



ASP isotopes

# Corporate Overview

June 2023

# Forward Looking Statements

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This presentation contains “forward-looking statements”. Forward-looking statements are neither historical facts nor assurances of future performance. Instead, they are based only on our current beliefs, expectations and assumptions regarding the future of our business, future plans and strategies, projections, anticipated events and trends, the economy and other future conditions. Forward-looking statements can be identified by words such as “believes,” “anticipates,” “expects,” “estimates,” “projects,” “will,” “may,” “might” and words of a similar nature. Examples of forward-looking statements include, among others but are not limited to, statements we make regarding expected operating results, such as future revenues and prospects from the potential commercialization of the Mo-100 isotope, and our strategies for product development, engaging with potential customers, market position, and financial results. Because forward-looking statements relate to the future, they are subject to inherent uncertainties, risks and changes in circumstances that are difficult to predict, many of which are outside our control. Our actual results, financial condition and events may differ materially from those indicated in the forward-looking statements based upon a number of factors. Forward-looking statements are not a guarantee of future performance or developments. You are strongly cautioned that reliance on any forward-looking statements involves known and unknown risks and uncertainties. Therefore, you should not rely on any of these forward-looking statements. There are many important factors that could cause our actual results and financial condition to differ materially from those indicated in the forward-looking statements, including: our reliance on the efforts of third parties; our ability to complete the proposed Mo-100 enrichment plant or to commercialize the Mo-100 isotope using the ASP technology; the financial terms of any current and future commercial arrangements; our ability to complete certain transactions and realize anticipated benefits from acquisitions; contracts, dependence on our Intellectual Property (IP) rights, certain IP rights of third parties; and the competitive nature of our industry. Any forward-looking statement made by us in this presentation is based only on information currently available to us and speaks only as of the date on which it is made. We undertake no obligation to publicly update any forward-looking statement, whether as a result of new information, future developments or otherwise.

This presentation includes market and industry data and forecasts that we obtained from internal research, publicly available information and industry publications and surveys. Industry publications and surveys generally state that the information contained therein has been obtained from sources believed to be reliable. Unless otherwise noted, statements as to our potential market position relative to other companies are approximated and based on third-party data and internal analysis and estimates as of the date of this overview. Although we believe the industry and market data and statements as to potential market position to be reliable as of the date of this presentation, we have not independently verified this information, and it could prove inaccurate. Industry and market data could be wrong because of the method by which sources obtained their data and because information cannot always be verified with certainty due to the limits on the availability and reliability of raw data, the voluntary nature of the data-gathering process and other limitations and uncertainties. In addition, we do not know all of the assumptions regarding general economic conditions or growth that were used in preparing the information and forecasts from sources cited herein. All forward-looking statements herein are qualified by reference to the cautionary statements set forth herein and should not be relied upon.

# ASP Isotopes: At a Glance



## 1. Proven & Proprietary Technology

ASPI's advanced technology platform leverages 20 years of R&D history to enrich isotopes in varying levels of atomic mass. Its innovative technology will enable the company to manufacture a diverse range of isotopes, which will meet the growing demand in the Nuclear Medicine and Green Nuclear Energy industry.



## 2. Multiple Geopolitical Tailwinds Favor Rapid Expansion

Favorable long-term market trends are expected to drive long-term secular industry growth. Recent geopolitical events have created high urgency for companies and countries to search for reliable sources of isotopes.



## 3. Consistent Operational Performance

The smaller isotope enrichment plant is getting commissioned. Construction of the Larger isotope enrichment plant is expected to finish in 2H 2023. Both plants are expected to enter commercial production from Late 2023 to early 2024, which should drive considerable free cash flow.

### ASP Isotopes (NASDAQ: ASPI)

Stock Price (as of 6/9/23)	\$0.41
Shares Outstanding (as of 3/31/23)	37.38M
Market Capitalization	\$15.9M
FD Shares Outstanding	~43.6M
Cash & Equivalents (pro-forma at 03/31/23)	\$5.1M
Long Term Debt	\$0
Insider Ownership	37.5%

# ASP Isotopes: Technology Highlights

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## 1. Cost-Effective

Isotope enrichment facilities using ASP technology can be constructed at a fraction of capital cost and time vs. traditional isotope separation facilities. This technology has been refined for over 20 years through the South African Nuclear Enrichment Program.



## 2. Modular, Scalable Design

The plants can be small in footprint and modular in design, allowing for capacity expansion and growing demand.



## 3. Environmentally Friendly

Our isotope enrichment plants are designed to harvest and enrich a natural mix of isotopes – not by-products from nuclear energy reactors. Accelerator-produced isotopes produce less than 10% of the amount of radioactive waste produced by a reactor<sup>1</sup>, and **our technology produces no waste at all (not radioactive or any other waste in any form).**

# ASP Isotopes: Macro Highlights

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## 1. Geopolitical Tailwinds

Recent geopolitical events have made governments and companies worldwide reassess their reliance on Russia to produce isotopes. Russia's production share of the global medical isotope market is 22%, and China and Russia together comprised 57% of the world's Uranium Enrichment capacity in 2020.<sup>2,17</sup>



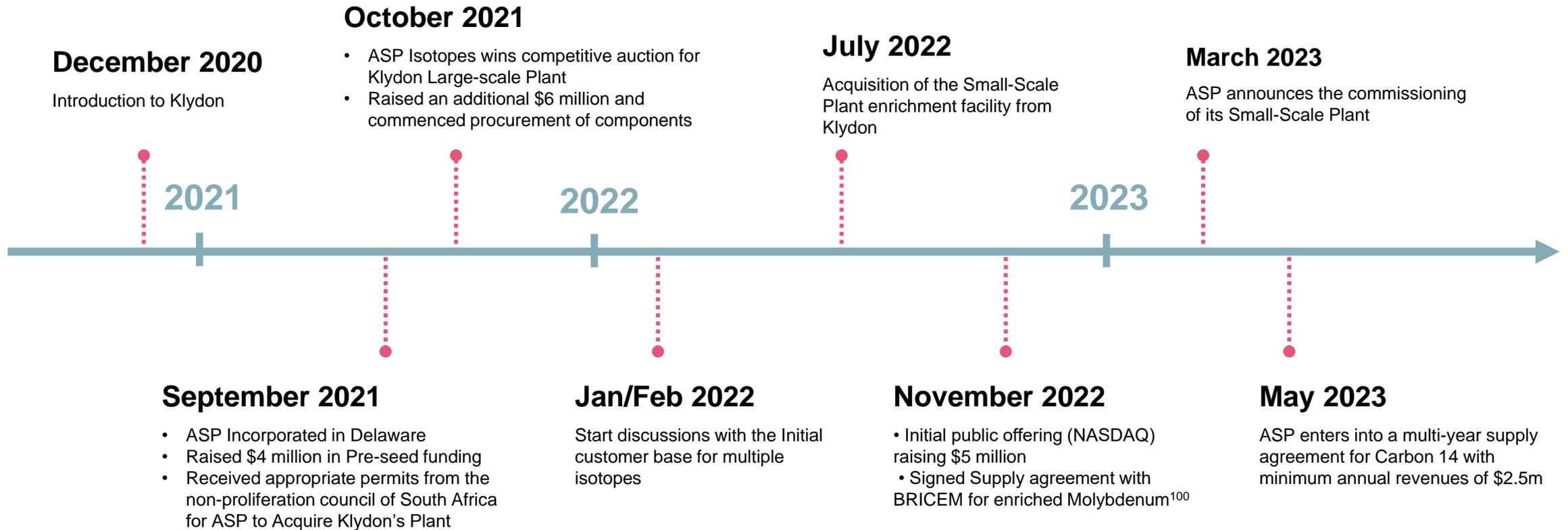
## 2. Global Supply Shortage

Over the next 15 years, 8 of the world's 9 major reactors producing medical isotopes are anticipated to shutter.<sup>1</sup> This will create a large gap in global supply for Mo-99 and other isotopes, providing a springboard for rapid scale and numerous growth opportunities.



**ASPI aims to deliver a reliable, cost-effective, and politically acceptable supply of isotopes supply during an extended period of geopolitical uncertainty**

# Company History



# Anticipated Milestones

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## MARKET MILESTONES

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1. Secure at least 2 more supply agreements for isotopes critical for new technologies and healthcare.
2. Generate sufficient revenues for the company to have annual positive operating cash flow.
3. Enter additional supply contracts for new isotopes in the 2025-2028 timeframe



## OPERATIONAL MILESTONES

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1. Complete the construction and commissioning of our larger isotope enrichment facility in South Africa – **2H23**
2. Start commercial production of isotopes at both isotope enrichment facilities in South Africa. – **Late 2023-Early 2024**
3. Start constructing a third isotope enrichment facility in a new location with advantaged energy costs. – **2H24**

# ASP Isotopes Leadership Team

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## **PAUL MANN**

*Chairman, and CEO*

- Co-founded ASP Isotopes in September 2021
- 20+ years of experience on Wall Street investing in healthcare and chemicals companies at Soros Fund Management, Highbridge Capital and Morgan Stanley.
- MA and MEng (Chemical Engineering) from Cambridge University, Research Scientist at Procter and Gamble. CFA charter holder.

## **SERGEY VASNETSOV**

*Vice-Chairman of the Board*

- Founder and Managing Director of ChemBridges, strategy consulting firm, since 2016.
- SVP of Strategy and M&A at LyondellBasell (NYSE: LYB) (2010-2016).
- Managing Director, Equity Research at Barclays Capital and Lehman Brothers (1996-2010).

## **HENDRIK STRYDOM, PhD**

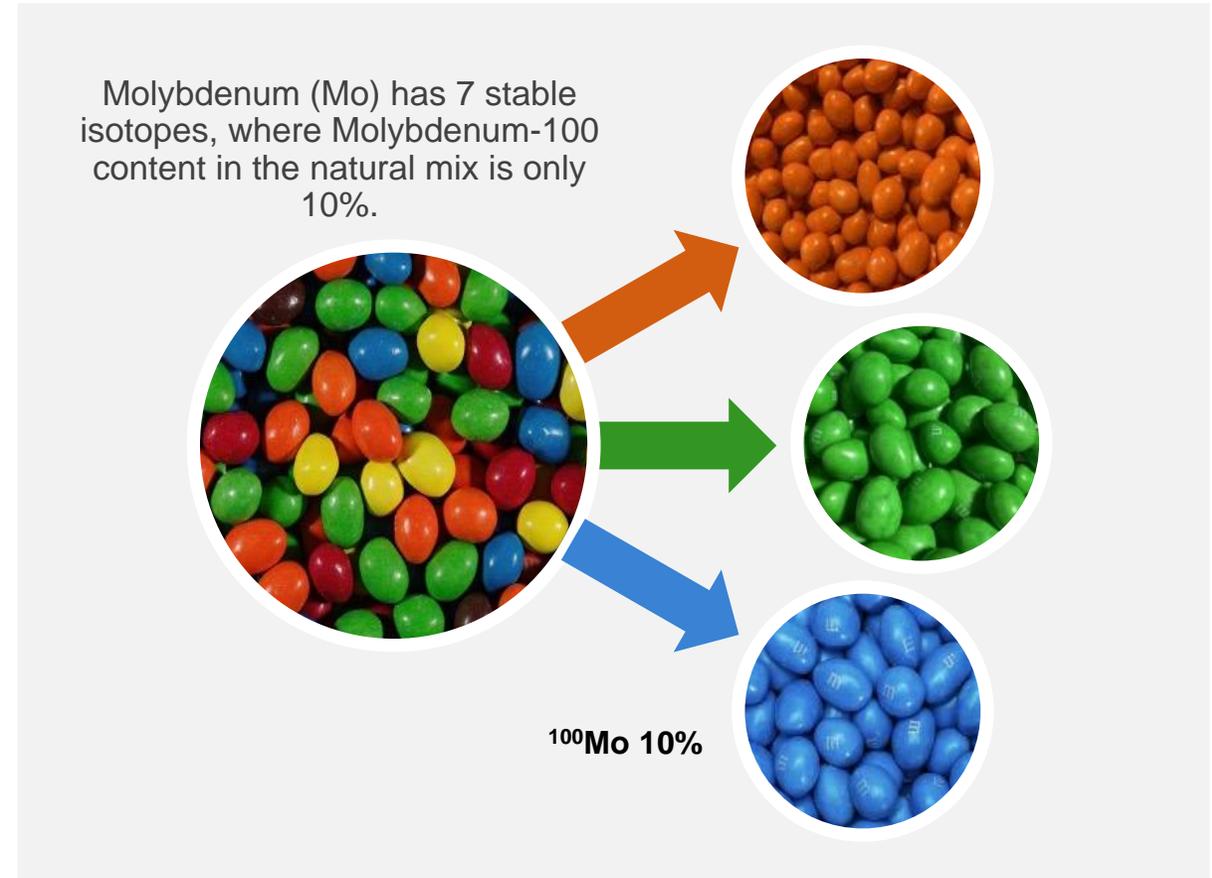
*Director, Chief Technology Officer*

- Co-developer of “Aerodynamic Separation Process” (ASP) and CEO of Klydon, the predecessor company since 1993.
- Dr. Strydom has PhD (Physics) (2000) from the University of Natal (Durban).

# What Is An Isotope?

**Isotopes are like identical twins or triplets: very similar in most aspects, except for a few subtle differences.**

- Isotopes are two or more atoms of the same chemical element with the same number of protons and electrons but slightly different numbers of neutrons.
- Isotopes are found in nature mixed together, just like M&M chocolate candies: same composition, taste, and size – just different colors. The isotope separation process should sort them into fractions of precisely the same types.
- This separation process is very challenging and expensive precisely because isotopes are so similar to each other, with only minor weight differences.



**We aim to increase (enrich)  $^{100}\text{Mo}$  content from its natural 10% content to the required >95% purity product**

# Isotopes of Interest

Isotopes	End-Market	R&D Stage	R&D Evaluation	Under Construction	Commercially Available	
Carbon-14	Pharma & Agrochem	→				
Silicon-28	Quantum Computing	→				
Germanium-70/72/74	Quantum Computing	→				
Molybdenum-100	Nuclear Medicine	→			→	Available in 2H23
Molybdenum-98		→			→	Available in 2H23
Zinc- 67/68	Nuclear Medicine	→				
Ytterbium-176		→				
Nickel-64		→				
Xenon-129/136		→				
Chlorine-37	Green Nuclear Energy	→				
Lithium-6		→				
Uranium-235		→				

# ASP Technology Creates Stable Isotopes More Efficiently

## TRADITIONAL TECHNOLOGY Expensive and Capital intensive

Traditionally, isotopes have been separated using a gas centrifuge, in which a cylinder spins extremely quickly. Thus, centrifugal forces allow heavier isotopes to get separated from lighter isotopes.

## ASP DIFFERENTIATION Cost-effective proprietary design

- In separation, the cylinder wall remains stationary while the gas spins around rapidly due to pressure applied through very precisely positioned high-pressure injection nozzles and flow directors
- No moving metal parts in the ASP design enables lower cost construction and simplicity in operations; vs. traditional centrifuges, our ASP plants are expected to have low CapEx and subsequent maintenance, moderate consumption of electricity and labor, and overall low cash production cost.

## TRADITIONAL TECHNOLOGY Enables long-term value capture

- ASP enrichment plants are designed to be modular and flexible: they can be built expeditiously in a wide range of locations and at a customized size
- ASP enrichment plants can enrich isotopes with various atomic masses and temperatures. In lab testing, we have used the technology to enrich isotopes from a mass of 16 to 300 and at temperatures of up to 270°C. This makes the technology suitable for a wide range of customer needs.

**ASP enrichment plants are expected to have attractive profit margins and high return on invested capital, based on long-term customer contracts for specific isotopes**

# ASP Technology: Stationary Wall Centrifuge

## Benefits of a Stationary Wall Centrifuge

1. No moving parts vs. a conventional centrifuge
2. No unique materials are required
3. Cost-efficient at small scale
4. High Separation Efficiency

**Small Production Modules**



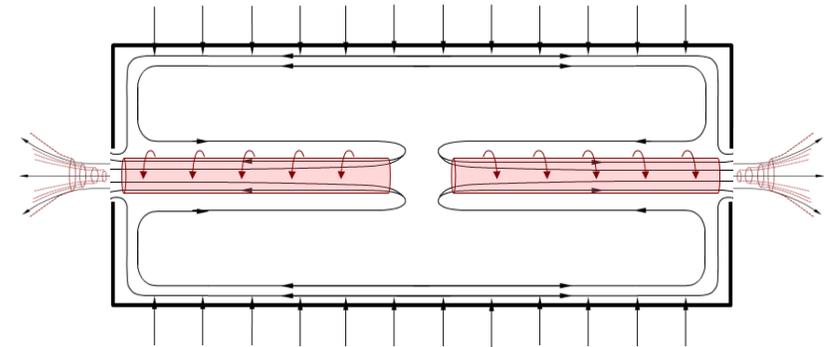
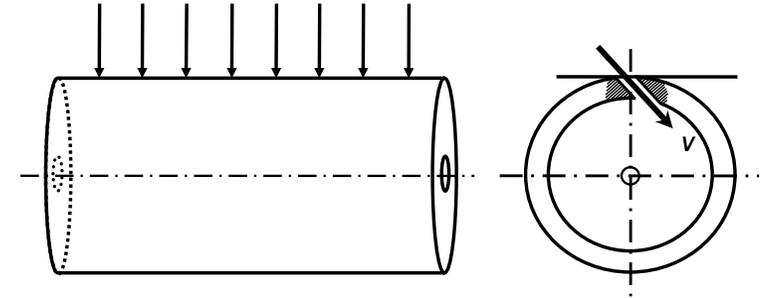
**Flexible Capacity Deployment**



**High Separation Efficiency**

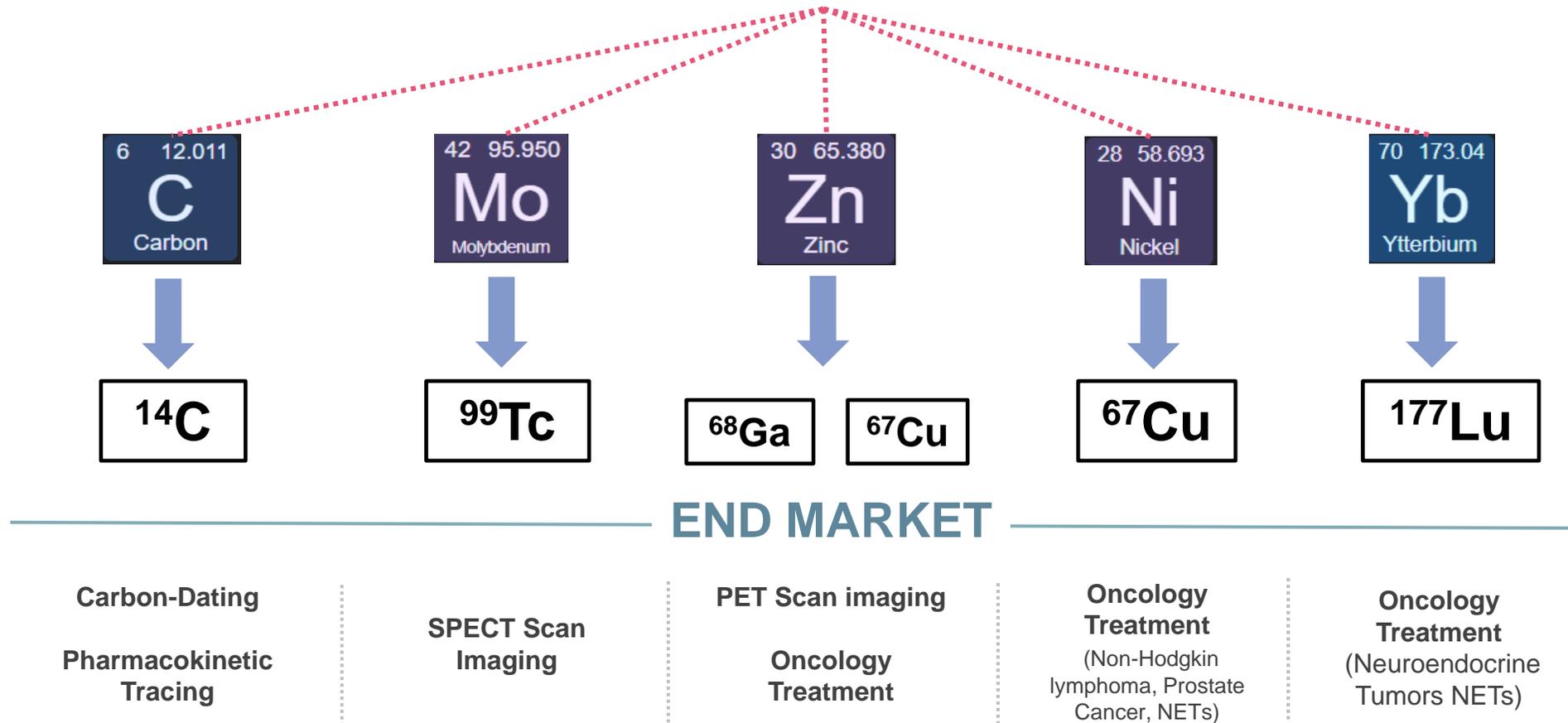


**Low Energy Cost**



# Isotope End Markets: Nuclear Medicine

## ISOTOPES OF INTEREST



# Isotope End Markets: Carbon-14 ( $^{14}\text{C}$ )

## Radiolabeling

A scientific technique used to track the passage of a molecule. The technique incorporates a radioisotope through a reaction, cell, organism, biological system, or metabolic pathway.

## Carbon-14

Used as a radiolabeling compound due to its' relatively harmless emission of alpha particles, and long-lasting half-life, which allows researchers to track drug molecules throughout the body.

ASPI has entered into **multi-year** supply agreement with **minimum annual revenues of \$2.5M** per year MOU to produce Carbon-14 for quantities that will be sufficient to meet the entire global demand.

**ASPI expects to commence commercial production of Carbon-14 by Late 2023**

ASPI's Carbon-14 enrichment facility



# Isotope End Markets: Molybdenum-100 and Zinc-68

Single-photon emission  
computed tomography (SPECT)

Global Market Size<sup>6</sup>

**\$4.61B**

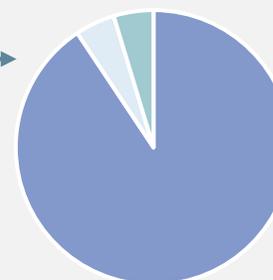
**<sup>99</sup>Tc**

Technetium-99

<sup>99</sup>Tc Global Market Size<sup>7</sup>

**\$4.17B**

Imaging Agent Distribution



It is estimated that **80-85%** of all SPECT procedures utilize Technetium-99<sup>8</sup>

Positron emission tomography  
(PET)

Global Market Size<sup>4</sup>

**\$1.15B**

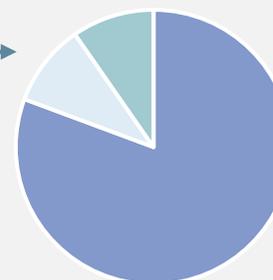
**<sup>68</sup>Ga**

Gallium-68

<sup>68</sup>Ga Global Market Size<sup>5</sup>

**\$127M**

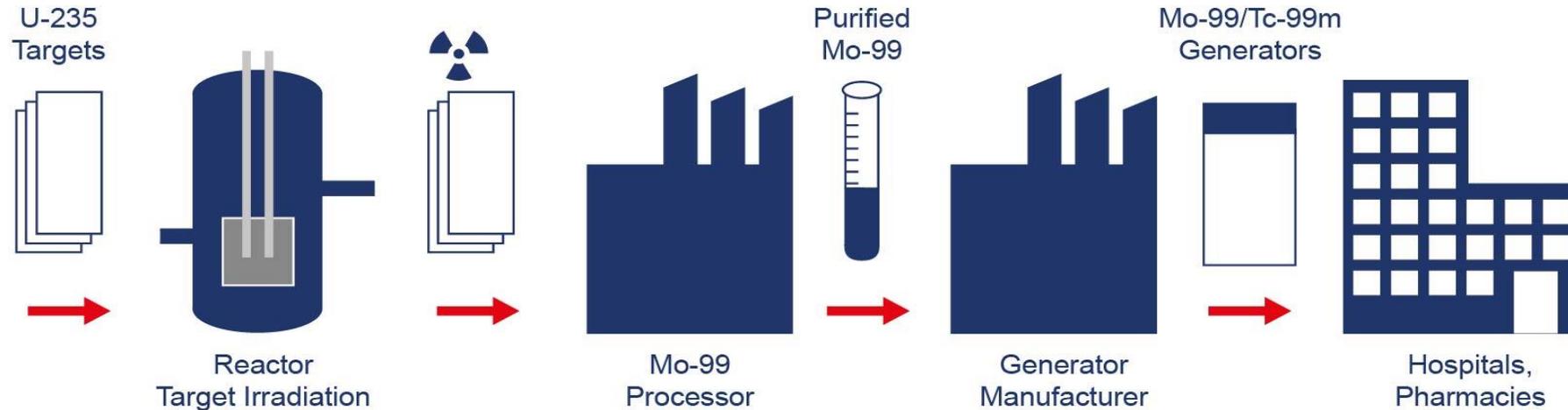
Imaging Agent Distribution



**Over 90%** of prostate Cancers Over-Express PSMA, and Ga68 hybrid therapy has a 76/97% Sensitivity/Specificity identification rate when compared to 58/82% in MRI alone.<sup>3</sup>

# Nuclear Medicine Supply Chain

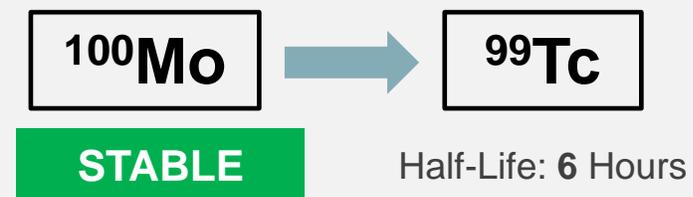
## Current Mo99 Supply Chain



## Current Isotope Conversion Process



## ASP Isotope Conversion Process



# Geopolitical Tailwinds for ASPI Nuclear Medicine

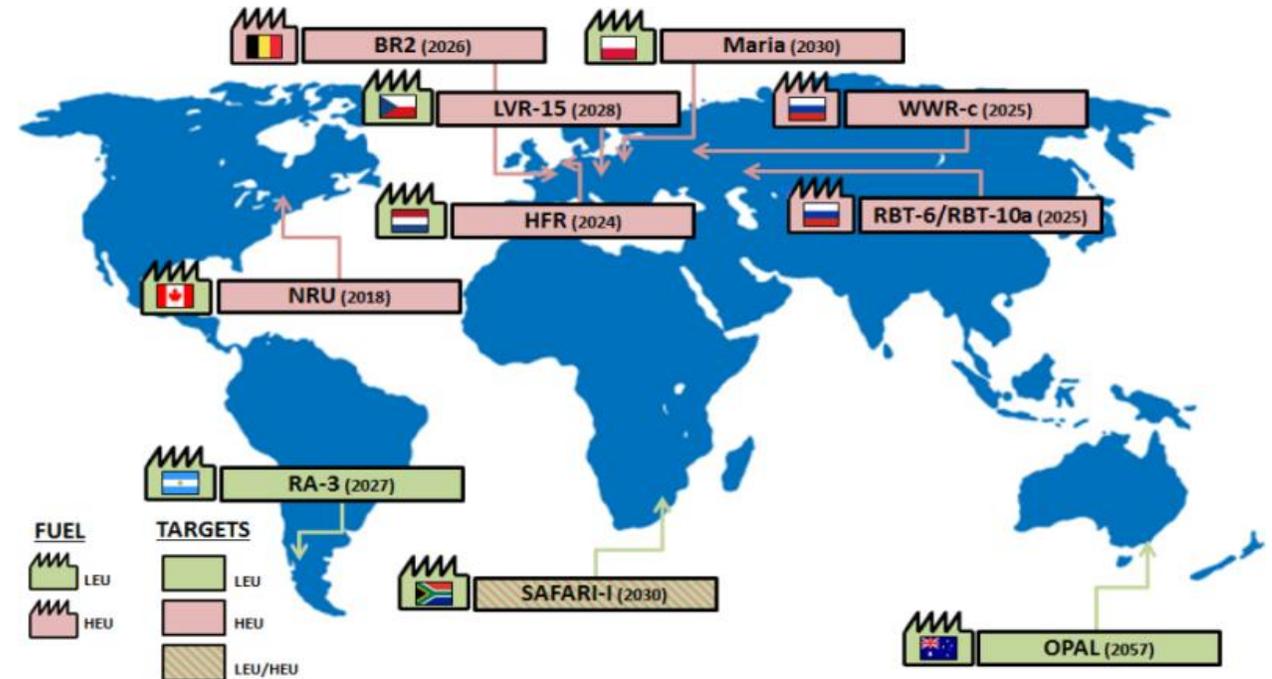
## 1. Government Support for Alternative Supply

“Between 95 and 98 percent of  $^{99}\text{Mo}$  is currently being produced using highly enriched uranium (HEU) targets, which was the major concern of Congress.”<sup>8</sup>

## 2. Imminent Supply Constriction

8 of the world’s 9 major reactors producing medical isotopes are anticipated to shutter in the next 15 years, due to planned retirement after several decades of service.<sup>1</sup>

World’s Largest Nuclear Facilities Manufacturing Isotopes



# Isotopes End-Markets: Green Nuclear Energy

Nuclear Power provides ~10% of global electricity generation<sup>13</sup>

## NUCLEAR FUEL SOURCES

### HIGH ASSAY LOW ENRICHED URANIUM HALEU (15-19.75%)

To reach Net Zero emissions by 2050, the World Must:



**Increase** global electricity generation by **250%** &  
Increase Nuclear Energy output by more than **2x**<sup>13</sup>



**Decrease** fossil fuel Co<sup>2</sup> electricity emissions  
by **100%**<sup>13</sup>

### LOW-ENRICHED URANIUM LEU (5%)



In 2021 nuclear power capacity **declined** by almost 3 GW globally, as newly completed reactors could not compensate for over 8 GW of retirements.<sup>10</sup>

# Leveraging ASP Technology in Green Nuclear Energy

## OUR SOLUTION

1. Enrich LEU (5.0%) + ASP isotopes → HALEU (15-19.75%)



Our Process produces waste with Uranium-235 content at 0.71%.  
**Equivalent to naturally occurring uranium**

## NEXT STEPS

2. Conduct Bench Tests

*Demonstrate the effectiveness of ASP for <sup>235</sup>U enrichment*

3. Complete Partner Discussions

*Find potential partners that may be interested in using ASP technology*

4. Build & Scale

*Deliver ASP technology to address future SMR demands in HALEU*

# Geopolitical Tailwinds for ASPI Green Nuclear Energy

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## Energy Security

- Russia is responsible for 35% of enriched uranium globally<sup>15</sup>
- The United States imports 95% of its uranium and 81% of its enrichment comes from overseas.<sup>16</sup>

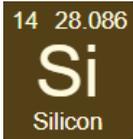


## Increasing Focus on Nuclear Power By Country

- UK plans to build 8 new nuclear power plants to increase nuclear power from 15% to 25% of the mix by 2050.<sup>10</sup>
- France plans to build up to 6 new large reactors. <sup>10</sup>
- India plans to build 10 new large reactors. <sup>10</sup>
- Japan is targeting 20-22% of electricity generation from nuclear by 2030. <sup>11</sup>
- China has 38 operable reactors; 19 are under construction, and the country plans to produce 70 GW of power by 2025<sup>12</sup>
- United States Bipartisan support for nuclear power with billions of dollars of incentives already paid

# Market Opportunities of Other Isotopes

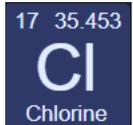
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## For Use in Quantum Computing

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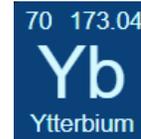
1. Quantum computing requires ultra-pure Silicon-28 Which is not available at any price at commercial scale
2. ASP Intends to conduct further testing to enhance the current capability of enrichment of Si28 up to commercial requirements of > 99.99%



## For Use in Molten Salt Reactors

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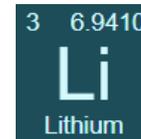
1. Molten Salt Reactors (MSRs) are nuclear reactors that use a fluid fuel in the form of very hot fluoride or chloride salt.
2. Chlorine-37 has been proposed as a potential neutron absorber in specific MSR designs.



## For Use in Oncology

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1. Ytterbium-176 is emerging as a better method of producing Lutetium-177, which is an emerging therapeutic used in Oncology
2. In March of 2022, Novartis's' Pluvicto (<sup>177</sup>Lu vipivotide Tetraxetan) was approved for use in men with PSMA-positive metastatic castration-resistant prostate cancer (mCRPC).<sup>14</sup>



## For Use in Nuclear Fusion

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1. There is an emerging need for lower enriched levels of lithium-6 for nuclear fusion, which is a promising energy source being developed in both the United states and Europe.

# Investment Thesis

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## 1. Proven & Proprietary Technology

ASPI's advanced technology platform leverages 20 years of R&D history to enrich isotopes in varying levels of atomic mass. Its innovative technology will enable the company to manufacture a diverse range of isotopes, which will meet the growing demand in the Nuclear Medicine and Green Nuclear Energy industry.



## 2. Multiple Geopolitical Tailwinds Favor Rapid Expansion

Favorable long-term market trends are expected to drive long-term secular industry growth. Recent geopolitical events have created high urgency for companies and countries to search for reliable sources of isotopes.



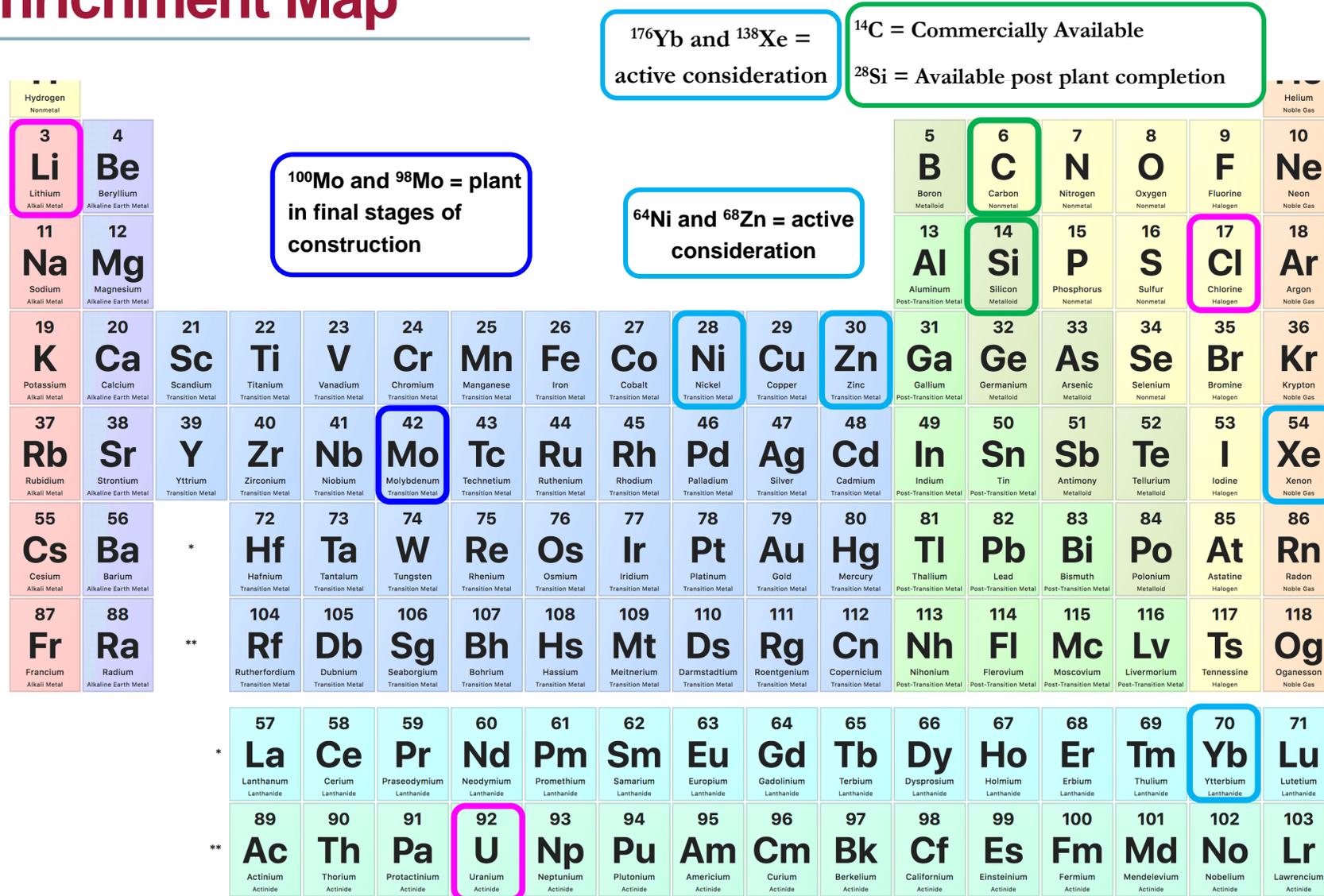
## 3. Consistent Operational Performance

The smaller isotope enrichment plant is getting commissioned. Construction of the Larger isotope enrichment plant is expected to finish in 2H 2023. Both plants are expected to enter commercial production from Late 2023 to early 2024, which should drive considerable free cash flow.

# Supplemental Background Information

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# Isotope Enrichment Map



# Advantages of ASP vs. Competing Technologies

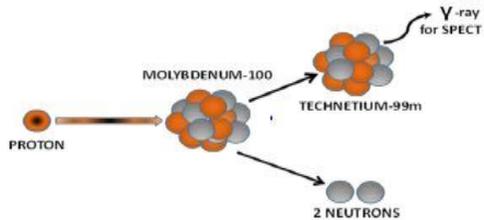
- ASPI has a robust, versatile platform of isotope enrichment technologies – which can offer solutions to the current problems of supply shortage and demand growth.
- ASP enrichment plants are expected to have high-profit margins and high return on invested capital based on long-term customer contracts.

Process	Separation Mechanism	Energy Used for Separation	Energy Intensity, kWh	Capex Cost
Diffusion	Differential Diffusion through porous barriers	Mechanical	2,500	High
Gas Centrifuge	Differential Diffusion	Mechanical	50-240	Very High
SILEX	Photon Induced Migration of Molecules	Photons / Mechanical	500-1,500	Moderate
UCOR	Stationary Wall Centrifuge	Mechanical	>3,000	Moderate
ASP	Stationary Wall Centrifuge	Mechanical	<500	Low

# Tc-99m Production Pathways

- $^{99}\text{Tc}$  can be produced using  $^{100}\text{Mo}$  or  $^{98}\text{Mo}$  either directly or indirectly
- $^{100}\text{Mo}$  and  $^{98}\text{Mo}$  are stable and do not undergo radioactive decay; they can therefore be shipped and stored like traditional products, removing many supply chain issues associated with the current methods of producing Tc-99m

## DIRECT



### Production of $^{99}\text{Tcm}$ from $^{100}\text{Mo}$

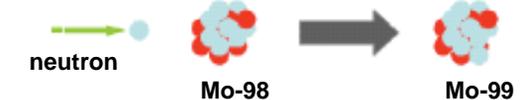
- A cyclotron is used to bombard  $^{100}\text{Mo}$  with a proton.
- Technetium-99m and two neutrons are produced.
- We believe this is a very cost competitive route to  $^{99}\text{Tcm}$  production.
- There are over 250 Cyclotrons globally that are capable of this.

## INDIRECT



### Production of $^{99}\text{Mo}$ from $^{100}\text{Mo}$

- A Linear accelerator is used to bombard  $^{100}\text{Mo}$  with gamma-ray, producing  $^{99}\text{Mo}$ .
- This  $^{99}\text{Mo}$  can then be supplied to customers in an Tc generator
- There are only a few LINACs available worldwide.



### Production of $^{99}\text{Mo}$ from $^{98}\text{Mo}$

- Neutron bombardment of  $^{98}\text{Mo}$  produces  $^{99}\text{Mo}$ .
- This  $^{99}\text{Mo}$  can then be supplied to customers in an Tc generator.
- There are very few companies or entities capable of this process.

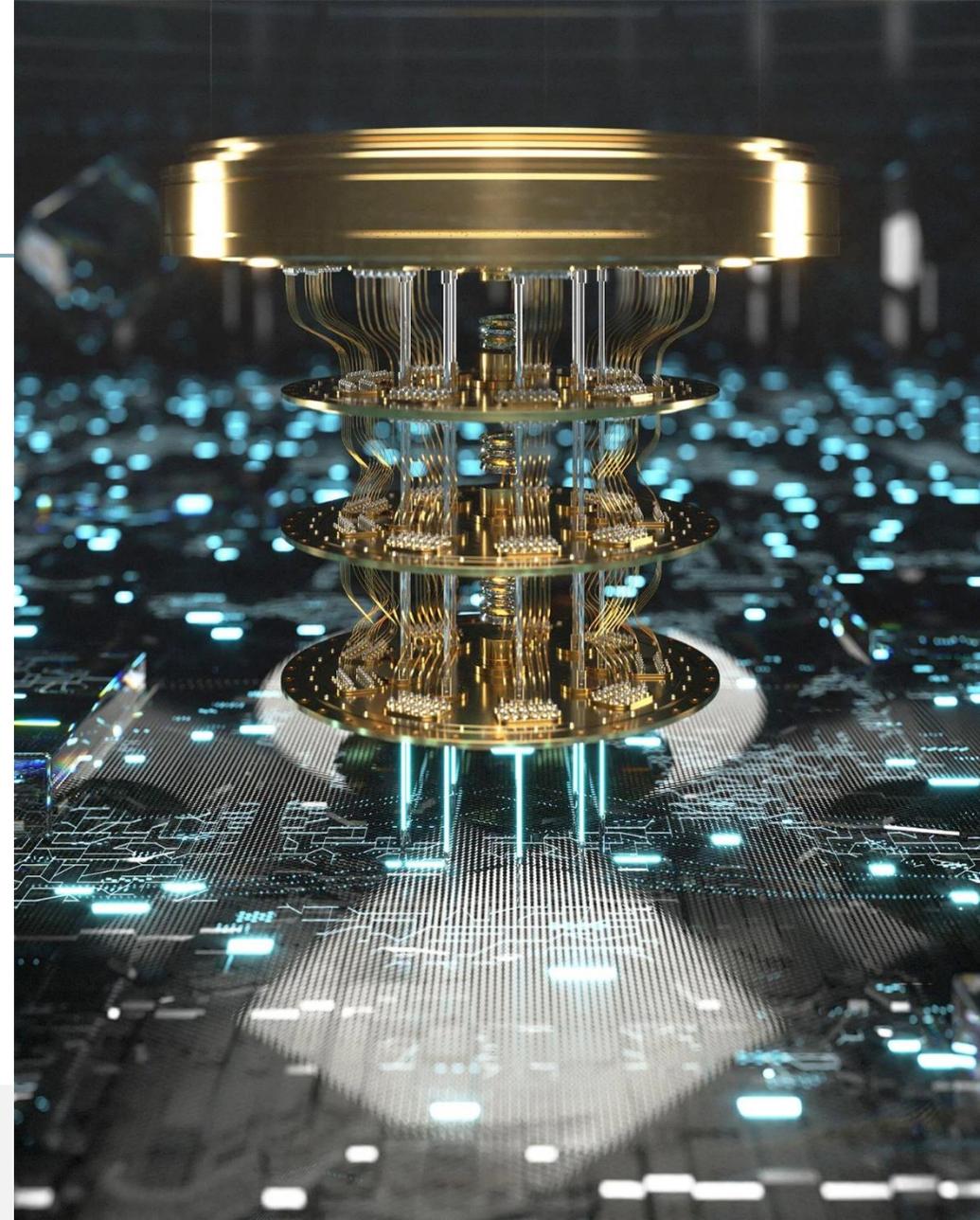
# Silicon-28: Enabling Quantum Computing

Quantum Computers are expected to be 1000x more powerful than today's conventional computers, and widely anticipated that they will create new opportunities in medicine, artificial intelligence, cybersecurity, finance, logistics, and other industries.

For the processing of Qubits, the semiconductor has to be extremely fast. Silicon-29 is a problem in quantum computing because it dominates the breakdown of quantum information, or "decoherence," of the qubits.

- Instead of information being processed in nanometer-scale transistors with binary 'bits' which can have only two states (0 or 1), silicon-based quantum computer processors will utilize atomic-scale quantum spin effects with 'qubits' which can be in multiple superimposed states at the same time, thereby dramatically increasing the processing power in a minuscule fraction of the volume.
- An isotopically pure form of silicon has a thermal conductivity about 60% higher than naturally occurring mono-crystalline silicon. It is believed that isotopically enriched silicon may provide benefits to fiber optics and

**ASPI could purify natural Si mix of isotopes which may allow for higher performance of Si-based chips**

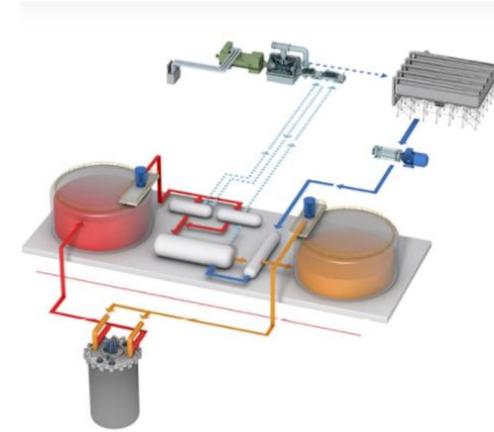


# SMR (Small Modular Reactors) = Next Wave in Nuclear Energy

## The world is moving to a new type of nuclear reactor: SMR

- Modular, smaller size (50 MWe to 300 MWe) reactors allowing greater flexibility in deployment
- Designed for production-line manufacturing rather than conventional custom built capital projects
- Limited on-site preparation to substantially reduce lengthy construction times
- Simplicity of design, enhanced safety features, economics and quality afforded by factory production, and more flexibility (financing, siting, sizing, and end-use applications)
- Can provide power for applications where large plants are not needed or sites lack infrastructure to support a large unit (e.g., smaller electrical markets, isolated areas, smaller grids, sites with limited water and acreage, or unique industrial applications)
- US DOE has already committed billions of dollars to Advanced Reactor Design Program (ARDP) to facilitate and accelerate development of advanced reactors

TerraPower's Natrium



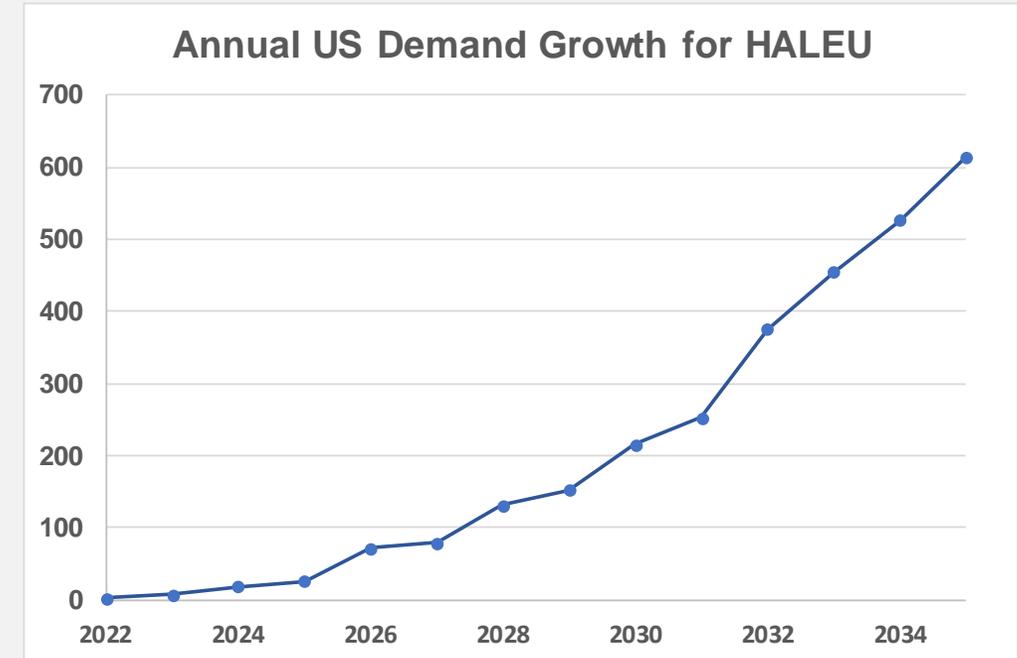
X-Energy's Xe-100



Rolls-Royce's SMR

# HALEU Supply Issue Looming for SMR Reality

- Current commercial LWRs use low-enriched uranium (LEU) which has less than 5%  $^{235}\text{U}$  content.
- Many SMRs and advanced reactors will require High Assay Low Enriched Uranium (HALEU) with  $^{235}\text{U}$  enrichment up to 19.75%.
- Currently, there is no commercial source of the supply of HALEU in the Western World. Without fuel, these SMR's are unlikely to become a reality.



- The U.S. government has made a multi-billion-dollar commitment to help commercialize HALEU-fueled advanced reactors. Inflation Reduction Act passed August 2022 - supporting nuclear power generation and domestic nuclear fuel supply including \$700 Million funding for the DOE's HALEU Availability Program.
- The NEI estimates (below) that by 2035 US domestic demand for HALEU could reach >600 Metric Tons.

# Data Sources

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