

# USNC-Tech

*Commercial Radioisotope Solutions for Lunar  
Thermal Management, Watt Scale Electricity,  
X-Ray Remote Sensing and More*

Lunar Surface Innovation Consortium Power  
Monthly Telecom

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# USNC-Tech Designs and Builds Novel Nuclear Systems



## Surface fission power reactor for Earth

Permanent power, mobile power, and industrial heat



## Surface fission power reactor for Space

Power for ISRU, life-support, mining, reprocessing of materials



## Nuclear Thermal Propulsion (NTP) reactor

High Thrust High ISP Propulsion



## Nuclear Electric Propulsion (NEP) reactor

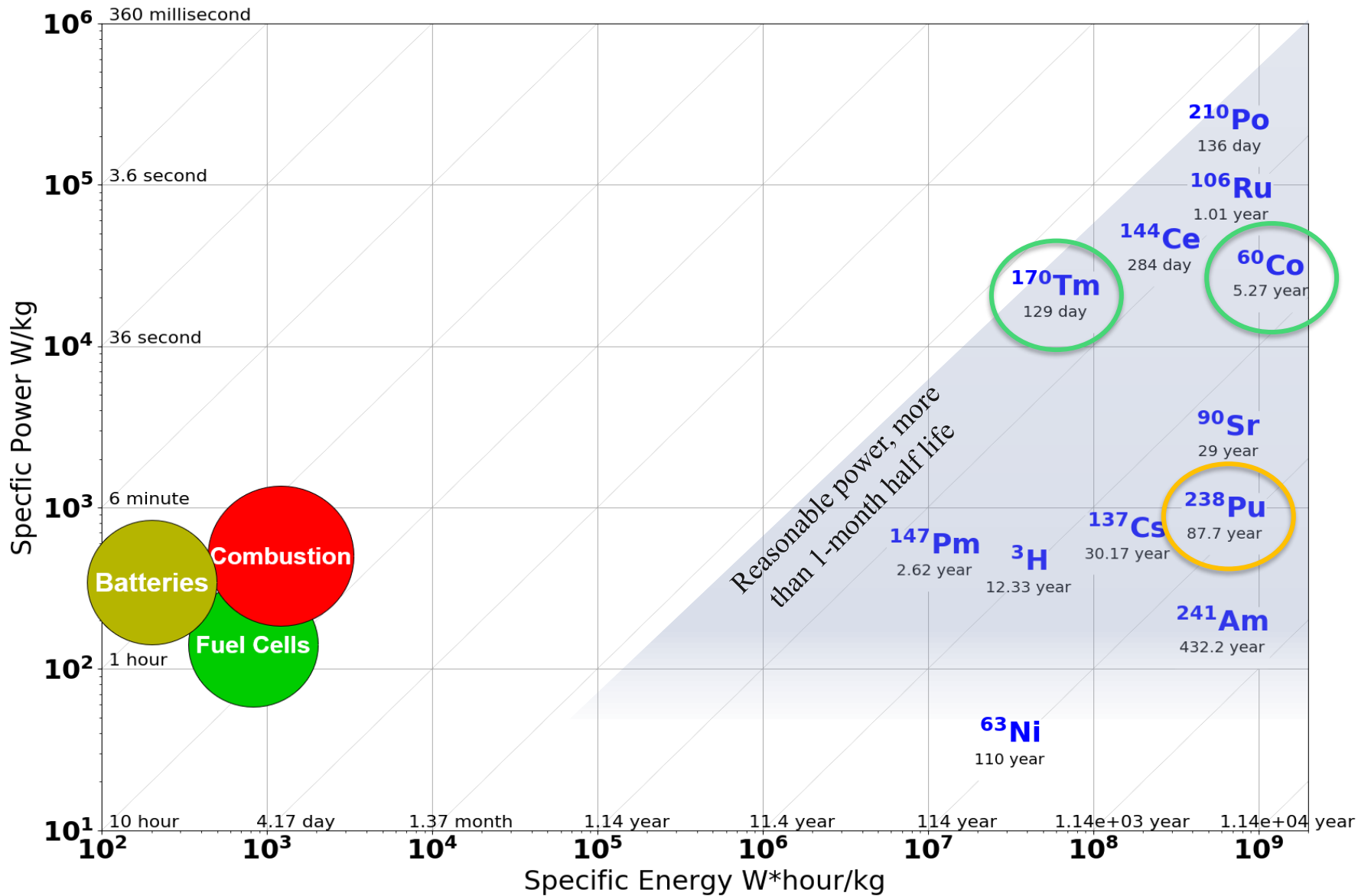
Exploration of the Solar System



## Nuclear Batteries

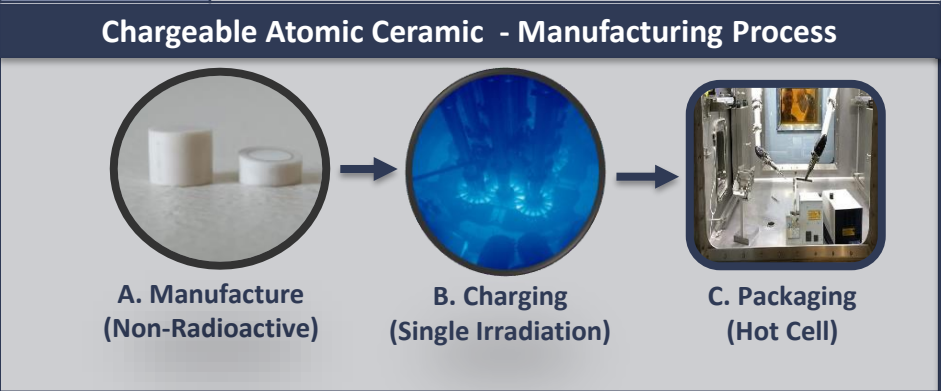
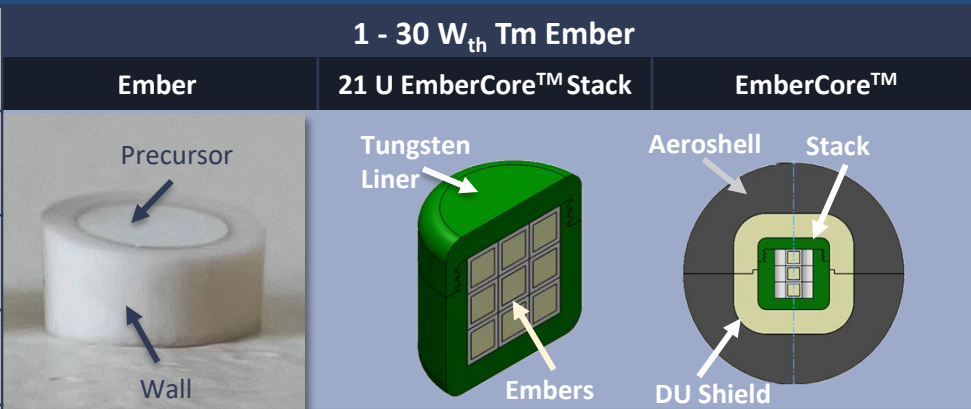
Long term reliable atomic batteries for space and terrestrial markets

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# Commercial Product – Embercore™ – AA Heat Battery of the Future

<b>Performance</b>	<ul style="list-style-type: none"> <li>Up to 1 million x the energy density of Li-ion</li> <li>Compact volume/surface area</li> </ul>
<b>Safety</b>	<ul style="list-style-type: none"> <li>Multiple encapsulation</li> <li>Regulatory/launch approval focused</li> </ul>
<b>Cost Effective</b>	<ul style="list-style-type: none"> <li>Charge and go (no radiochemistry)</li> <li>Affordable raw materials, commercial radioisotopes</li> </ul>
<b>Modular</b>	<ul style="list-style-type: none"> <li>Compatible with different radioisotope &amp; power needs</li> <li>Pack designs for heat, electricity, or x-rays</li> </ul>
<b>Technology Maturation</b>	<ul style="list-style-type: none"> <li>Lunar Heater Product TRL 6 Plan for 2023 and flight in late 2023/2024 based on Tm-170</li> <li><b>First Isotope Production Next Month</b></li> </ul>
<b>Patents</b>	<ul style="list-style-type: none"> <li>WO/2021/159043</li> <li>WO/2021/159041</li> </ul>



# Survive the Lunar Night (Heat)

$20 \text{ W}_{\text{th}} \times 384 \text{ hours} \Rightarrow 7.68 \text{ kWh}$

384 Hour Day  
400 K

## Traditional Batteries

125 Wh/kg  $\Rightarrow$  60 kg

300 Wh/liter  $\Rightarrow$  26 liters

vs.

## EmberCore™

4-8 kg (5-15 x)

0.4-1.0 liters (25-100x)

50 K

384 Hour Night



# Survey the Lunar Environments (X-Rays)

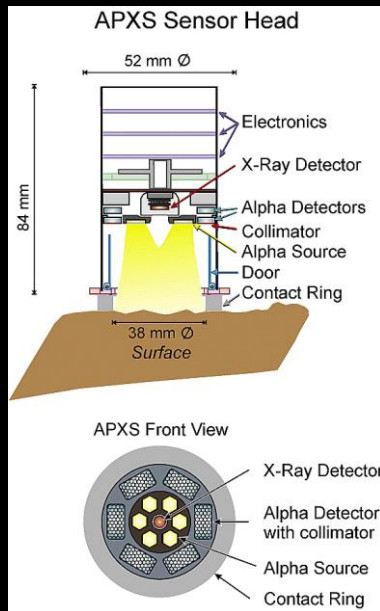
## MER AXPS

0.030 Ci Cm-244 Source

vs.

## EmberCore™ + Detector

10 kCi Tm-170 Source (400,000 x)



- Columnated x-ray laser allows for remote detection
- Strong source reduces counting time
- X-Ray backscattering allows for surface penetrating elemental analysis reducing need for drilling
- XRF/XRD methods for elemental and chemical analysis
- Additional isotopes available for custom photon spectrum for desired analysis
- Drive a rover through a PSR and characterize top few cm of ice/regolith
- Combine with other wavelengths (visible, IR, UV) for improved detection

# Thrive in the PSRs (Electricity)

"Make the Most of the Dark"

EmberCore™ + Thermoelectric

$1 W_e, 20 W_{th}$

Operate in the Dark



# ISRU on the Moon (Temperature)

EmberCore™  
Temperatures >2000 K



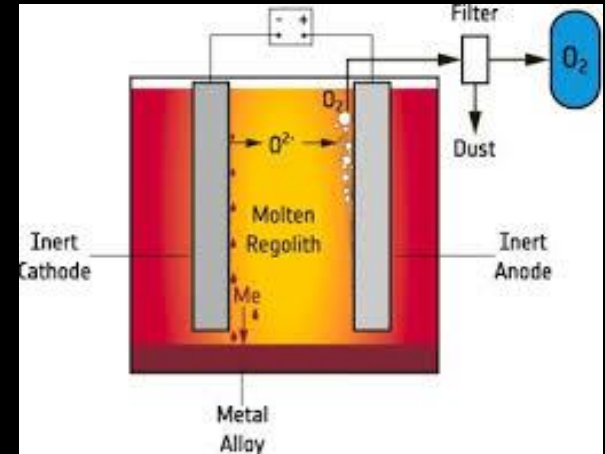
Volatiles Melt ~300 K

$H_2O$ ,  $CO_2$ ,  $NO_2$ ,  $NH_3$ ,  $CH_4$ , etc.

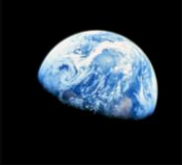


Regolith Melt ~ 2,000 K

$SiO_2$ ,  $Al_2O_3$ ,  $TiO_2$ ,  $Cr_2O_3$ ,  $FeO$ , etc.



# Travel in Cislunar Space and Beyond (Propulsion)



## EmberCore™ Radioisotope Electric Propulsion

100 km/s  
20 kg payload  
< 10 kg/kW<sub>e</sub>

Extra Solar Object Sample Return NIAC



## Heater 1-300 W<sub>th</sub>

- Lunar Night Survival

## Electric Power 1-100 W<sub>e</sub>

- Mobile or stationary platforms
- Long term science stations such as the lunar Gravitational Wave Observatory

## ISRU (1800 – 2500 K)

- Process heat applications

## X-Ray/Remote Sensing

- Elemental and chemical assay

## Position Navigation & Timing

- Passive X-Ray navigation beacons
- Active communication stations

## Looking For

- Users/Partners
  - Are we a good fit for your science application or commercial need?
- Flight Opportunities as soon
  - Opportunities as soon as Mid-2024
  - Landers/Rovers/Payloads
  - Open to proposals
- Contact

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