

Space Nuclear Technology Symposium: Closing

Dr. Robert C. O'Brien

Director,
Center for Space Nuclear Research,
Idaho Falls, ID
3/21/2024

USRA's Center for Space Nuclear Research (CSNR)

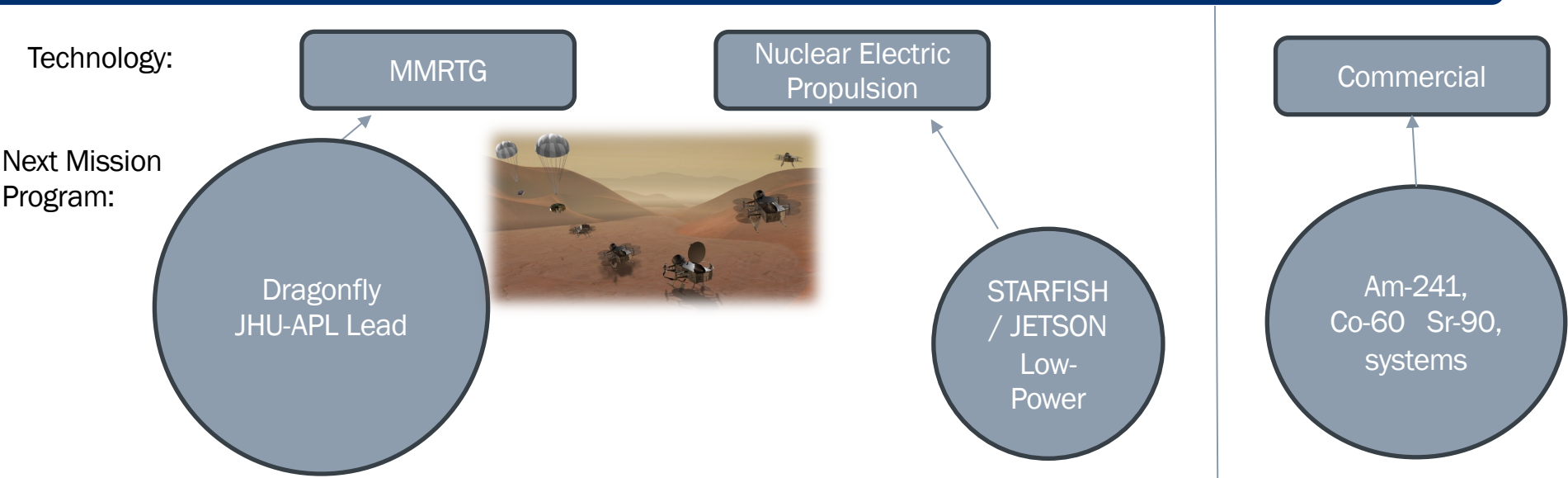
Supporting NASA and DOE Since 2005



- Located in Idaho Falls, adjacent to Department of Energy's Idaho National Lab.
- Fellowship Program Supporting Space Nuclear Technologies:
 - Talent Pipeline and Staff Augmentation
 - Research in support of programs
- Research collaboration projects with Industry & Government programs.
- Research, Modeling & Simulation, and Test Capabilities:
 - Space Reactor Systems
 - Radioisotope Systems
 - Nuclear Thermal and Electric Propulsion
 - Advanced Nuclear Fuels
 - Directed Energy and Thermal Management



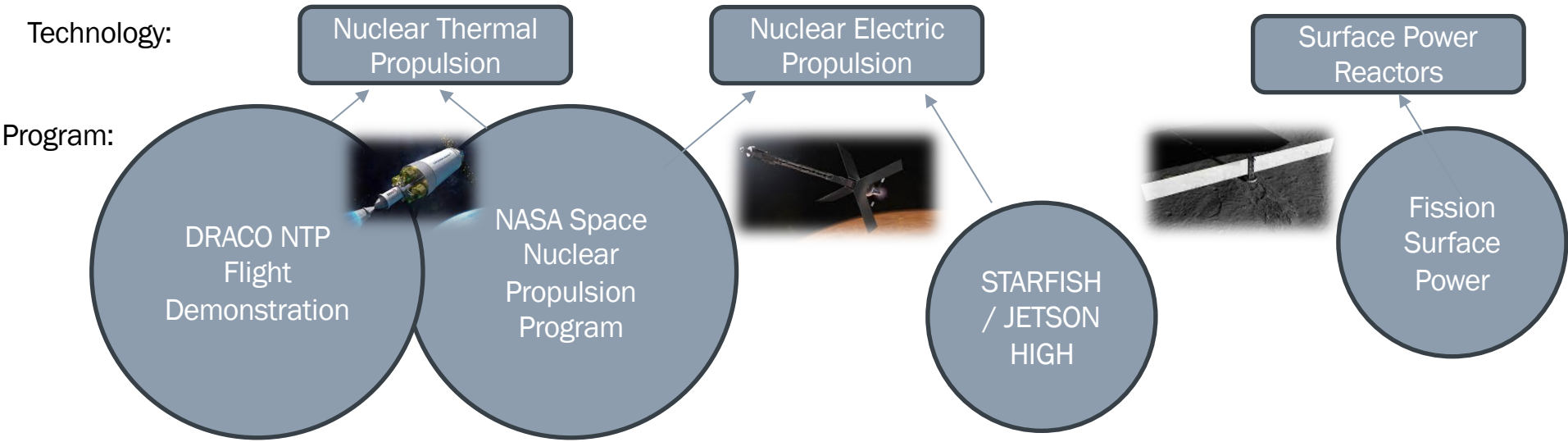
US Programmatic Landscape in Radioisotope Power



Program Sponsoring Agencies



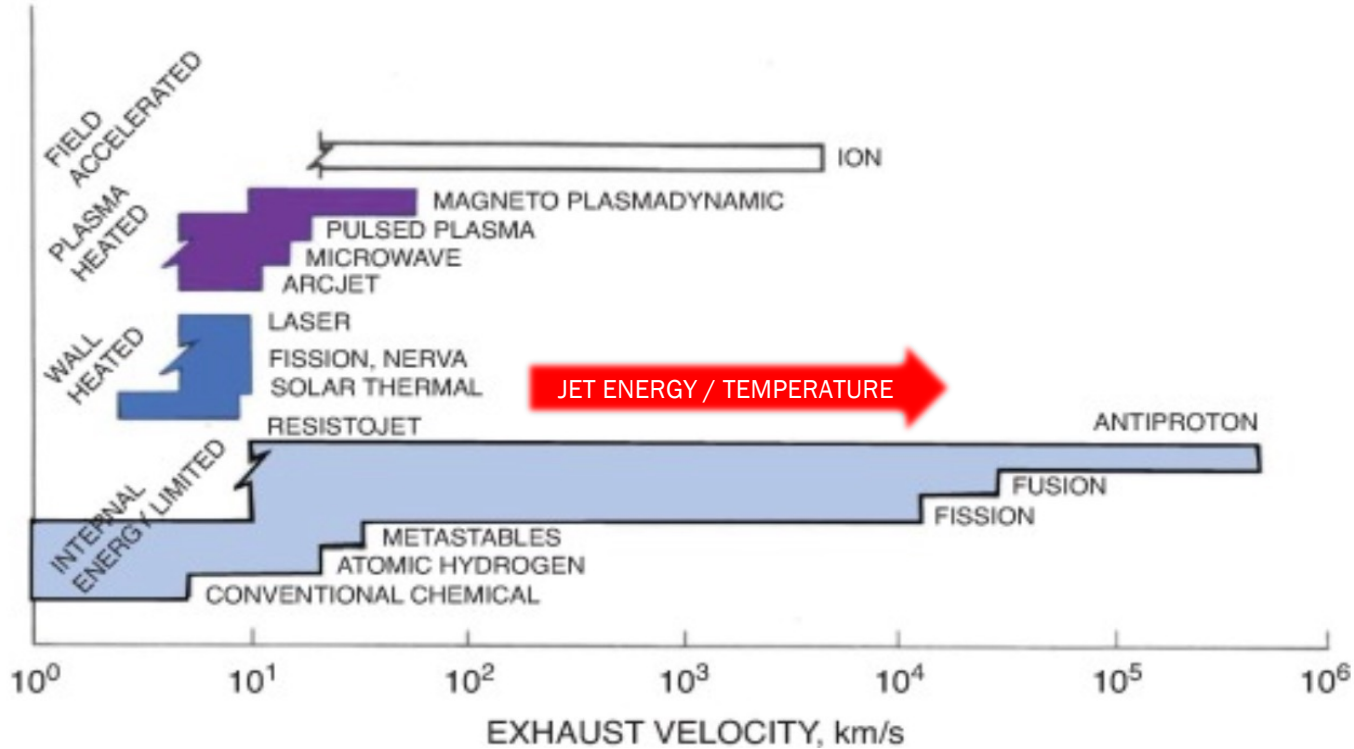
US Programmatic Landscape in Nuclear Fission Power & Propulsion



Program Sponsoring Agencies



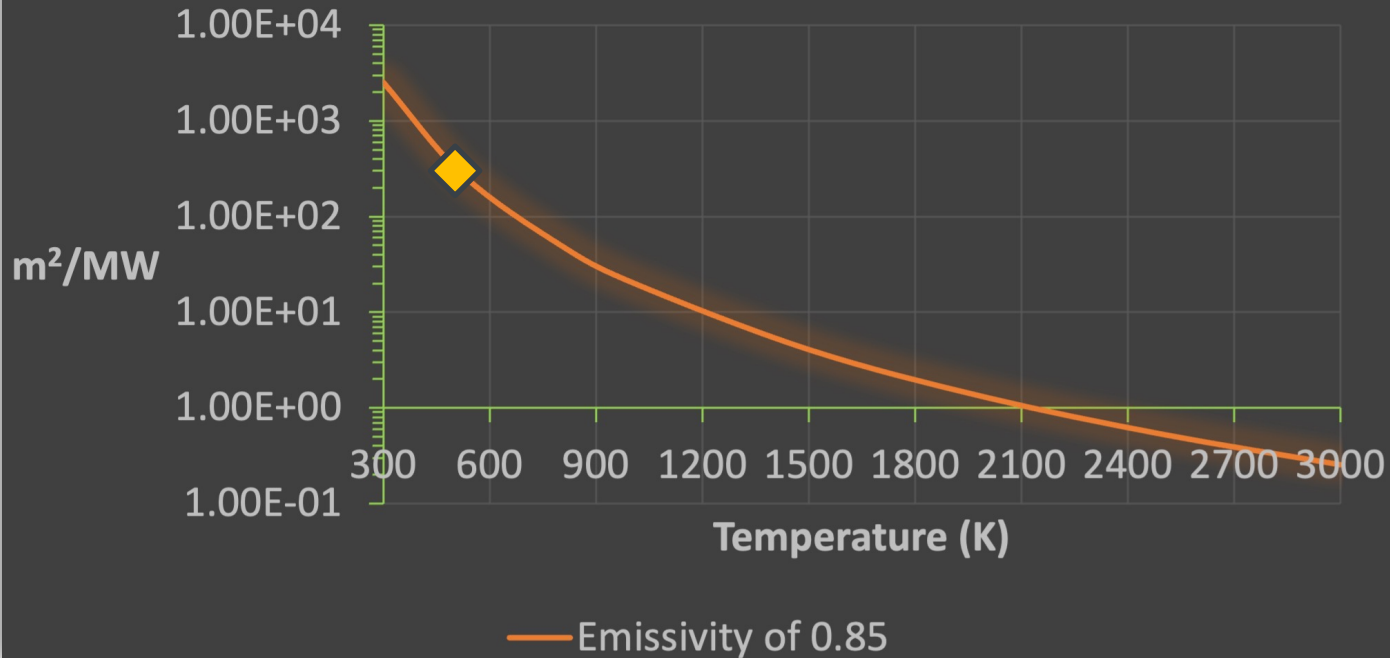
Exhaust Velocities of Propulsion Technologies



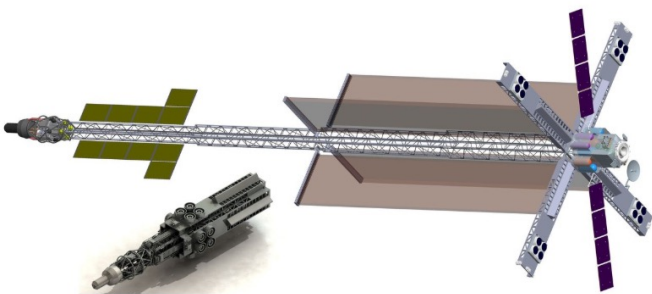
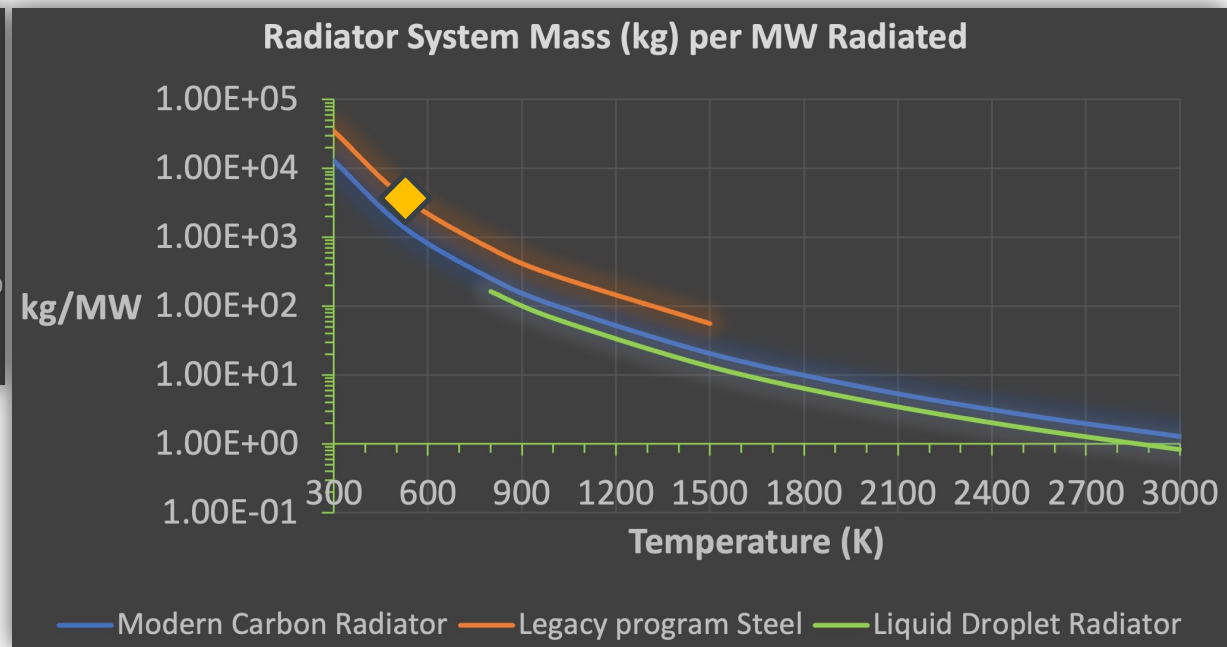
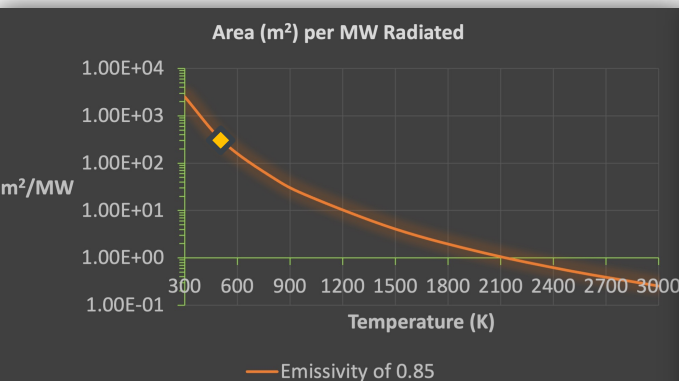
*Exhaust Velocity: Zhang, International Journal of Advanced Nuclear Reactor Design and Technology 5 (2023) 53-71

System Performance Envelopes Driven By Temperature

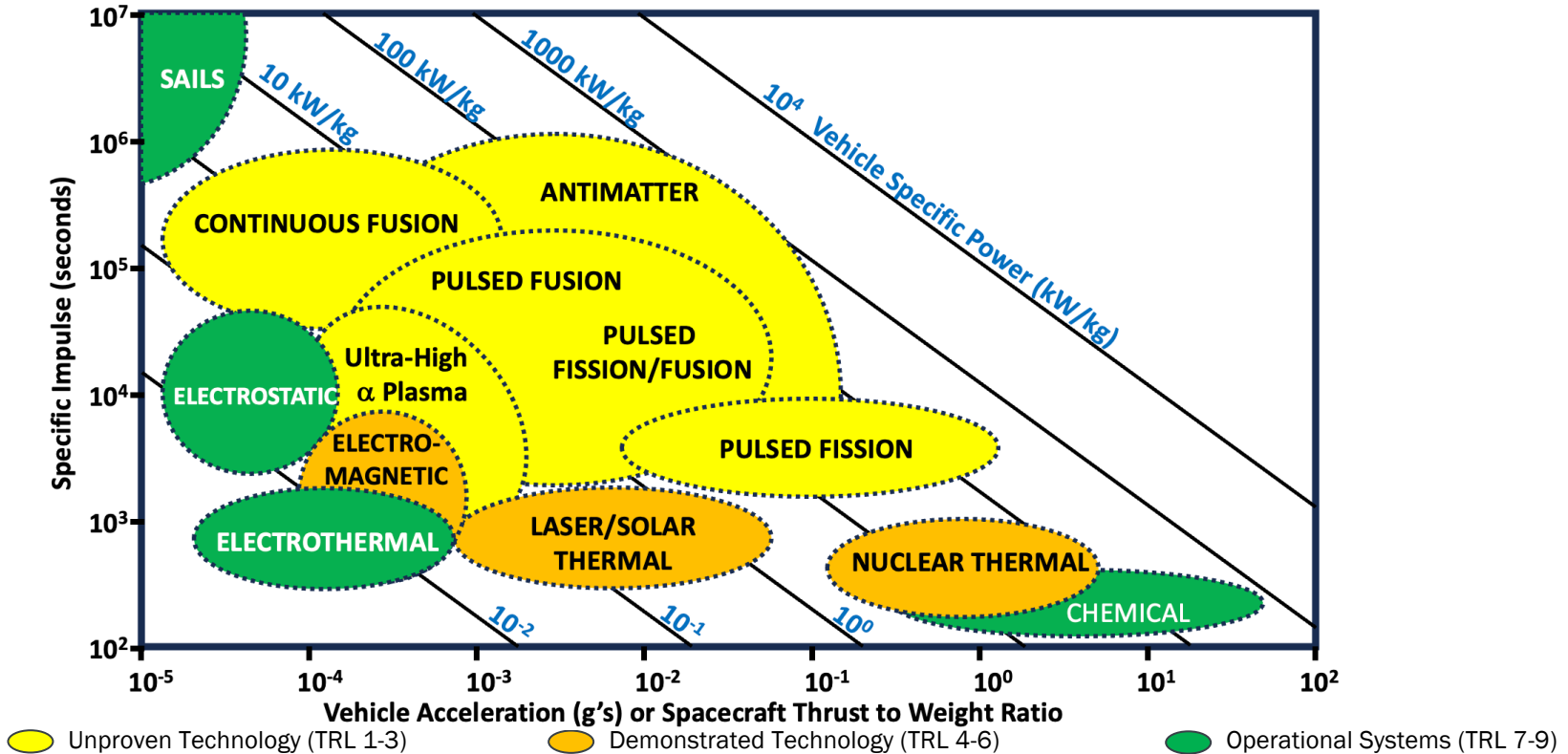
Area (m²) per MW Radiated



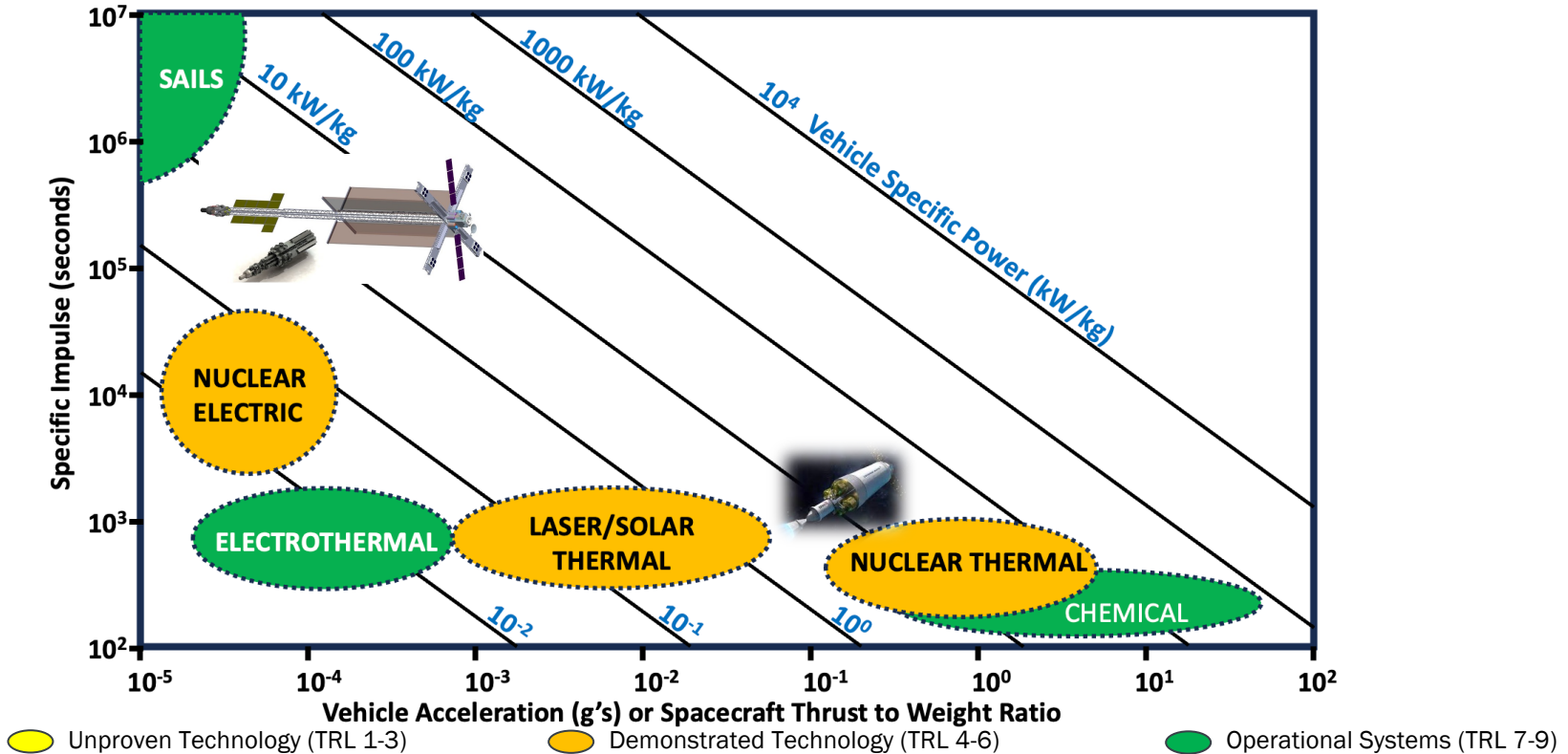
System Performance Envelopes Driven By Temperature



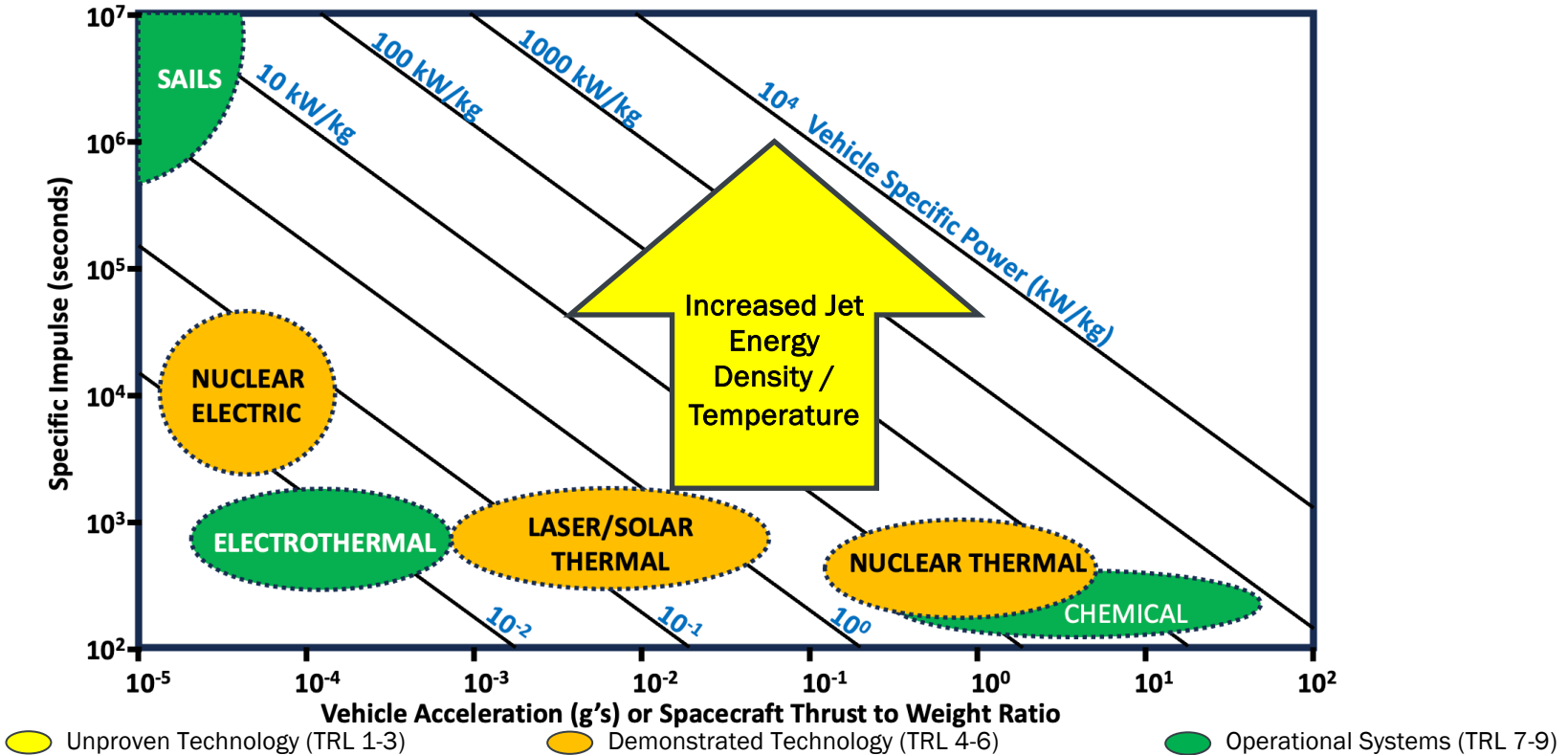
Space Propulsion Performance



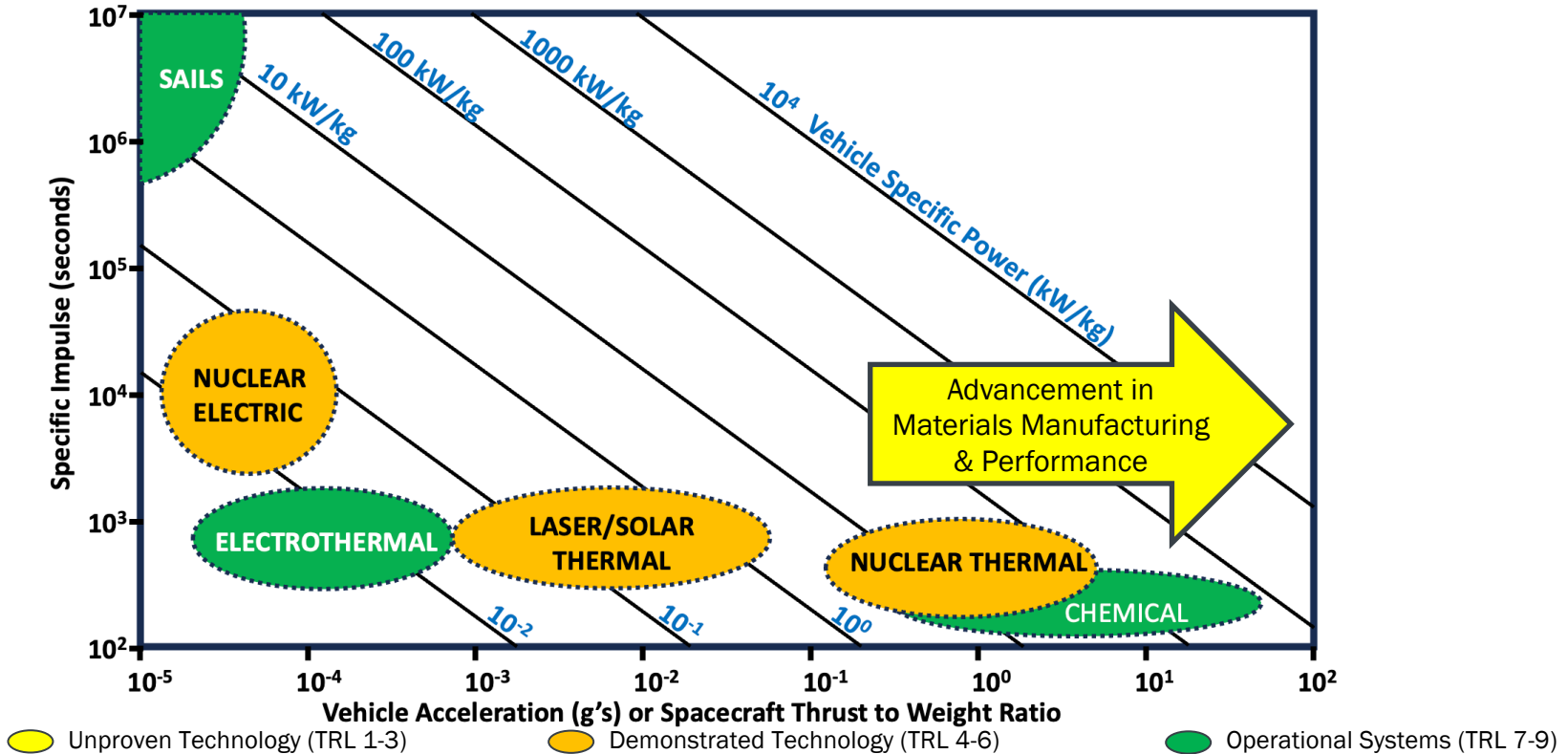
Space Propulsion Performance



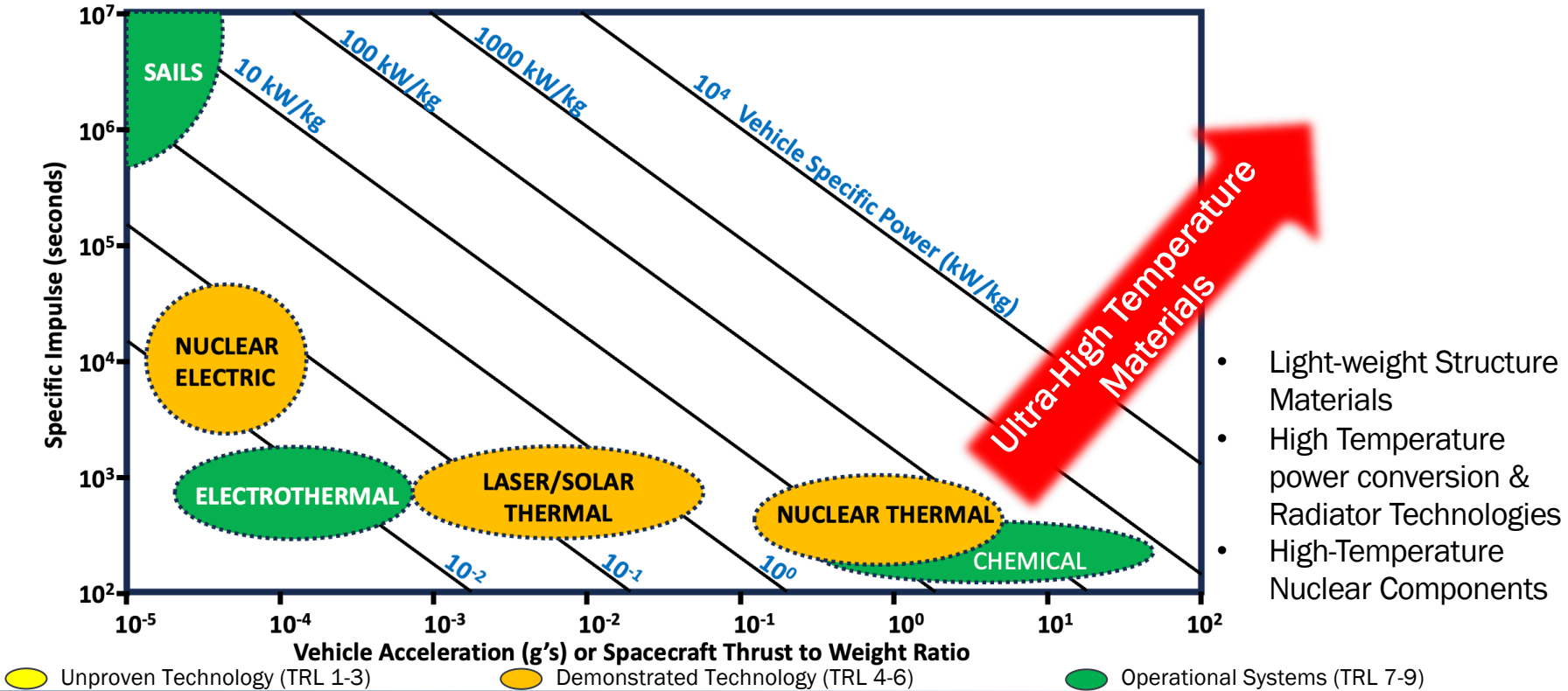
Space Propulsion Performance



Space Propulsion Performance



Space Propulsion Performance



Continuous fission

Pulsed plasma

Fission

Fission/Fusion

Fusion

Continuous fusion

Solid fuel

3100 K

Plasma fuel

1400K

Liquid fuel

4400 K

Gaseous fuel

8000 K

Transformative Manufacturing

Radiative heat transfer

Thermal protection

Thermal physics of coolant/propellant

Fuel enrichment & economy

Vortex and Magnetohydrodynamics

Thermal physics of plasmas

Energy Transmission / Directed Energy

Continuous fission

Pulsed plasma

Fission

Fission/Fusion

Fusion

Continuous fusion

Solid fuel

3100 K

Plasma fuel

1400K

Liquid fuel

4400 K

Gaseous fuel

8000 K

Transformative Manufacturing

Radiative heat transfer

Thermal protection

Thermal physics of coolant/propellant

Fuel enrichment & economy

Vortex and Magnetohydrodynamics

Thermal physics of plasmas

Energy Transmission / Directed Energy

Department of Energy

Department of Defense

NASA

DOE Office of Science

Atoms For Space: A Strategy for US Space Nuclear Leadership & Security



- Declaration of program and investment within the confluence between government agencies, Academia and Industry.
- *Building on the triumphs of the Atoms For Peace program:*
 - *Walk:* NASA & DOD continued investment for use of high-TRL Space Nuclear Technologies.
 - *Enable the Sprint:*
 - *Reinvigorate Nuclear Testing Infrastructure* across NASA Centers and the Department of Energy Laboratories and University Campuses.
 - *Investment in our future Talent:* Deliberate cross-functional development of future Aerospace-Nuclear Engineering “fluent” expertise will develop Transformative Bandwidth and lead to:
 - Significant reduction in time-to-breakthroughs
 - Compressed technology development to flight timelines
 - Increased Investment in NASA and DOD user program sponsorship of Space Nuclear Technologies.
 - Formation of a *Space Nuclear Technology Consortium* composed of representatives from key federal sponsoring agencies and departments, Industry and Academia to *empower appropriated co-operation: Leveraging USRA’s COI-Sponsored Space Nuclear Working Group*

Thank You

