



High-Efficiency Radiolysis: Nuclear Hydrogen

Michael McNeely, Ph.D., PMP – President/CEO

michael.mc@herl.tech

New Reality:

“Energy security, not climate activism, is now the primary driver of global energy transformation”

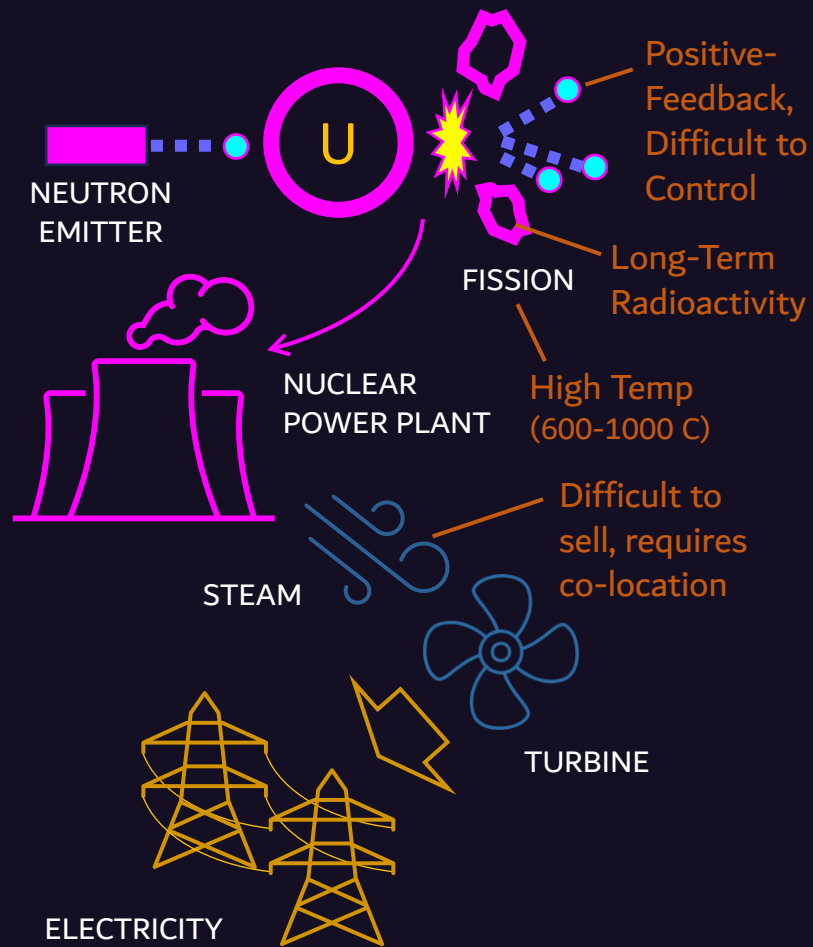
- Jeff Currie, Chief Strategy Officer, Carlyle Group Private Equity

Herl Tech Value Proposition:

Herl Technologies is unique in its opportunity to simultaneously solve the challenges of both Energy Security and the Hydrogen Economy.

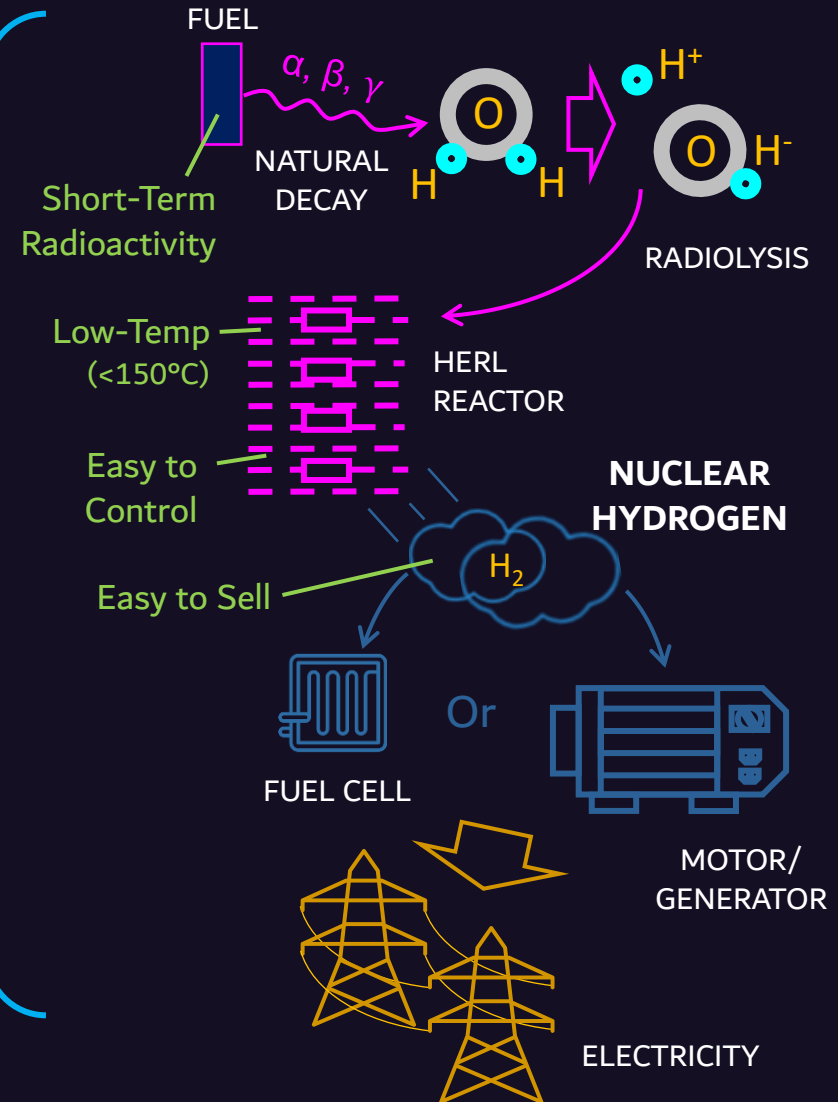
HERL™ is a New Form of Nuclear Power Based on the Radiolysis of Water

FISSION



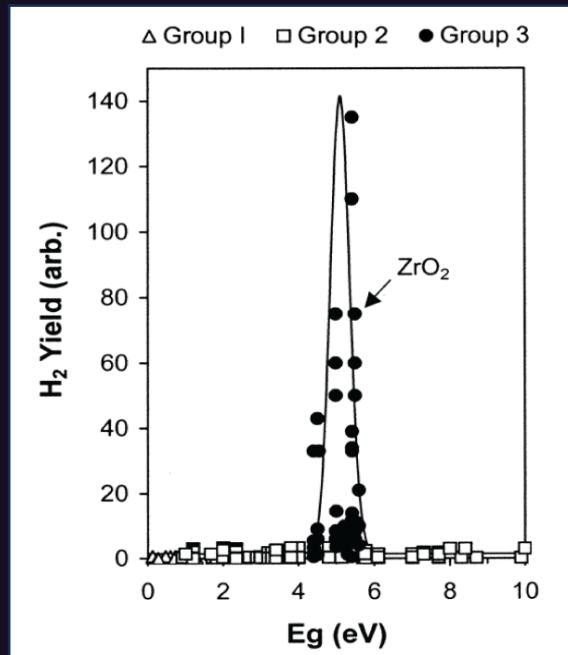
*Safer
and
easier
than
Fission
or
Fusion*

HERL



High Efficiency Radiolysis (HERL™) Enhanced Electrolysis

HERL TECHNOLOGIES is proposing a unique application of the concepts of **RADIOELECTROLYSIS**¹ and **RADIATION CATALYSTS**² with new technology exclusively owned by HERL TECH, to create a revolutionary method of hydrogen production.



Research cited by Le Caër showing levels of hydrogen when various water saturated oxide surfaces are irradiated with γ rays.

What is **RADIOELECTROLYSIS** ?

A term coined by Dr Genn Saji, Ex-Secretariat of the Nuclear Safety Commission of Japan (retired), for the excess generation of hydrogen gas caused by the radiolytic ionization of water in the presence of an electric field.

What are **RADIATION CATALYSTS** ?

A term used by Dr Sophie Le Caër, Research Director at the Interdisciplinary Laboratory of the Atomic Energy and Alternatives Energies Commission of France, to describe materials that have a band-gap energy similar to the hydroxyl (O-H) bond strength of water, that increase the generation of hydrogen gas in the presence of ionizing radiation.

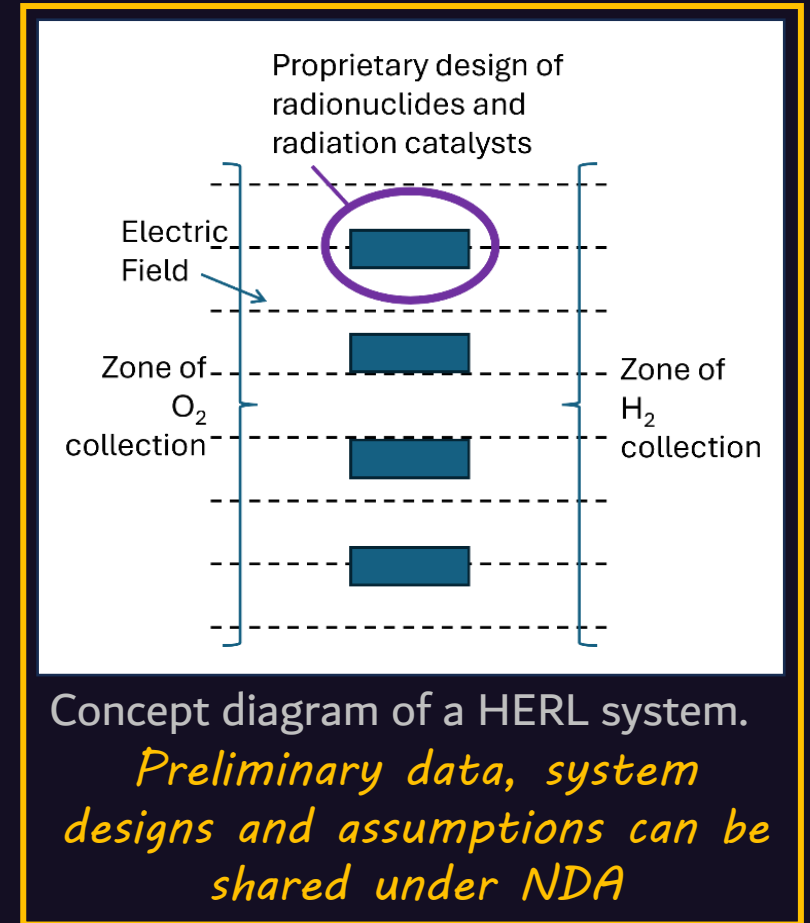
¹ Saji, Genn. (2014). Review on Water Radiolysis in the Fukushima Daiichi Accident: Potential Cause of Hydrogen Generation and Explosion. International Conference on Nuclear Engineering, Proceedings, ICONE. 1. 10.1115/ICONE22-30991.

² Le Caër, S. (2011). Water Radiolysis: Influence of Oxide Surfaces on H₂ Production under Ionizing Radiation. Water, 3(1), 235-253. DOI: 10.3390/w3010235

WHY IS HERL SAFER THAN FISSION OR FUSION?

- No extreme temperatures
- No complex heat management needed
- No difficult to control positive-feedback loops
- No long-term radioactivity

Can lead to faster adoption and deployment to more quickly meet energy demands.



Challenges of Energy Security and the Hydrogen Economy

Challenges of Energy Security

	HERL	SOLAR	WIND/WAVE	SMR	COAL/NG/OIL
DECENTRALIZED	✓✓*	✓✓*	X	X	X
CONSISTENT/RELIABLE	✓	X	X	✓	✓
PROTECTED/SECURED	✓	X	X	X	X
LOW/NO CARBON	✓	✓	✓	✓	XX

Challenges of the Hydrogen Economy

	HERL	GREEN	BLUE	GREY	RED/PINK
COST ¹	✓	X	✓	✓	✓
NET POWER	✓	X	X	✓	✓
TRANSPORTATION & STORAGE	✓**	X	X	X	X
LOW/NO CARBON	✓	✓	✓	X	✓

¹ The cost of HERL hydrogen is expected to be at least 60% less than green hydrogen, based on voltage needs, and potentially greater than 80% less (e.g., < €1/kg H₂). However, HERL's value proposition is associated with satisfying needs of both energy security and the hydrogen economy, not just cost alone.

- * Solar is the ideal decentralized/distributed energy source when it is placed on or near the facility it is providing power to. HERL can replicate this model, depending on fuel type, by being buried next to the building to be energized.
- ** HERL can solve hydrogen transportation & storage challenges because it is net power positive, has no carbon emissions, can be deployed locally and built-to-suit the needs of the facility it is providing hydrogen/power to.

Why Has Nobody Done this Before?

Our Guess-

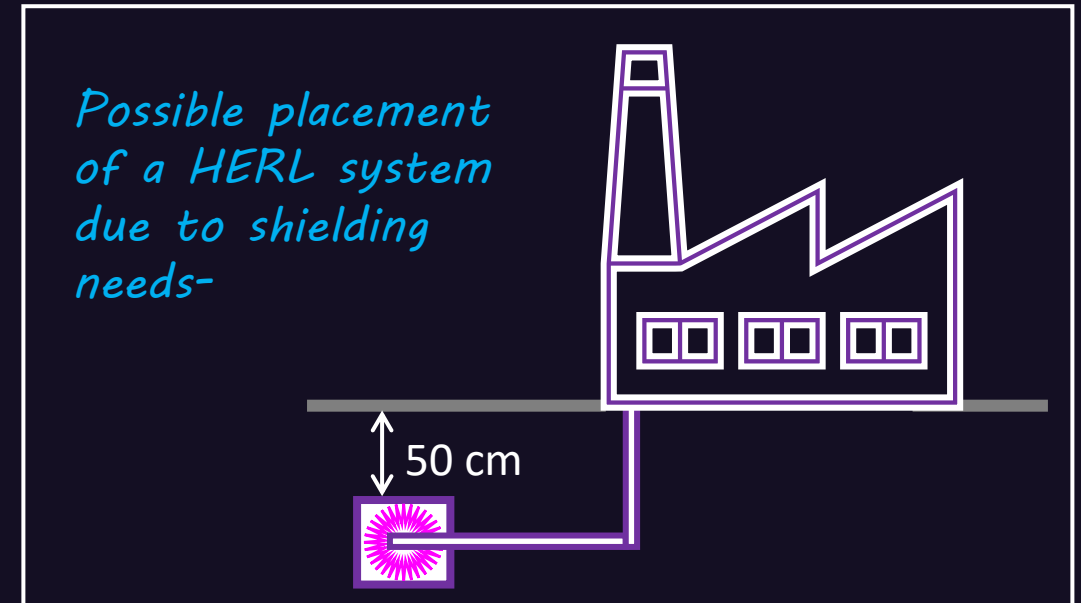
Radiation Catalysts and Radioelectrolysis are, generally, unknown in industry and not an area of active research in academia, probably due to limited downstream (translational) opportunities. Both are just considered academic curiosities.

Why Now?

Only due to new, patent pending materials science discoveries and resulting designs made by Herl Tech, does Nuclear Hydrogen become a commercial opportunity.

Fuel Options

- *Naturally Occurring Radionuclides*- Scaled-up extraction methods (already demonstrated at Oak Ridge National Labs, USA ¹)
- *Synthetic Radioisotopes*- 'Industrialized' manufacturing processes (already demonstrated in Qinshan, China ²)
- *Fission Products*- Current High-Level Nuclear Waste (HLW) recycling projects are underway in the US, UK, Japan and South Korea for Nuclear Battery production.



¹ <https://www.energy.gov/em/articles/oak-ridge-project-boosting-isotope-supply-cancer-treatments>

² <https://www.sustainability-times.com/research/china-just-did-the-impossible-yttrium-90-cancer-isotope-produced-in-commercial-reactor-sparks-medical-and-nuclear-shockwaves/>

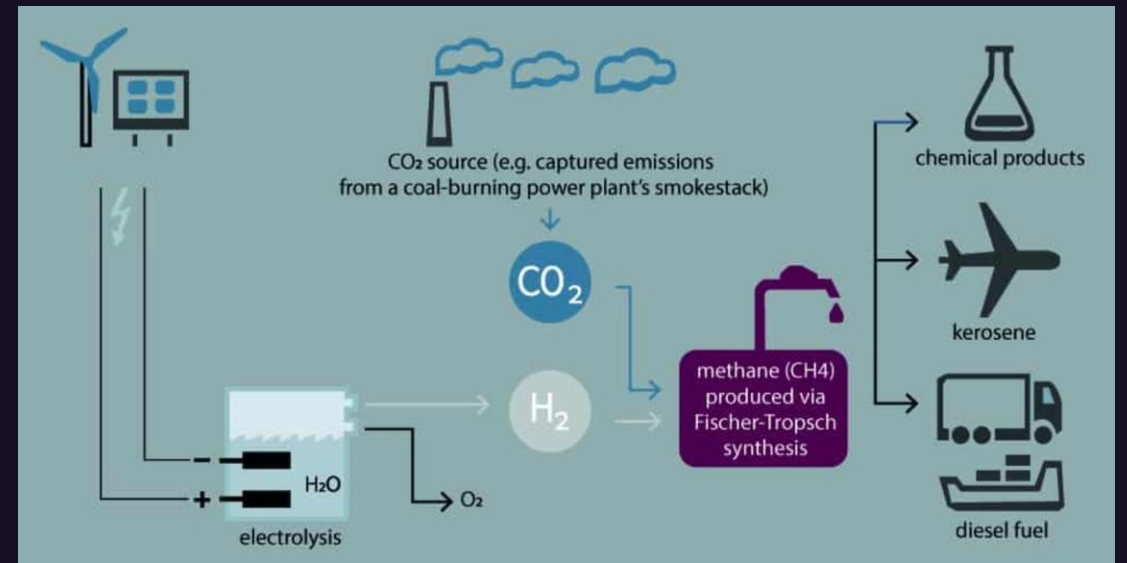
HERL TECHNOLOGIES Intellectual Property

Provisional Patent covering:

- *Designs* for optimal use of Radioelectrolysis and Radiation Catalysts
- *Materials and Methods* for accessing the ionization energy of Alpha and Beta particles
- *Data* supporting ability to access Alpha and Beta energy

Other applications of HERL

- *Power to Gas (LNG from $\text{CO}_2 + \text{H}_2\text{O}$)*
- *Higher-Level Organic Synthesis (eg $\text{C}_3\text{H}_7\text{OH}$)*
- *Removal of forever chemicals from water*
- *Industrial Sterilization Processes*



<https://as-schneider.blog/2022/03/02/what-are-power-to-x-solutions/>

Opportunity

Revenue

- *HERL Technology Licensing*
 - *Electrolysis Companies*
 - *Chemical Synthesis Companies*
 - *Water Purification Companies*
- *Hydrogen Production Systems*
 - *Hydrogen refueling stations*
 - *Hydrogen co-injection with NG*
- *Power Generation Systems*
 - *EaaS*
 - *Eaap*

↖ Goal

*All Income Sources Provide
Recurring Revenues*

Competition

- *Electrolysis Companies*
- *Use of Excess Nuclear Power Plant
Electricity & Steam to drive Electrolysis*
- *Fission (SMR), Fusion & Nuclear Batteries*
- *Other Renewable Energy Systems*

Markets

	2023-24 US\$ B	2032-34 US\$ B	CAGR %
<i>Hydrogen Generation</i>	<i>176</i>	<i>278</i>	<i>5.8</i>
<i>Solar</i>	<i>273</i>	<i>436</i>	<i>6</i>
<i>Wind</i>	<i>89</i>	<i>260</i>	<i>10</i>
<i>Total Renewables</i>	<i>1,085</i>	<i>2,271</i>	<i>9.5</i>

Hydrogen <https://www.fortunebusinessinsights.com/industry-reports/hydrogen-generation-market-100745>

Solar <https://www.fortunebusinessinsights.com/industry-reports/solar-power-market-100764>

Wind <https://www.environmentenergyleader.com/stories/future-trends-in-wind-energy-2608-billion-growth-by-2034,44970?>

Renewable <https://straitsresearch.com/report/renewable-energy-market>

HERL TECH Founders

Michael McNeely, PhD, PMP- President/CEO



- *Dr McNeely is a serial inventor & entrepreneur*
 - *Over 40 patents*
 - *Founded 3 companies which he initially led as Pres/CEO*
- *PhD degree in BioEngineering from the University of Utah*
- *Certified as a Project Management Professional (PMP) from the Project Management Institute (PMI) #3907087, exp 2027*

Mr Smith, MS- Corporate Position TBD



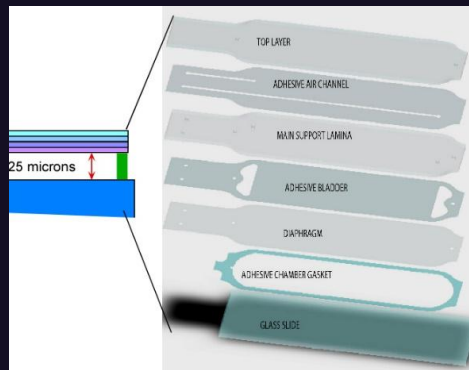
- *Mr Smith is a citizen of Japan with an MS degree in a scientific field from a premier Japanese technology university*
- *He is an executive at a major energy market advisory firm*
- *He has been an invited speaker to multiple Investor and Industry conferences on Energy and the Hydrogen Economy*

ADDITIONAL BACKGROUND - DR MCNEELY

Past Companies-

BioMicro Systems, Inc

- Founder, initial Pres/CEO, later CTO
- Developed the MAUI™ Hybridization System
- Partnered with AsOne Corp (Japan)
- Sold to Roche Diagnostics in 2010



MAUI™ Hybridization System

GattaCo Inc

- Co-Founder, initial Pres/CEO, later Director Global Business Development
- Developed the A-PON® Plasma Separator
- Plug & Play Japan Alum
- Collaboration with Mitsubishi Pharma
- Used by SpaceX during Inspiration4 flight
- Current Advisor



A-PON® Plasma Separator

Macko Labs Inc

- Consulting
- HERL Technology Development

Radiation Science Research-



Dr McNeely spent 18 months studying Radiation Safety, Nuclear Physics & Radiochemistry at the Radioisotope Research Facility of Tokyo Metropolitan University as a part of a project funded, in part, by Fukushima Prefecture. The purpose of the project was to develop a low-cost Radio Bio-Assay for the detection of radioactive particles in urine. Principles studied are directly relevant to HERL.

Key Risks

- *Fuel Availability-* 'Ideal' fuels (low-gamma) are currently limited in their availability and time will be needed to scale-up to satisfactory levels. High-gamma fuels can be used in the interim but may then require remote system deployment or heavier shielding.
- *Regulatory-* HERL is expected to, eventually, enjoy less stringent regulatory scrutiny than SMRs due to its favorable risk profile compared to fission. However, there will be an initial regulator 'education' period of unknown duration due to HERL being a new technology.

HERL 5-Year Development Plan

Development

Current Project

- Establish core Development and Management Team
- Obtain MOUs w/ R&D Partners
- Secure Fuel & Catalysts
- Construction & Testing of Functional Prototypes
- Digital Modeling & Simulation

**ELIMINATE
TECHNICAL RISKS !!!**

TRL of 2 → 4

- Addit'l Testing & Modeling
- Initiate 0.1kg H₂/day Bench-Top System design
- Validate 0.1kg System

- Initiate 1kg H₂/day Pilot System design
- Validate 1kg System
- Scale-Up Manuf. of 1kg System
- Initiate Power Design (HERL+ ICE or FC)

- Initiate 10kg System
- Validate Power System
- Scale

2030 **Series C,
IPO or
Acquisition**

**Series B
\$50M raise**

2028 **Series A
\$15M raise**

Financial

- Additional financial support available via grants at TRL-4 and higher
- 27H2- Partner Revenue possible
- 29H1- Launch of 1st H₂ Generation System
- 30H2- Launch of 1st Power Generation System

2027 **Seed
\$5M raise**

2026 **Pre-Seed
\$500K raise**

*All values shown are hypothetical
Dates assume closing of Pre-Seed in Q4 2025*

Pre-Seed Fund Raising Details

<i>Issuer:</i>	<i>HERL TECH INTERNATIONAL PTE. LTD.</i>
<i>Amount of Financing:</i>	<i>US\$500,000</i>
<i>Type of Security:</i>	<i>SAFE</i>
<i>Valuation Cap:</i>	<i>US\$3.5M POST-Money</i>
<i>Interest:</i>	<i>5%</i>
<i>Discount:</i>	<i>20%</i>

12-Month Milestones

- *Set-Up Singapore holding company*
- *Convert U.S. provisional patent to PCT international patent application.*
- *Negotiate MOUs with nuclear research technical partners*
- *Establish core management and staff (based upon needs and gaps with tech partners)*
- *Secure supply of test reactor fuel and radiation catalysts*
- *Construction and testing of vO HERL Reactor functional prototype*

THANKS !!!

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michael.mc@herl.tech

<https://herl.tech>