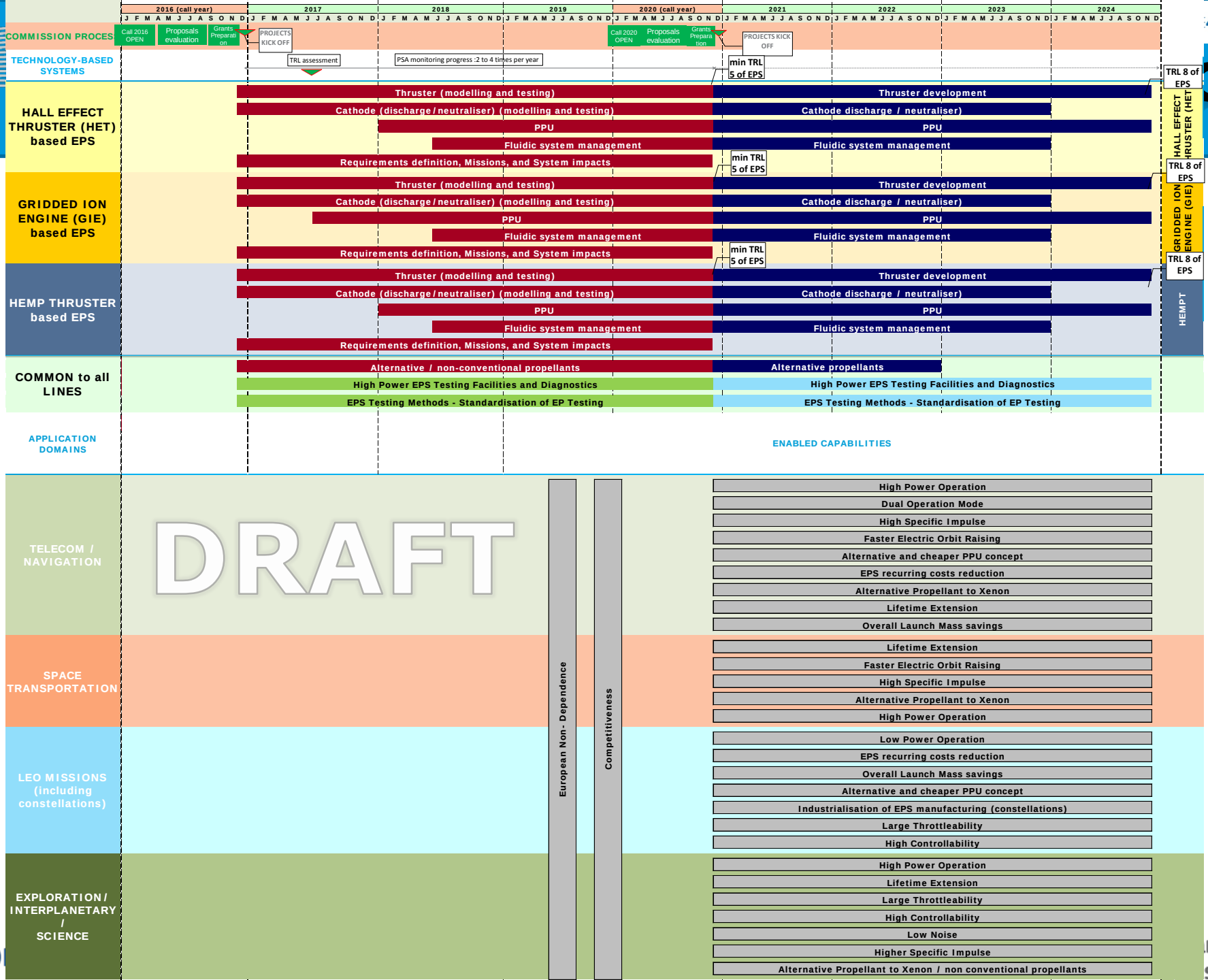
EPIC Draft ROADMAP
Incremental line

PSA Consortium
Workshop Stockholm – 11/02/2015

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 640199.


2016 (call year)
2017
2018
2019
2020 (call year)
2021
2022
2023
2024
COMMISSION PROCESS
Call 2016 OPEN
Proposals evaluation
Grants Preparation
PROJECTS KICK OFF
Call 2020 OPEN
Proposals evaluation
Grants Preparation
PROJECTS KICK OFF
TECHNOLOGY-BASED SYSTEMS
TRL assessment
PSA monitoring progress :2 to 4 times per year
min TRL 5 of EPS
TRL 8 of EPS
HALL EFFECT THRUSTER (HET) based EPS
Thruster (modelling and testing)
Thruster development
Cathode (discharge / neutraliser) (modelling and testing)
Cathode discharge / neutraliser)
PPU
PPU
Fluidic system management
Fluidic system management
Requirements definition, Missions, and System impacts
min TRL 5 of EPS
TRL 8 of EPS
HALL EFFECT THRUSTER (HET)
GRIDDED ION ENGINE (GIE) based EPS
Thruster (modelling and testing)
Thruster development
Cathode (discharge / neutraliser) (modelling and testing)
Cathode discharge / neutraliser)
PPU
PPU
Fluidic system management
Fluidic system management
Requirements definition, Missions, and System impacts
min TRL 5 of EPS
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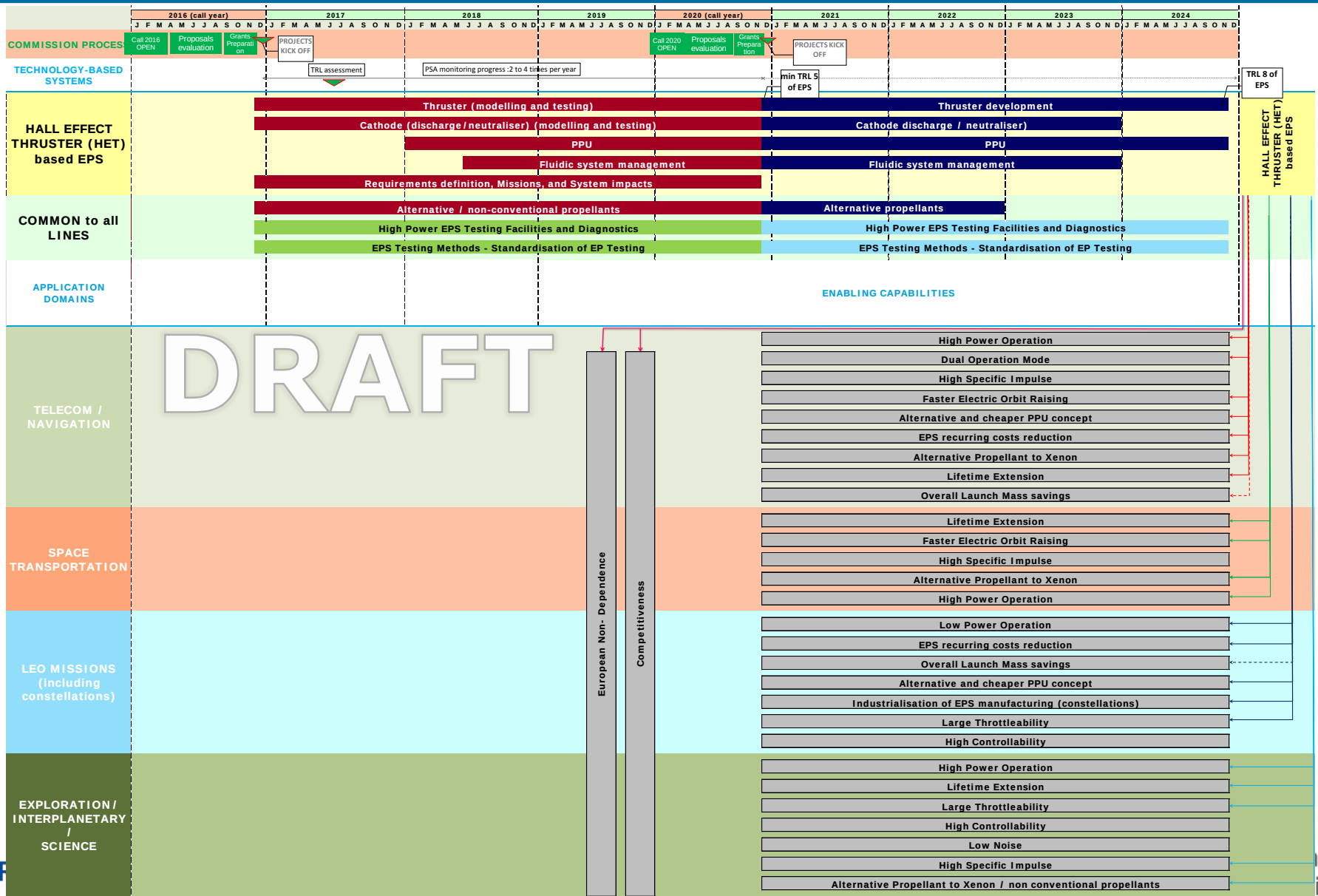
GRIDDED ION ENGINE (GIE)
HEMP THRUSTER based EPS
Thruster (modelling and testing)
Thruster development
Cathode (discharge / neutraliser) (modelling and testing)
Cathode discharge / neutraliser)
PPU
PPU
Fluidic system management
Fluidic system management
Requirements definition, Missions, and System impacts
HEMPT
COMMON to all LINES
Alternative / non-conventional propellants
Alternative propellants
High Power EPS Testing Facilities and Diagnostics
High Power EPS Testing Facilities and Diagnostics
EPS Testing Methods - Standardisation of EP Testing
EPS Testing Methods - Standardisation of EP Testing
APPLICATION DOMAINS
ENABLED CAPABILITIES
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
European Non- Dependence
Competitiveness
DRAFT

HET based EPS

EPIC



HET based EPS - *Explanatory Notes*

- Based on previous and on-going studies heritage should be used to develop
  - High power HET EPS
    - thruster
    - high power/current cathode/neutraliser
    - fluidic management system (including High Pressure Gas Regulation HW)
    - PPU (Electrical Harness Technology)
  - Low power HET EPS
    - thruster
    - cathode/neutraliser
    - fluidic management system
    - PPU
- Clustering of newly developed HET EPS for very high thrust possibilities
- Development shall include modelling and testing
- Requirement refinements, Missions and system impacts (including modelling of Spacecraft – thruster interactions)

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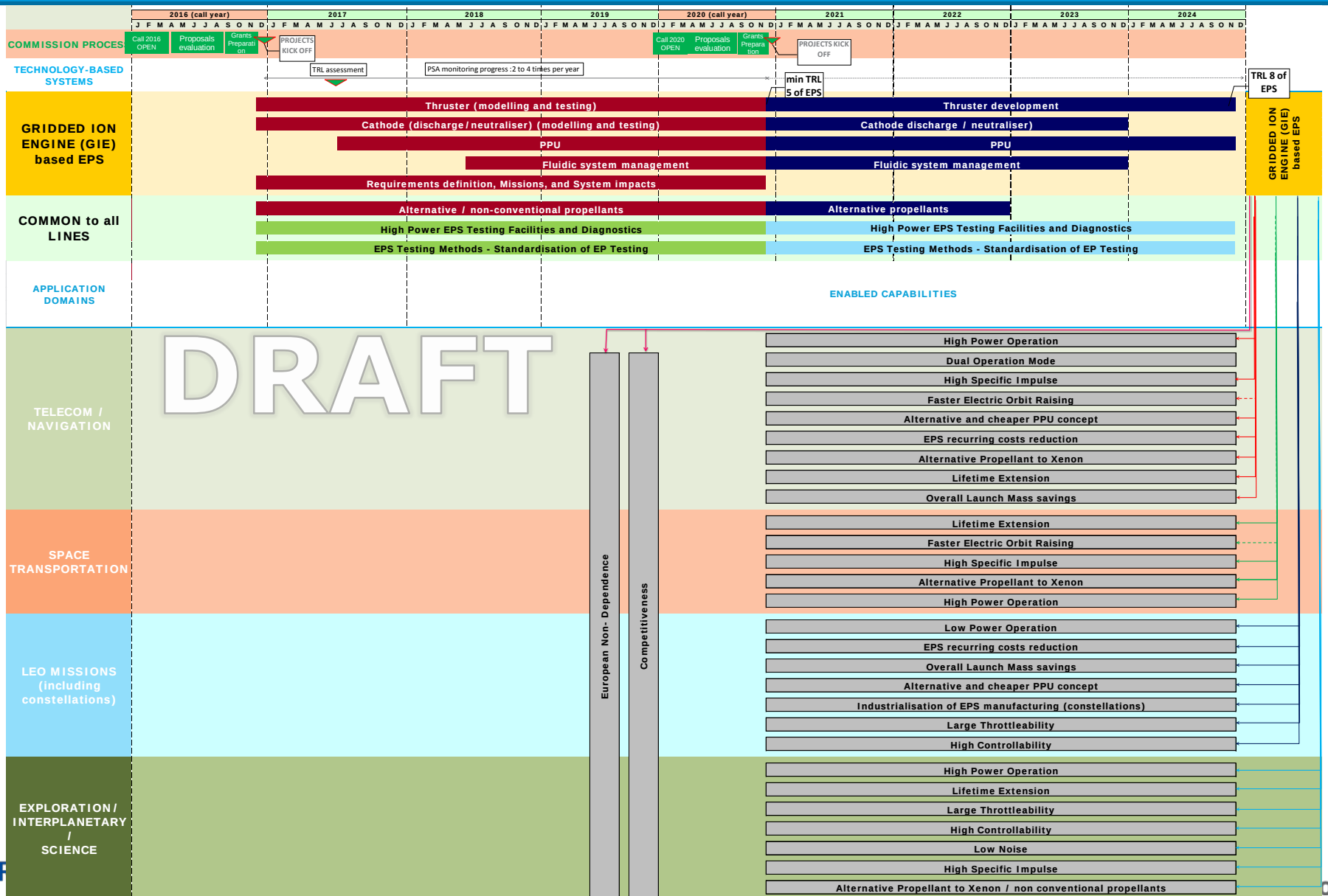
GIE based EPS



GIE based EPS - *Explanatory Notes*

- Based on previous and on-going studies heritage should be used to develop
  - High controllability and low noise GIE EPS
    - Thruster
    - cathode /neutraliser
    - fluidic management system
    - PPU
  - High power GIE EPS
    - Thruster
    - high power/current cathode/neutraliser
    - fluidic management system (including High Pressure Gas Regulation HW)
    - PPU (Electrical Harness Technology)
- Clustering of newly developed GIE EPS for very high thrust possibilities
- Development shall include modelling and testing
- Requirement refinements, Missions and system impacts (including modelling of Spacecraft – thruster interactions)

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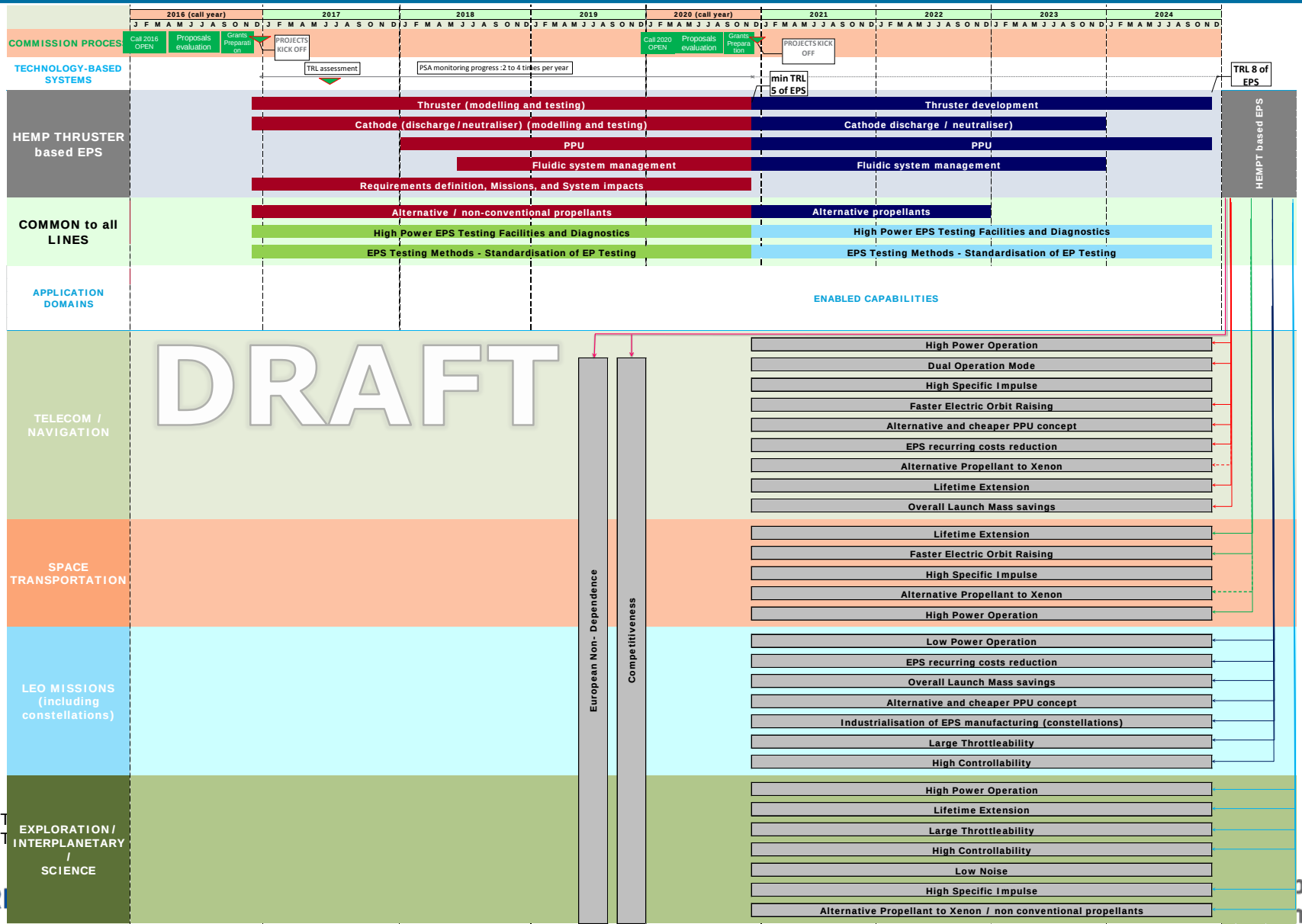
HEMPT based EPS



HEMPT based EPS - *Explanatory Notes*

EPIC

- **HEMP thruster based EPS**
- Based on previous and on-going studies heritage should be used to develop
  - High power HEMPT EPS
    - Thruster
    - high power cathode/neutraliser
    - fluidic management system (including High Pressure Gas Regulation HW)
    - PPU (Electrical Harness Technology)
  - Dual Operation Mode Thruster
    - Thruster
    - PPU (e.g. 400 V – 1200 V)
    - Fluidic management system (wide range throttleability)

- Clustering of newly developed HEMPT EPS for very high thrust possibilities
- Development shall include modelling and testing
- Requirement refinements, Missions and system impacts (including modelling of Spacecraft – thruster interactions)

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Explanatory Notes

General Note: High current Cathode technology

- Depending on thruster technology and propellant selection the development/qualification time can be high.
- Generic development, capable of supporting all Electric Propulsion Technologies (discharge cathodes, cathode/neutralisers, Neutralisers).
- This activity feeds into all the lines (HET, GIE and HEMPT).

Common to all lines

➢ **Evaluation of Alternative and/or non conventional propellants**

- Despite high specific impulse (1500→5000s), exploration applications and Telecom/Navigation and LEO constellations implementing electric propulsion will require enormous quantities of propellant (> 1000 kg for Exploration missions).
- Alternative propellants will need careful assessment to establish impact on thruster design, operations, storage and handling aspects.
- Evaluation of alternative propellants will also need to confirm compatibility with hollow cathode devices.
- This activity feeds into HET, GIE and HEMPT based EPS.

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Explanatory Notes

EPIC

- **High power EPS testing facilities and Diagnostics**
- Test facilities represent a large capital expenditure for the development of EPS
- Pumping technology
- Target development (thermal dissipation)
- Usage of the testing facilities at low costs
- Ground based diagnostics and instrumentation

- **EPS testing Methods / Standardisation of EP testing**
- Qualification and acceptance represent a large part of the costs and time of the development of EPS
- Standardisation of EP testing methods according to ISO17025 would allow to increase the confidence in EP and potentially reduce the qualification and acceptance time of numerous identical EPSs (industrialisation)

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