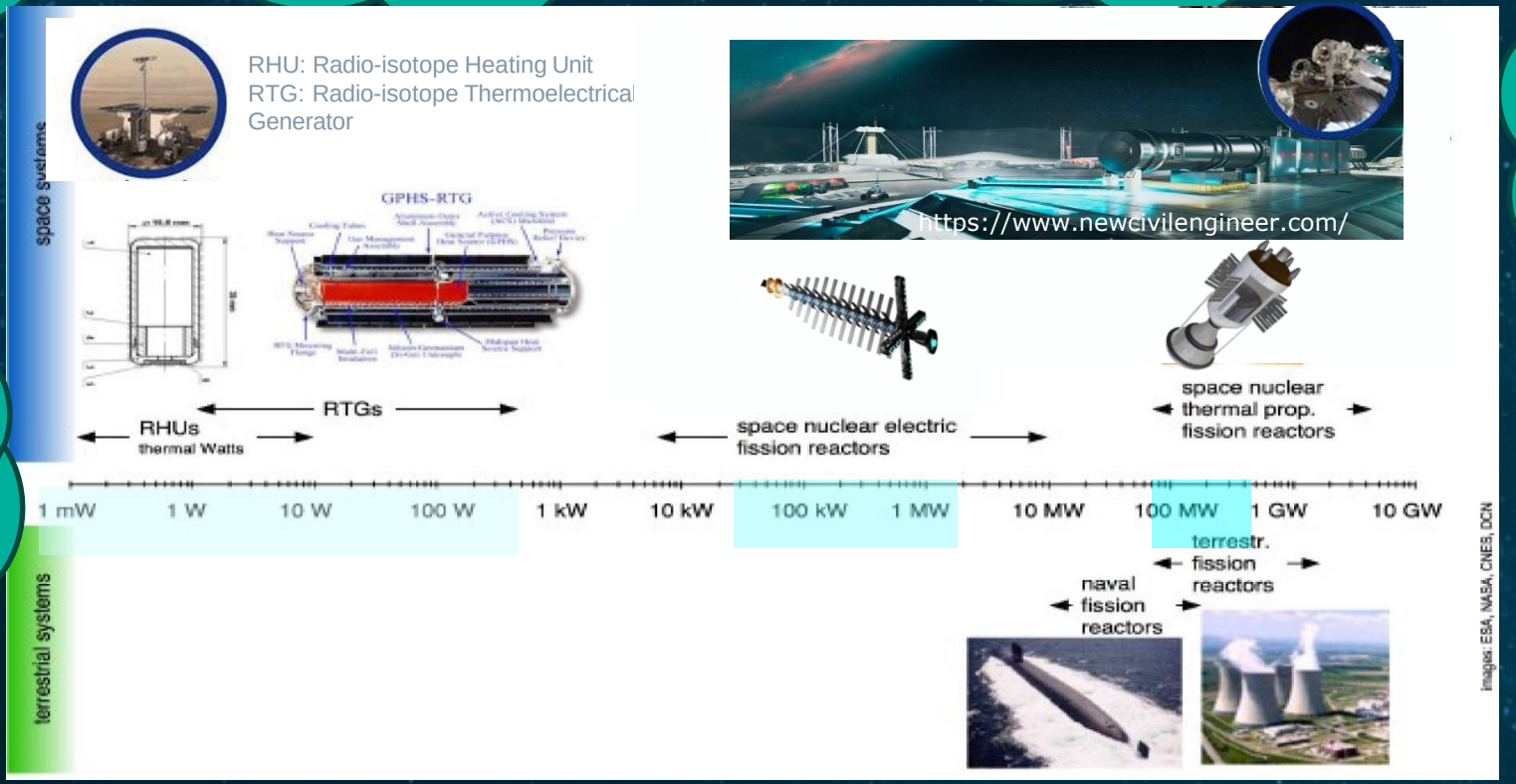
MODULARITY AND SUSTAINABILITY IN NEW NUCLEAR APPLICATIONS

SPACE NUCLEAR : enabler for sustainable space transfer and power management on surface habitat

Total needed power function of application : incremental and modular !!!

Compact / transportable by European Space transportation Systems

Compabible with Assembly / Integration in outer space



Reflection on Sustainable and Circular Economy

Push the limits of physics in Space (from classical propulsion & power to nuclear use)

Accelerate European non-dependance

Thanks for your attention

www.esa.int