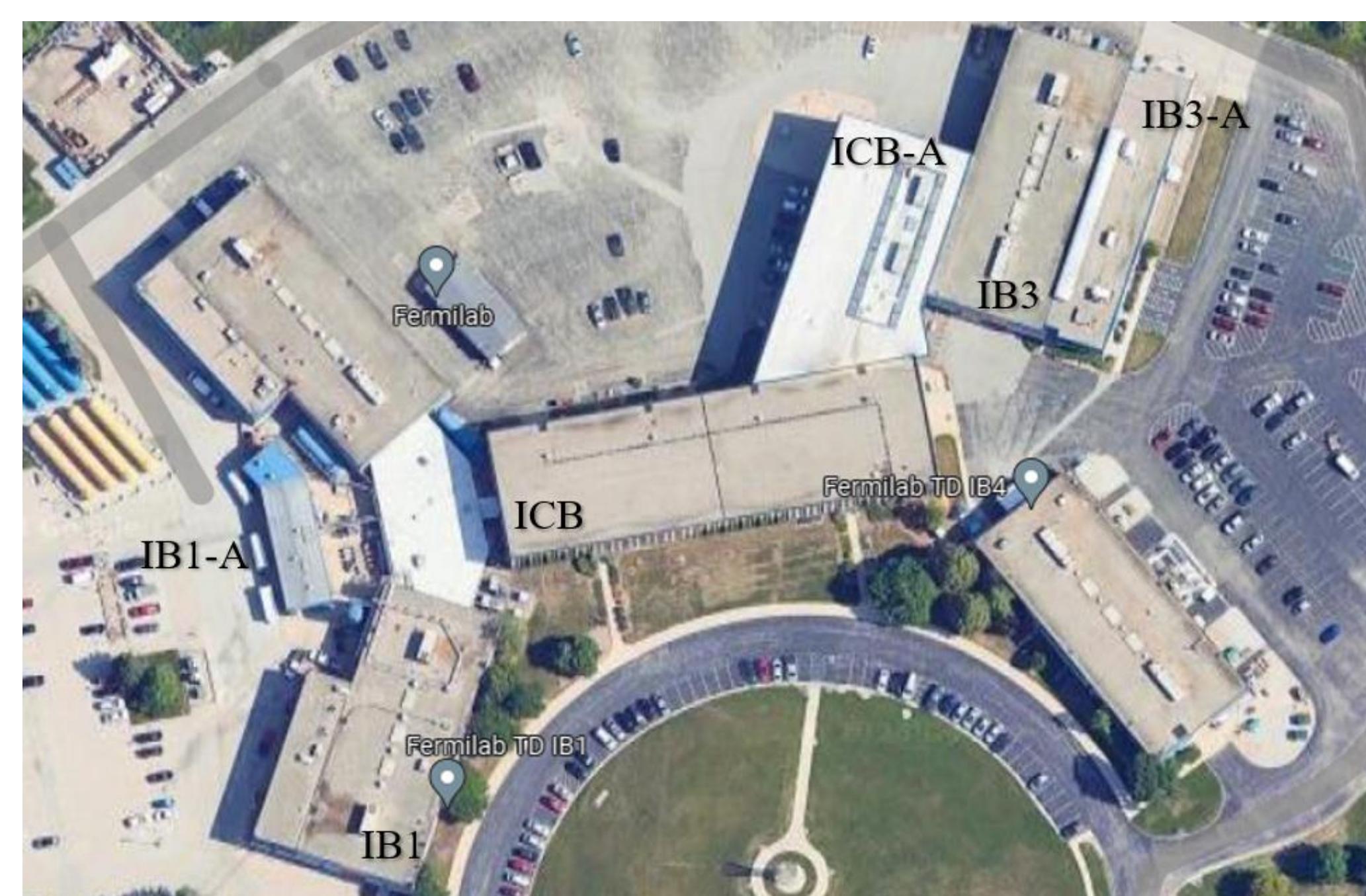


IB3A Helium Recovery System

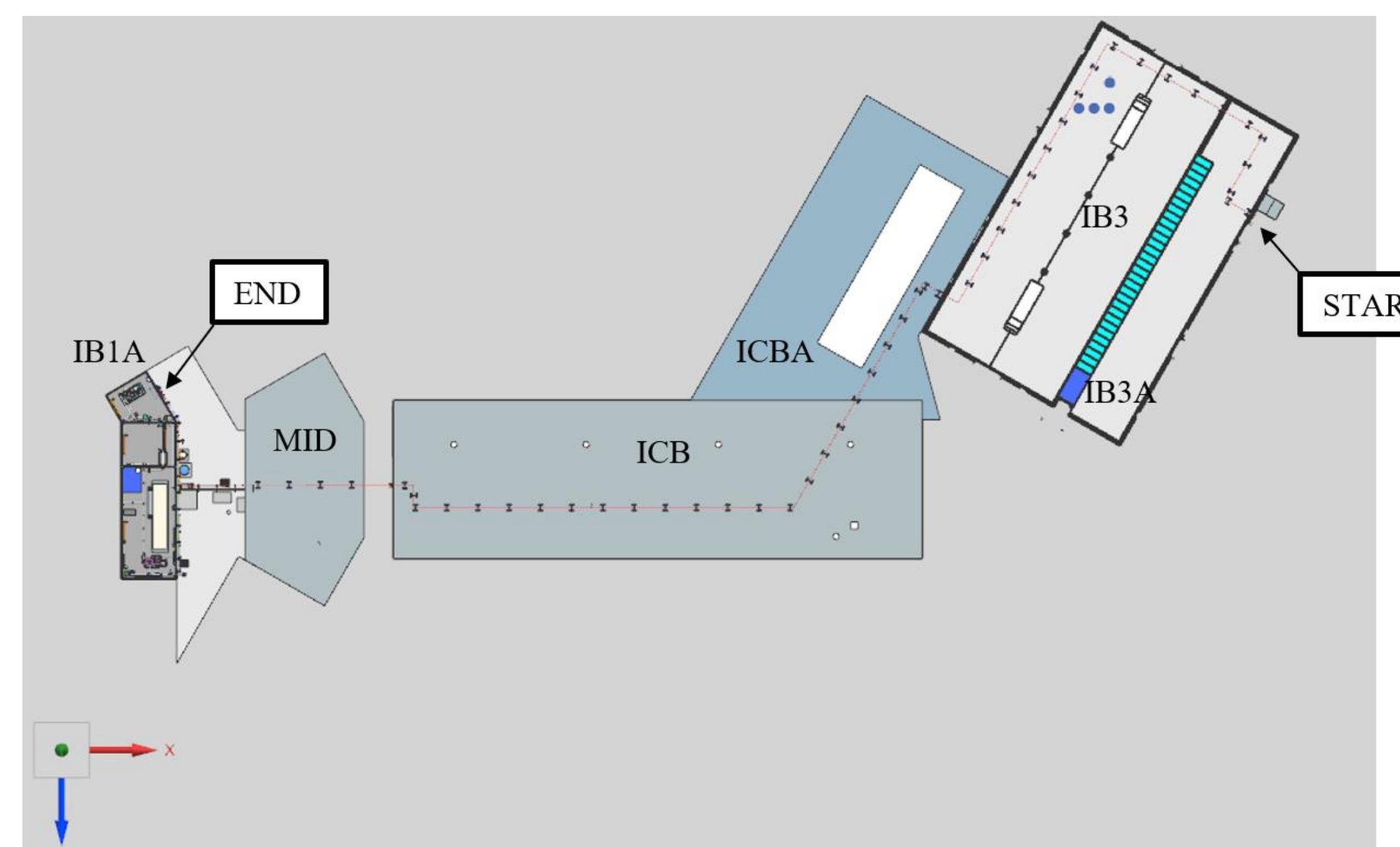
Dominika Porwisiak, Benjamin Hansen, Michael J White, APS/TD Cryo

Background

The need for the optimal and sustainable use of cryogenic resources in fulfilling Fermilab's science mission necessitated assessment of the Laboratory's test facilities that utilize helium cryogenics. The assessment has shown a clear and immediate need to upgrade the Technical Division's Industrial Building 3a (IB3A) with a helium recovery system. The IB3A cryogenic test facility is used to characterize and test superconductors, cables, and coils for R&D and various projects, such as the US High-Luminosity LHC Accelerator Upgrade (AUP), the Mu2e projects, and other external requests. The facility currently utilizes 500 L Helium Dewars and vents the vaporized helium to atmosphere. The annual consumption of helium at IB3A is presented in Table 1. Helium is a non-renewable resource and therefore conserving and recovering the gas for reuse is a high priority to ensure the long-term sustainability of Lab's science mission.



Industrial buildings complex – top view

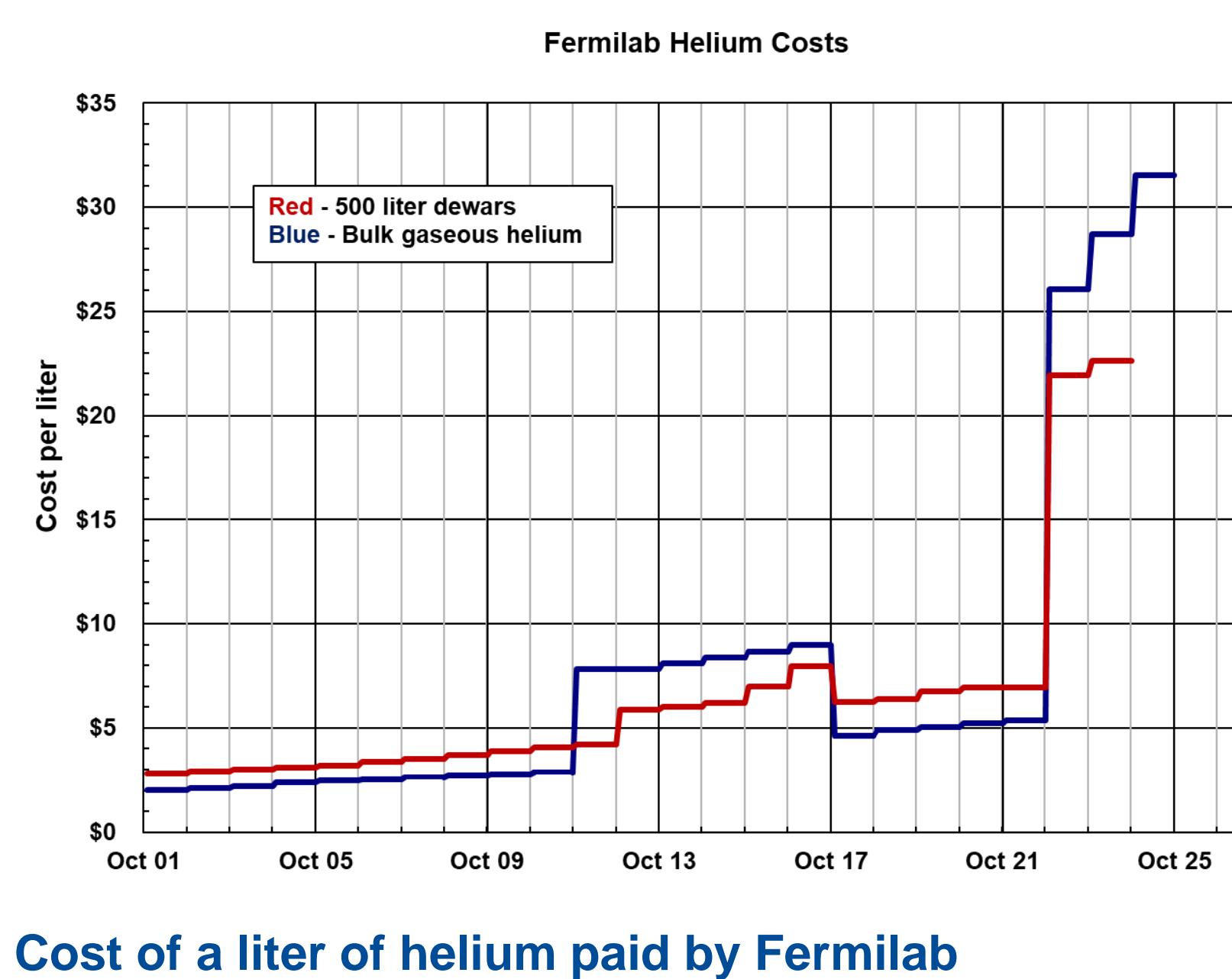


Overview of new piping at Industrial Buildings Complex for helium recovery.

Benefits of helium recovery

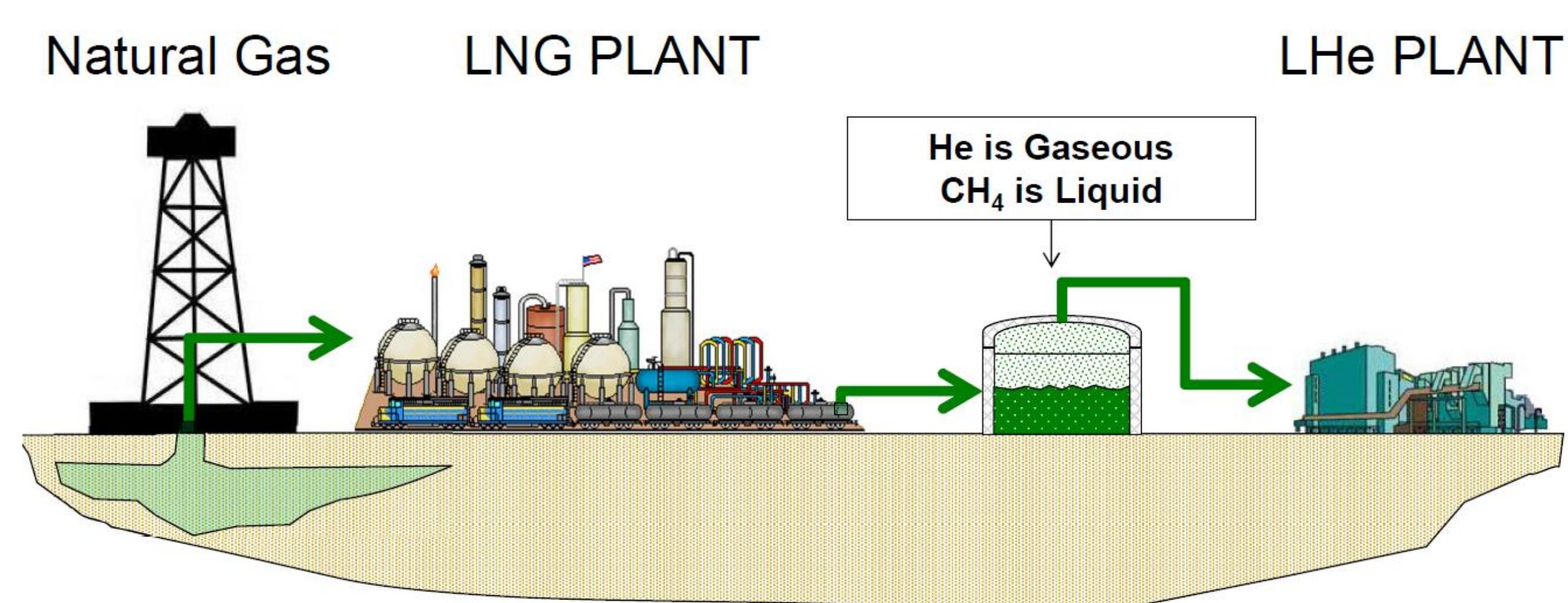
Helium, a byproduct of the decay of heavy elements within the Earth's crust, undergoes a process that spans hundreds of years, marking it as a non-renewable resource. Not being gravitationally bound to Earth, helium escapes into space. Often referred to as **gaseous gold**, helium saw its price triple in 2022, exceeding \$23 per liter, with no viable alternatives available.

- Cost savings** – Helium recovery systems allow for the reuse of this gas, significantly reducing the operational costs associated with its purchase.
- Environmental protection** – Since helium is a limited resource, its recovery and reuse help conserve this natural asset.
- Enhanced reliability and safety** – Recovery system will reduce the risk of helium shortages at IB1A and will help ensure operational continuity.



1L of He-4 → \$23
1L of He-3 → \$2,750

The lab consumes
~80,000 L/yr (\$1.8M)



Helium production process

Project objectives

- GHe capture** from 4 Teslatron cryostats at IB3a Laboratory. Helium will be transported to IB1 purifier compressor suction.
- Reuse** of recovered helium at IB1
- Saving costs** associated with buying helium for IB1 operations.

Table 1. IB3A helium consumption

Fiscal Year	Helium Consumed	Cost
[-]	[L]	[\$k]
FY23	7,500	\$135
FY22	17,956	\$125
FY21	46,763	\$325
FY20	25,185	\$170
FY19	33,438	\$213

Proposed solution of the problem

Helium from IB3A will be recovered through roof piping which will connect IB3A Teslatron cryostats with IB1A purifier compressor suction. The system will require minimal operational input. Helium will be reliquefied at IB1A facility and used for the purposes IB1A tests. Table 2. presents project milestones schedule.

Table 2. Project milestones schedule

IB-3a Recovery System Milestones	Date
Start Project	August 2023
Final Design Complete	February 2024
Installation Contract PO Awarded	June 2024
Installation Complete	October 2024
Safety ORC Received	November 2024
Commissioning Complete	January 2025

Current works

- Roof piping purchase process** – Roof piping was designed and will be purchased by competitive bid
- IB3A interface design** – determining the layout of piping connecting to the roof piping
- Materials purchase process** – Buying all hardware needed to assemble roof piping