Update on Strategic Research Clusters
Electric Propulsion

Costa Pinto,

EFACEC,

industry

cpinto@efacec.com, +351 229403450

The EPIC project

SCOPE

- The H2020 project **Electric Propulsion Innovation and Competitiveness** (EPIC) provides a **P**rogramme **S**upport **A**ctivity (PSA) for the Electric Propulsion **S**trategic **R**esearch **C**luster (SRC)
- The objective is to advice the Commission over a 5-year period through preparing **roadmaps, drafting call texts and assessing results** of the SRC operational grants

RELATED TOPICS IN THE H2020 CALL 2015

- COMPET-1-2015: Technologies for European non-dependence and competitiveness
- COMPET-3-2015: Bottom-up space technologies at low TRL

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THE 1st CONSULTION WORKSHOP (Brussels, 25th to 28th November 2014)

- Presentation and discussion of state-of-art of **technologies** in use by PRIME industry for **in-space Electric Propulsion**

- Presentation of **future or emergent technologies** for Electric Propulsion

- 3 mission concepts analyzed:
  - **TELECOMUNICATIONS (GEO):** Power > 10KW, technology MOSFET, FPGA, GaN, SiC, digital or mixed ASIC, innovative cheaper PPU fater EOR (Electric Orbit Raising)
  - **LEO/MEO: LEO (Low Earth Orbits)** Force 4-50 mN, ISP > 1,300s, high cycles >10000, 200W > Power > 2KW. NanoSats included. **MEO (Medium Earth Orbits):** Force > 250mN, 1650 < ISP < 4000s, 5,5KW < Power < 9.5KW
  - **SPACE TRANSPORTATION:** Huge volumes and mass. Force > 2-3N, impulse > 50 MNs, Power > 20KW

- All information about presentations, speakers, developers in http://www.epic2014.eu/

- 2nd workshop was scheduled to February 2015 in Stockholm to present and discuss the roadmap

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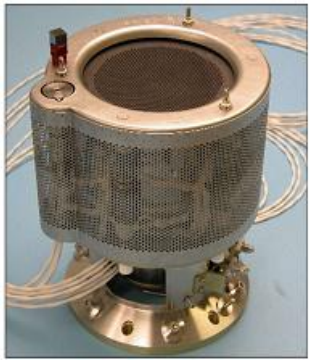
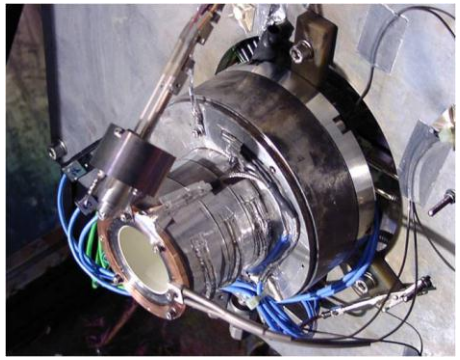
Technologies that may be developed in EPIC

Hall Effect Thrusters (HET)
High Efficiency Multistage Plasma Thrusters (HEMP-T)
Magnetoplasmadynamic thrusters (MPD)
Quad Confinement Thrusters (QCT)
Field Emission Electric Propulsion (FEEP)
Colloid or Electrospray thrusters
Vacuum Arc Thrusters (VAT)
Ablative Laser Propulsion (ALP)

Gridded Ion Engines (GIE)
Pulsed Plasma Thrusters (PPT)
Pulsed Inductive Thrusters (PIT)
Arcjets
Resistojets
Helicon thrusters
Hollow cathode
…others

Power Processing Units (PPUs) – For thrusters power and control

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THE 2nd CONSULTION WORKSHOP (Stockholm, 11th to 12th February 2015)

Two roadmaps presented:

- **The incremental track**: for widely used and currently available technologies which require incremental evolution and gap fillings for near future deployment **(Target: HET, GIE e HEMPT)**
- **The disruptive track**: for high risk low TRL Electric Propulsion concepts or technologies for future breakthrough

End of February: Send the Commission the Roadmap, the action plan and the list of suggested topics to include in the H2020 SPACE 2016-2017 calls.

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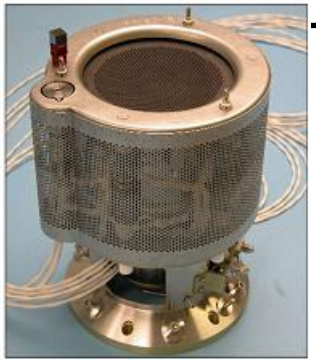
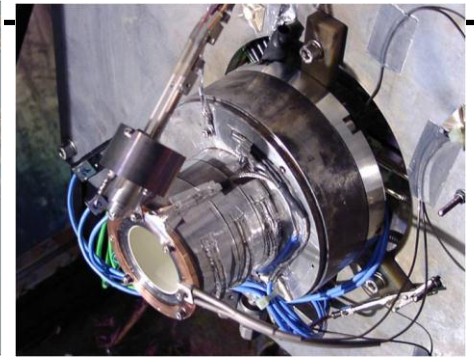
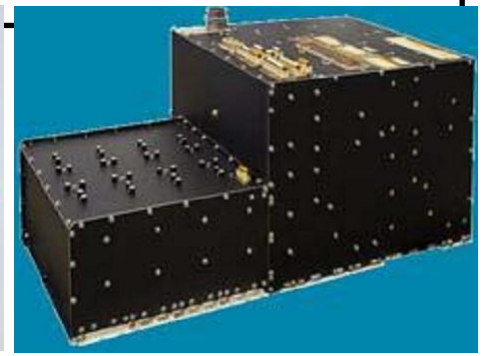
Outcome of 2nd Workshop

- Too short time for preparing the Roadmap. Problems and adjustments needed.
- Send contributions to EPIC until end February
- EPIC suggest Commission to continuous monitoring of the SRC projects
- Very difficult to set roadmap priorities
- Cost of new EP technologies is critical, but should not prevent new breakthrough
- Flexibility within the EPIC action plan



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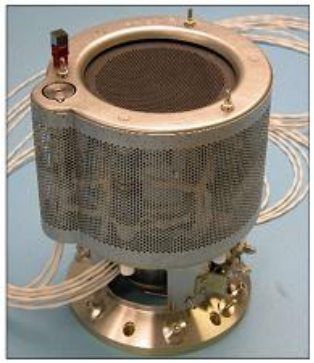
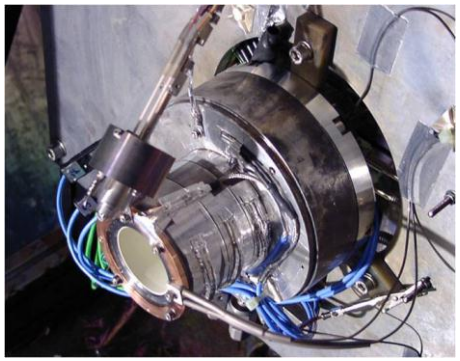
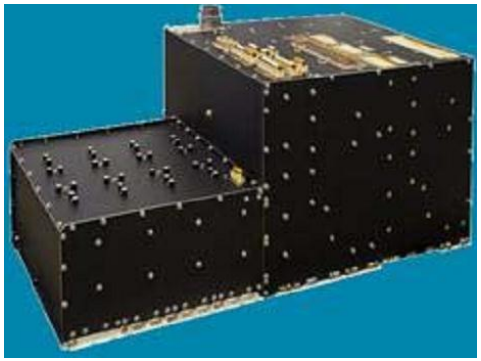
Outcome of 2nd Workshop
Incremental track – Conclusions

- ❑ Consider demo projects for *de-orbiting*
- ❑ Define systems and mission beyond 2020
- ❑ Rank priority levels
- ❑ Need for alternative propellants to Hydrazine
- ❑ Increase TRL levels of components (TRL>5)
- ❑ Increase competitiveness and reduce EP costs by one order of magnitude
- ❑ Reduce cost, Improve autonomy and capacity of PPUs
- ❑ Reduce development cost, development effort and *time-to-market* < 10 years

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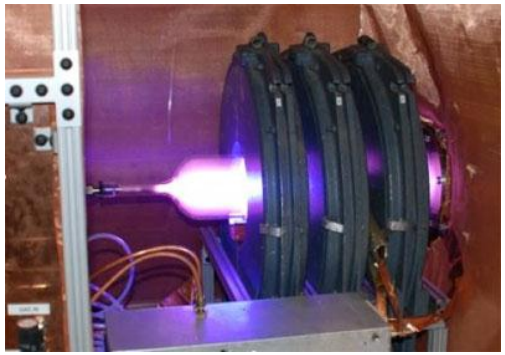
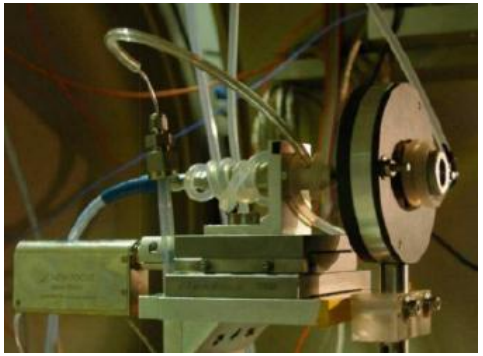
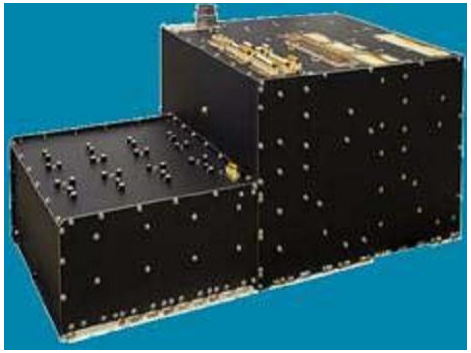
Outcome of 2nd Workshop
Disruptive track – Conclusions

- Focus on applications (swarms and constellations as case studies for micro-propulsion)
- No clear starting point or end point, the opposite of the incremental track
- Consider and develop all EP system not just the propulsion module
- Consider alternative propellants (10 year ahead)
- Explore new and sounding concepts for EP
- Include transversal functions such as PPU



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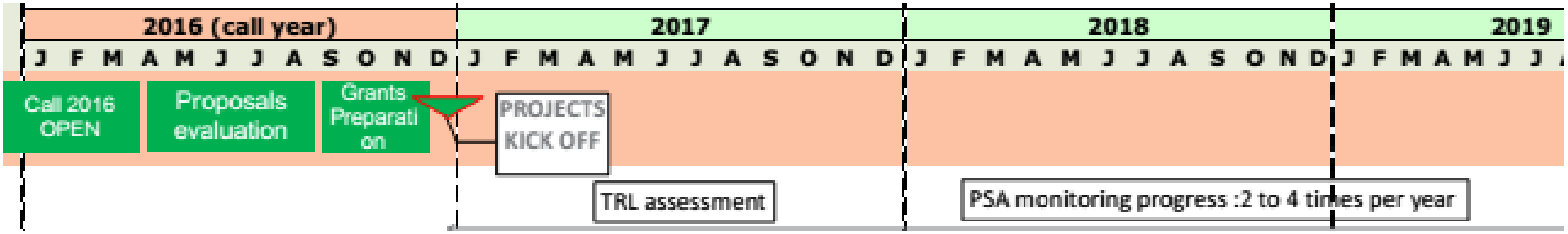
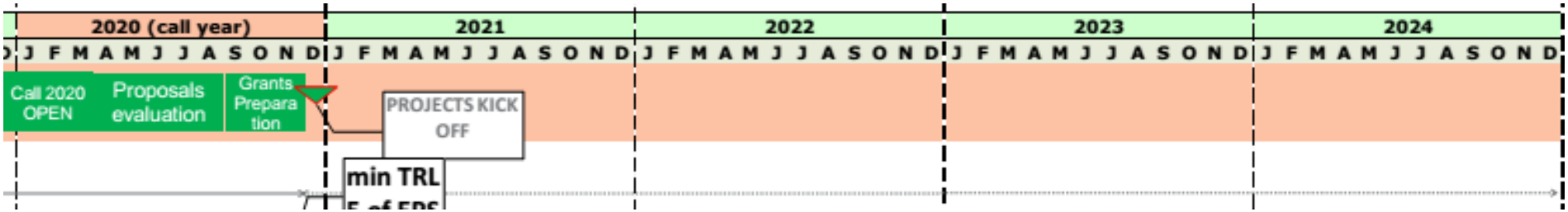
The EPIC project

- The **incremental** roadmap has the following time-line:





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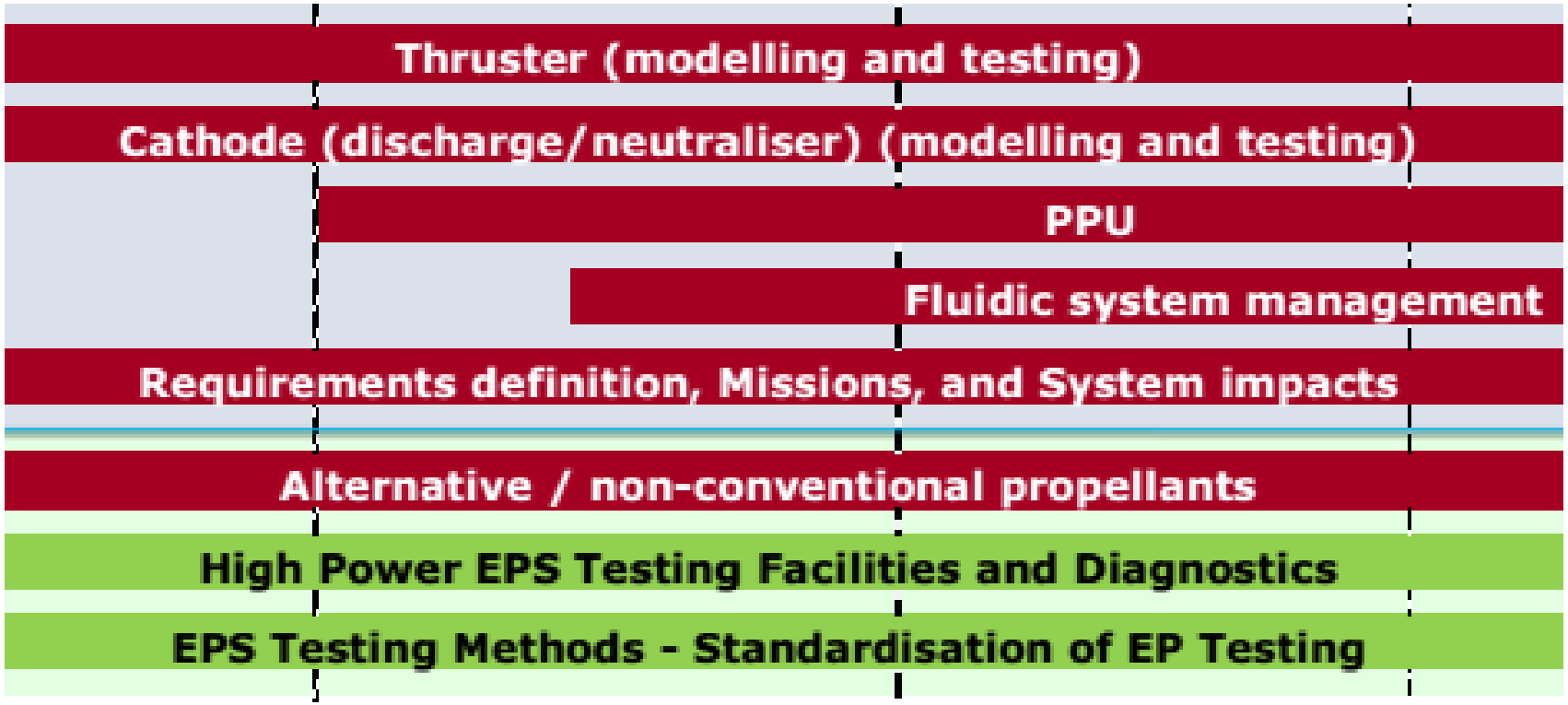
- The **incremental** roadmap has the following tasks identified for the first call:



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- The **incremental** roadmap has the following gaps identified:

TELECOM / NAVIGATION	High Power Operation
	Dual Operation Mode
	High Specific Impulse
	Faster Electric Orbit Raising
	Alternative and cheaper PPU concept
	EPS recurring costs reduction
	Alternative Propellant to Xenon
	Lifetime Extension
	Overall Launch Mass savings
SPACE TRANSPORTATION	Lifetime Extension
	Faster Electric Orbit Raising
	High Specific Impulse
	Alternative Propellant to Xenon
	High Power Operation
LEO MISSIONS (including constellations)	Low Power Operation
	EPS recurring costs reduction
	Overall Launch Mass savings
	Alternative and cheaper PPU concept
	Industrialisation of EPS manufacturing (constellations)
	Large Throttleability
	High Controllability
EXPLORATION/ INTERPLANETARY / SCIENCE	High Power Operation
	Lifetime Extension
	Large Throttleability
	High Controllability
	Low Noise
	Higher Specific Impulse
	Alternative Propellant to Xenon / non conventional propellants

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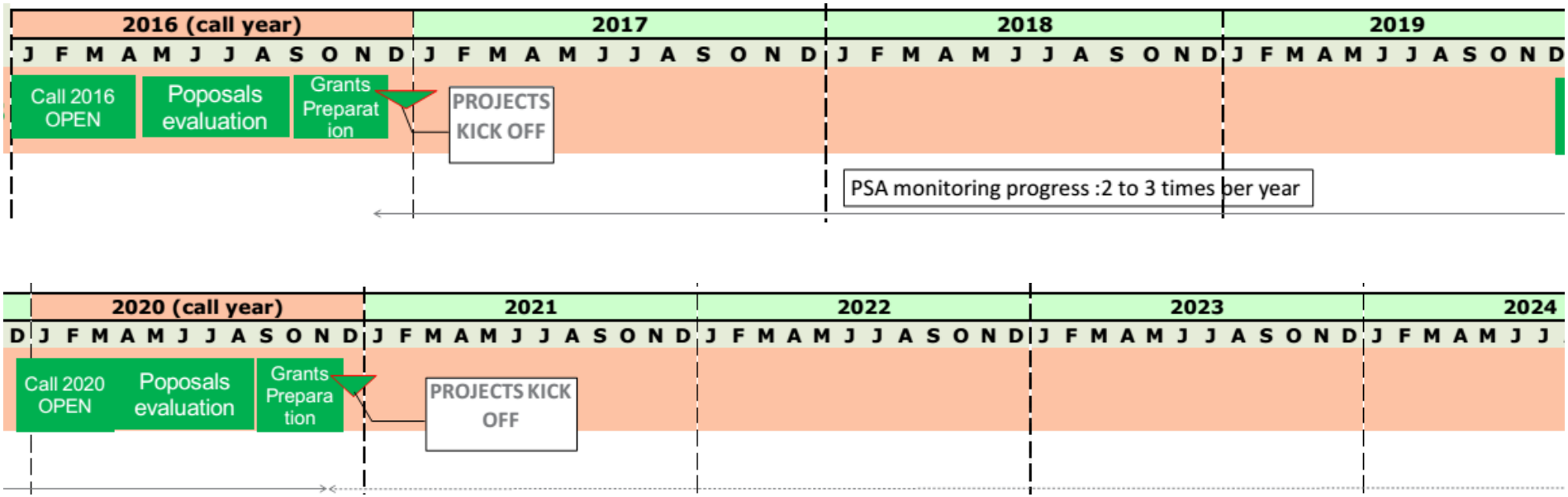
- The **disruptive** roadmap has the following time-line:



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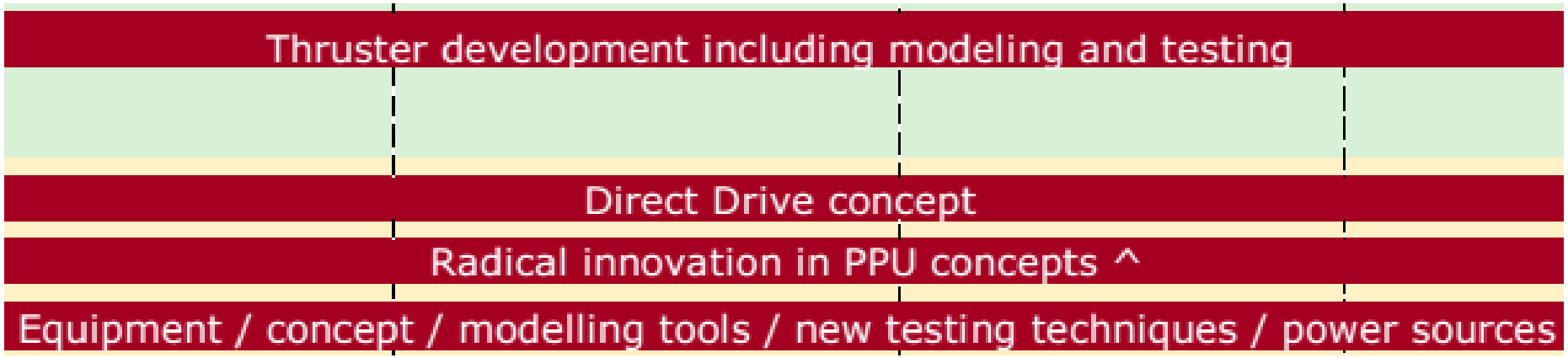

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Thank you for your attention

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(industry)
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