There are innovative magnetic and electric confinement fusion power and propulsion system designs with potential for:

- Vacuum specific impulses of 1500-2000 seconds with rocket engine thrust/mass ratios of 5-10 g's
- Environmentally favorable exhaust emissions if aneutronic fusion propellants can be used
- A 2 to 3-fold reduction in the mass of hypersonic airliners and SSTO aerospace planes
- A 10 to 20 fold reduction in Mars expedition mass and cost (if propellant from planetary atmospheres is used)

And feasibility or in-feasibility of these systems could be confirmed with a modest applied research and exploratory development cost
Plasma Focus

- Outer Electrode
- Insulator
- Inner Electrode
- Propellant Tank
- Propellant Pump
- Auxiliary Electrical Power Unit
- Transpiration Cooled Nozzle
- Transpiration Cooled Chamber
- Turbine
- Hyperconducting Generator
- Electrical Storage Unit
- Transpiration Cooled Electrodes

Plasma Focus Fusion

- Pinch
- Outer Electrode
- Insulator

W: Propellant Tank
P: Propellant Pump
A: Auxiliary Electrical Power Unit
N: Transpiration Cooled Nozzle
C: Transpiration Cooled Chamber
T: Turbine
G: Hyperconducting Generator
H: Electrical Storage Unit
E: Transpiration Cooled Electrodes

F: Fusion Region
S: Start-Up Pony Motors
R: Radiation to Propellant
J: Propellant Jet

Plasma focus Engine
Additional facilities and equipment for nuclear propulsion systems support

\[ \text{Fixed Weight} \]
\[ \text{Structural Weight} \]
\[ \text{Propellant Weight} \]

Ground-Launched Rocket Plane

Air-Launched Rocket Plane

Ground-Launched Airbreathing Plane

Chemical Combustion

Nuclear Fusion

Circular Polar Orbit
185 nm. Altitude
Payload \( \sim 4.5 \text{ mt} \)

Events:
- Land and Wheel Stop
- Vehicle/Crew Safing Tow
- Inspection
- Download Payload Service and Repair
- Load Payload
- Load Off
- Tow
- Preflight Test
- Propellant Load
- Taxi
- Horizontal Takeoff

Mission Planning, Simulator

Payload Integration & Preflight

Refuel Pad

Hangars

Facility, Operation, and Support
(1) Reaction products are energetic charged particles,
(2) Which escape against spherically symmetric radial voltage gradient,
(3) To yield radiation-free direct electric power output

Energy/Matter Conversion Corp.
Manassas, Virginia

Typical Integration of Subsystems for Fusion-Electric Rocket
A 2 to 3-Fold Reduction in Hypersonic Airliner Mass is Possible if Fusion-Electric Propulsion is Used For the Long Cruise Phase of Flight.
Oxygen and nitrogen obtained from Earth’s atmosphere for propulsion from Earth to Mars

Earth-Mars vehicle: powered by fusion rocket propulsion

Launch vehicle: powered by chemical airbreathing and rocket propulsion

Carbon dioxide obtained from Mars’s atmosphere for propulsion for return to Earth
Habitation Module for Each Trip Leg
5-Person Crew

25 mt Payload to Mars Surface
7 mt Mars Material Returned

250 Day Piloted Round Trip to Mars

A Mars Expedition Takeoff Mass of 2.5 to 5 Million Pounds is Possible — Depending upon the Fusion Propulsion Efficiency Achieved During the Trip