

24 August 2023

Pearling in the North Rukwa Basin

NEED TO KNOW

- NHE is about to drill two exploration wells in Tanzania’s North Rukwa basin targeting 15.7 Bcf of prospective Helium resource.
- These wells will inform the basins’ potential with multiple on-trend leads dubbed a “String of Pearls”.
- Helium markets are tight, prices are rising, and there is a need for more supply.

NHE’s North Rukwa Basin acreage has independently certified, prospective helium resources of 175 Bcf which is world scale. Naturally occurring Helium requires unique geology, which exists in the North Rukwa Basin where Helium is detected at surface in world-high concentrations.

Two wells on the Mbebele prospect are imminent. These wells target a combined 15.7 Bcf of Helium. If successful, this could be company making and inform follow-on activity on multiple leads on-trend in similar geological settings. These follow-on leads are the so-called “String of Pearls”.

Helium demand is robust driven by high-tech industries, but supply is from unreliable sources and prices are trending higher. The economic case if NHE finds commercial volumes of helium is compelling.

Investment Thesis

The Helium market is tightening, and whole-sale prices are in an uptrend. Helium is a critical input to high-tech industries but 95% of supply comes a by-product of petroleum production and ~60% is from Russia & the Middle East.

Catalysts to drive a re-rating in the near term are the two Mbebele exploration wells, to be drilled in Q3 CY2023. These aim to confirm the geology and if results are positive unlocks numerous other prospects for future drilling with substantial valuation implications to the upside.

A future commercial project is valued at ~A\$3.40/share on an un-risked basis. Our base-case valuation is heavily risked given the uncertainties ahead, however the analysis demonstrates substantial upside in the event of success.

Valuation: A\$0.79 (Previously A\$0.67)

MST’s valuation is based on a risked assessed cash flow from a potential Mbebele Helium project, combined with peer group market valuations for undrilled prospects. The valuation increase is from NHE retaining 100% of the project, increases in Mbebele resource estimates and equity issuance.

Risks

Exploration success is critical, and failure will materially reduce value. NHE will require funding after the current exploration phase which may not be available. The Helium market is small, and prices are volatile. There is country risk in Tanzania.

Equities Research Australia

Energy

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Noble Helium Limited (ASX:NHE) is an exploration company focused on discovery and development of naturally occurring Helium in the Tanzania. The size of the prospective resource, which has been independently certified, would be transformational for Noble in the success case

<https://noblehelium.com.au>

Valuation	A\$0.79 (previously \$0.67)
Current price	A\$0.20
Market cap	A\$72M
Cash on hand	A\$12M (Current est.)

Upcoming Catalysts / Next News

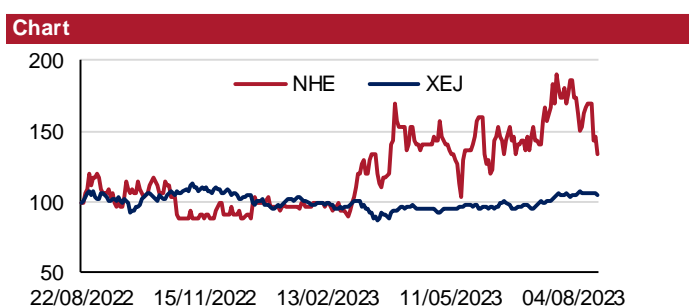
Period

Q3 CY23	2-well drilling program commences
Q3 CY23	Exploration results from 2x Mbebele wells



Figure 1: Financial summary

Market Data	Y/E Jun 30	A\$	Lo	Hi
Share price	A\$/sh	0.2		
52 week range	A\$/sh		0.14	0.29
Shares on issue	M	358.826		
Perf shrs + Options	M	0		
Market Cap	A\$M	72		
Net Cash	A\$M	12		
Enterprise Value	A\$M	60		



Valuation multiples	2021A	2022A	2023	2024	2025
EPS (us cents)	0.00	0.00	0.00	0.000	0.000
PE	-	-	-	-	-
DPS	-	-	-	-	-
Yield-%	-	-	-	-	-
EBITDAX/sh (US cents)	-	-	-	-	-
P/FCF	-	-	-	-	-
EV/EBITDAX	-	-	-	-	-
EV/(2P+2C)- A\$/ GJ	-	1.5	-	-	-
Revenue/MM boe	-	-	-	-	-
EBITDAX/Sales-%	-	-	-	-	-
Net cash (US\$M)	0.0	8.5	4.1	0.9	8.7
ND/(ND+E)	-	-	-	-	-

Realised prices	2021A	2022A	2023	2024	2025
Gas- A\$/ GJ	na	na	na	na	na
Oil-US\$/bbl	54.05	83.37	77.31	75.23	76.67
A\$/US\$ rate	0.73	0.7	0.7	0.7	0.7
Helium- US\$/mcf					450

Production (Net)	2021A	2022A	2023	2024	2025
Gas- Bcf	0.00	0.00	0.00	0.00	0.00
Liquids (MMbbl)	0.00	0.00	0.00	0.00	0.00
Helium	0.0	0.0	0.0	0.0	0.0

Prosp. Resource (Bc)	Low	Best	High	Mean
Helium (100% basis)				
Mbele (100%)	1.8	8.2	36.8	15.7
Pegere (100%)	1.8	6.2	9.1	8.4
Kachinga-Dagaa	4.5	17.0	59.6	22.5
Chilichili	1.0	5.4	24.4	10.5
Kambale	1.9	10.9	48.6	20.7

Valuation-A\$	Bcf	A\$/mcf	Risk	Value
Mbelele Dev	15.7	13.69	15%	215
Other	160.0	0.40		64
Total Helium assets				279
Cash (June 30y, 2023)				4
Q3 Cash increase				12
Q3 Drilling payables				-12
Total equity value				283
Shares				359
Value Per share				0.79

Income statement	2021A	2022A	2023	2024	2025
Gas Revenue	0.0	0.0	0.0	0.0	0.0
Oil Revenue	0.0	0.0	0.0	0.0	0.0
Total sales	0.0	0.0	0.0	0.0	0.0
Sales Revenue	0.0	0.0	0.0	0.0	0.0
Opex	0.0	0.0	0.0	0.0	0.0
Royalties	0.0	0.0	0.0	0.0	0.0
G&A	0.2	2.7	2.0	2.0	2.0
EBITDAX	-0.2	-2.7	-1.9	-2.0	-2.0
Exploration exp.	0.0	0.0	0.0	0.0	0.0
Depreciation	0.0	0.0	0.1	0.1	0.1
EBIT u/l	-0.2	-2.7	-2.0	-2.1	-2.1
Finance charges	0.0	0.0	0.0	0.0	0.0
Tax	0.0	0.0	0.0	0.0	0.0
NPAT-underlying	-0.17	-2.7	-2.0	-2.1	-2.1
Significant items	0.0	0.0	-0.2	0.0	0.0
Reported NPAT	-0.2	-2.8	-2.2	-2.1	-2.1
Share count at EOP (M)		224	224	224	224

Cash flow	2021A	2022A	2023	2024	2025
Receipts	0.0	0.0	0.0	0.0	0.0
Payments	-0.1	-1.4	-1.9	-2.5	-2.0
Payments for E&A	0.0	0.0	0.0	0.0	0.0
Interest & other	0.0	0.0	0.0	0.0	0.0
Net cash from ops.	-0.1	-1.4	-1.9	-2.5	-2.0
Exp & Devb capex	-0.1	-1.6	-14.0	-12.2	-0.2
Acquisitions / other	0.0	0.0	0.0	0.0	0.0
Net investing	-0.1	-1.6	-14.0	-12.2	-0.2
Equity issuance	0.0	11.3	12.9	11.5	10.0
Debt Issue	0.0	0.0	0.0	0.0	0.0
Divs / other	0.0	0.0	0.0	0.0	0.0
Net cash Financing	0.0	11.5	12.9	11.5	10.0
Increase in cash	-0.2	8.4	-4.4	-3.2	7.8
Cash at EOP	4.1	8.5	4.1	0.9	8.7

Balance sheet	2021A	2022A	2023	2024	2025
Cash	0.0	8.5	4.1	0.9	8.7
Rcvbils / Inventory	0.0	0.4	1.0	9.0	11.0
P, P & E	0.3	1.6	9.2	9.4	9.6
Exploration & eval	0.0	0.3	6.9	18.8	18.7
other	0.3	0.0	0.0	0.0	0.0
Total Assets	0.6	10.8	21.2	38.1	48.0
Payables	0.0	0.2	0.8	0.8	0.8
Debt	0.0	0.0	0.0	0.0	0.0
Other	0.0	0.0	0.0	7.0	9.0
Total liabilities	0.0	0.2	0.8	7.8	9.8
Total equity	0.6	10.5	20.4	30.2	38.2

Source: MST Access

North Rukwa Basin and the string of Pearls

The North Rukwa project lies within the East African Risk System (EARS) in Tanzania and has the potential to host the world's largest naturally occurring helium resource. The geology is unique to capture naturally occurring helium, which has been measured in surface seeps and waters in world-high concentrations. NHE are about to drill two vertical wells to discover if the "basin margin fault closure" (BMFC) geological model that has been successful elsewhere in the EARS, is trapping helium in sub-surface reservoirs in the North Rukwa Basin.

A drilling rig is enroute from the UK to drill two wells, at Mbelele#1 and Mbelele#2. The Mbelele prospect is interpreted to contain 15.7 Bcf of Helium (unrisked recoverable, mean estimate). To put this figure in context, its approximately 2.5X current world demand and if successful would transform NHE.

Near term catalysts: Mbelele drilling- 2 wells.

In the past few months, NHE has been very active:

- A Master Service Agreement has been executed with SLB (formerly known as Schlumberger Inc.) for well data services.
- A drilling rig has been contracted for two wells and is enroute from the UK.
- Approximately \$25M has been raised over the past 12 months to fully fund the upcoming drilling.

Naturally occurring helium requires a unique combination of geological parameters, which are present in the North Rukwa Basin. This is evidenced by geochemical and geological field work, where helium has been detected in concentrations up to 17% in hot springs and seeps, and these are the highest recorded at surface in the world. All the leads and prospects have been defined from surface sampling, and 2D and 3D-seismic surveying and extensive geo-technical modelling.

Prospective resources are indicated in Figure 2 and are documented in NHE ASX announcements with the most recent 27 July 2023.

Figure 2: Mbelele prospect & other leads

Lead / Prospect	Unrisked Gross Prospective Helium volume (Bcf)			
	Low	Best	High	Mean
Mbelele-Neogene reservoirs	1.8	8.2	36.8	15.7
Peger	1.8	6.2	9.1	8.4
Kachina-Dagaa	4.5	17	59.6	22.5
Chilichili	1	5.4	24.4	10.5
Kambale	1.9	10.9	20.7	20.7

Source: Compiled by MST, from information in NHE's ASX market announcement dated 27 July 2023. .

The "String of Pearls" concept.

If the Mbelele wells are successful, it would lead to an upgrade of multiple BMFC prospects along the North Rukwa western margin for potential future drilling. These are so-called "String of Pearls". NHE has documented in various disclosures, as many as 10 prospects which are seismically defined and are geologically similar to the Mbelele targets. The total resource in four key prospects is documented in Figure 2, sourced from NHE's ASX release dated 27 July 2023 and shows a prospective resource of 62 Bcf (unrisked summed mean recoverable resources).

Value upside from success is very large, as are the risks.

NHE has spent seven years maturing this project and leverages considerable in-house experience in successful oil and gas exploration elsewhere in the EARS. There is science and data to support the campaign, but exploration is risky and negative results at this location would impact our valuation and drive a re-evaluation of the geological model. Exploration often requires multiple wells in order understand the geology. If so then NHE will need additional capital to continue activity beyond the imminent 2-well program

The upside in the event of exploration success is huge and justifies the investment and inherent risk in our view. A future helium project based solely of Mbelele would be worth ~\$3.4/sh. Negative exploration results would drive a material derating and leave the company with insufficient funds to continue follow-on activity.

Assets: World scale Helium in Tanzania

NHE is an exploration phase company, with 5400 km² of acreage, assembled since 2017 and which is prospective for naturally occurring helium. Figures 3 & 4 show the areas of interest. It has four project areas, in various regions of Tanzania along the “East African Rift System” (EARS). This is an extensive and prolific petroleum system extending for 5000km through many east African nations. The prospects for helium are backed by extensive surface samples, and in hot springs where Helium concentrations are commonly >10%, and as high as 17%. These are among the highest recorded globally.

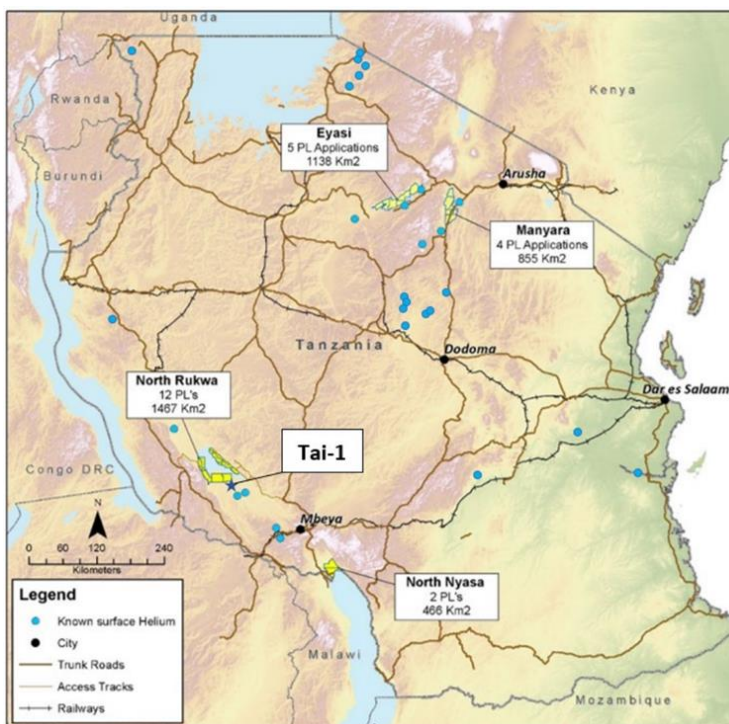
NHE’s acreage, specifically the North Rukwa licenses, have independently assessed resource potential from NSAI of 175 Bcf (100% basis, un-risked prospective mean resource). This would be enough to supply the world for ~30 years.

The two Mbelele wells are to be drilled in Q3 2023 and are targeting a combined resource of 15.7 Bcf of helium (un-risked summed mean prospective resource estimate). To put this figure into perspective, it is 2.5X current annual demand which was 6.2 Bcf in 2022. Proving this would be transformational for NHE and would re-shape the global helium market. NHE’s working interest in these prospects is 100%.

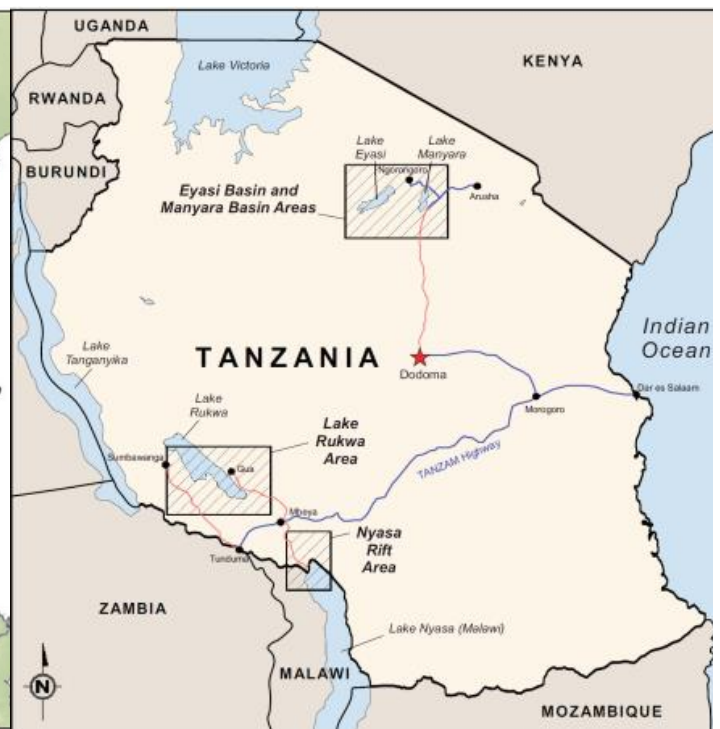
This is an exploration frontier and only one well has been drilled in this basin in modern times for Helium by another company (AIM listed Helium One) however that well did not target geological settings that are generally successful along the EARS trend.

Figure 3: Location of focus areas

Figure 4: Location of permits areas in Tanzania



Source: NHE Prospectus



Source: NHE prospectus

There are four core project areas:

- The North Rukwa Basin project, encompassing 2941 km² in SW Tanzania, and is bounded by the shores of Lake Rukwa.
- The North Nyasa Basin project, covering 466Km² in the SW of the country.
- The Eyasi Basin project with an area of 1138 Km² in north-central Tanzania.
- The Manyara Basin project, covering 854 Km² of acreage in north Central Tanzania.

Over the outlook NHE is prioritising its capital and focus at North Rukwa, due to previous conventional oil and gas exploration, encouraging pre-drilling geological studies, and seismic surveys to define the sub-surface structures, compared to the other project areas which have no previous drilling history.

In this report, we focus on the immediate North Rukwa activity due to its relevance and significance to the investment thesis.

North Rukwa Project background

The company has a licenced landholding of 1467km² in the Rukwa Basin and has benefited from legacy oil and gas exploration data to complement and accelerate its exploration activities.

The basin's resource potential has been independently certified by NSAI to contain 176 Bcf of helium (gross, summed unrisks mean prospect resource). NHE has spent 7 years pinpointing prospective drilling locations, supported by extensive surface sampling, and 2D and 3D seismic surveying. The leads and prospects are documented in the April 2022 Prospectus. Updated estimates for specific leads have been documented to the ASX on 27 July 2023, following ongoing seismic interpretation.

Previous exploration and the rationale for drilling.

Two wells drilled by Amoco in 1987 for conventional oil and gas on the EARS, defined the main stratigraphic sequence in the Rukwa basin.

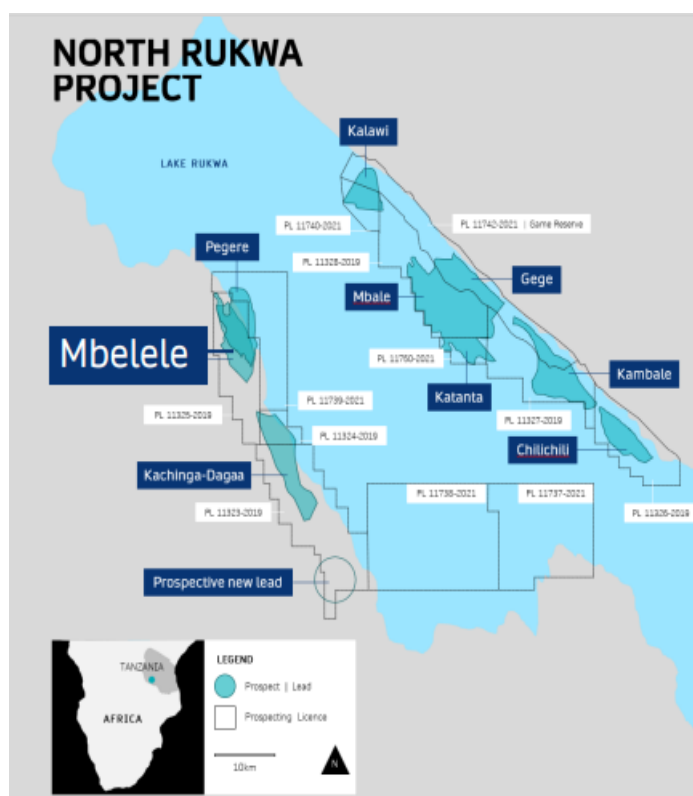
Further north in the EARS, over the border in Uganda and Kenya, numerous conventional oil and gas discoveries oil have been made in the past decade, helping to define geological understanding, in particular the mechanisms to trap sub-surface gases. Exploration success rates along the EARS since 2012 has proved to be highly successful for conventional oil and gas, and key NHE senior management helped pioneer those discoveries.

Surface sampling from seeps and hot springs since 2017, shows Helium present in concentrations up to 17%, and while globally high, may not represent helium concentration in subsurface reservoirs which may include other gases not detected at surface.

In South Africa, Renegen Ltd (ASX: RLT) is producing naturally occurring helium along with methane, at helium concentrations ~3%, which is high compared to USA and Canadian producers which report helium concentrations in the range 0.1-1%, with ~0.3% viewed as economic cut-off.

Figure 5: North Rukwa Project area.

Figure 6: Marriott Drilling rig#16.



Source: NHE ASX Presentation, 18 August 2023

Source: NHE ASX Presentation 18 August 2023

Drilling coming up on two wells: Q3 2023

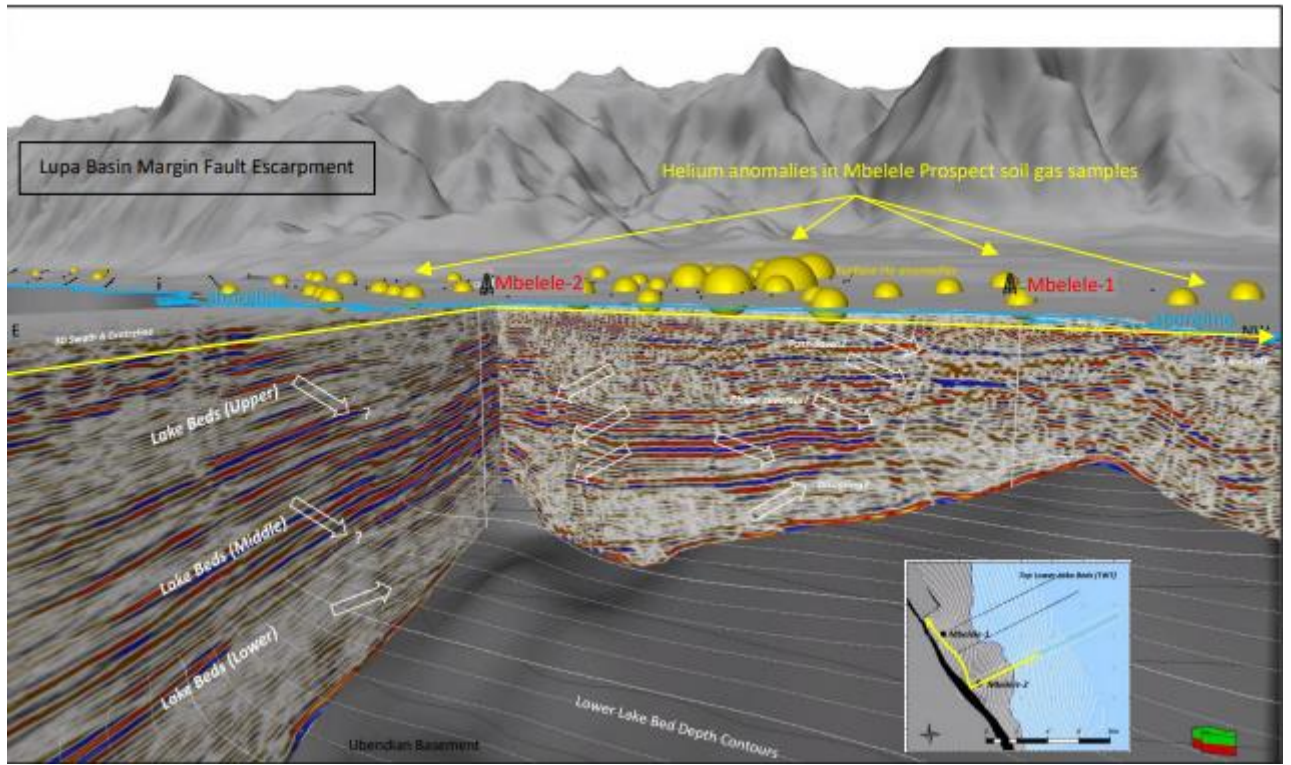
Marriott Rig#16 (Figure 6) is enroute from the UK and expected to begin drilling in later September.

The first well Mbelele#1 will be drilled to a depth of 500m to target Upper, Middle and Lower Lake Bed formations, which are seismically defined. Mbelele#2 is planned 4 km to the south, to drill to 850m to appraise the same reservoir sequence approximately 100m down-dip.

Drilling follows a comprehensive de-risking program including soil gas surveys, reservoir and seal studies, airborne gravity gradiometric, 2D and 3D seismic surveys and the latest helium charge theories. Surface sampling of helium in seeps and springs shows concentrations which are world-highs.

What remains to be determined from the Mbebele wells is the effectiveness of trapping helium in the sub-surface reservoirs.

Figure 7: Mbebele prospects.



Source: Noble Helium

Valuation: A\$0.79 (Previously A\$0.67)

MST's valuation has increased for the following reasons (1) Increased prospective resource estimate at the Mbebele prospect (2) Assumption that NHE retains 100% working interest in the resources as compared to our previous expectation of 50% post a farm-out, offset by (3) expansion in share count from 223M shares to 358M following a series of capital raising and (4) re-assessment of cash levels post the drilling phase. We assume the \$12M capital raising completed on August 18 is fully expended. Refer to figure 8.

Our principal valuation tool is a DCF of expected future cash-flows from a proposed commercial helium development, in the event the helium resource is proven, at the Mbebele location, appropriately risked for exploration and development risk.

We have developed project cashflow forecasts and there are many scenarios depending upon input factors, with the key ones and our assumptions outlined as followed:

- Helium prices ex-field. We have reviewed several public company corporate presentations for pricing guidance. Figures indicated by NHE and Helium One are perhaps the most relevant and are in the range US\$350-450/Mcf. We choose US\$450 as a base case.
- Capital costs. We have reviewed a sample of projects in the USA where small projects of <0.1 Bcf p.a. can be erected for US\$40-60M. Helium One discloses US\$50M for a modular plant in Tanzania and NHE's discloses US\$305M (gross), for a large scale plant. We adopt this latter figure.
- Opex costs. We have reviewed a sample of projects that disclose annual per-unit opex in the range US\$15-40/mcf. NHE disclose US\$20/mcf, and we adopt this figure.
- Timing of start-up: We assume at the earliest, 2026.
- Project capacity. Helium plants are typically modular, so production rates come in blocks. We assume an 850,000 mcf p.a. project, as indicated in NHE's presentational material, however this is a large scale plant and in reality development would likely be staged over many years in smaller units, to dove-tail with demand.
- Financing. NHE would need to fund project capex beyond the size of the current balance sheet. We make no assumptions as to the funding mechanisms.
- We assume Tanzania fiscal terms of a 16% carry, 4% royalty +export levy, and 30% corporate tax.
- Cash-flows are discounted at a post-tax WACC of 12%.
- The US\$ per-share valuation is converted to A\$/share at a spot rate of 67c.

Cash-flow Model results

Our preliminary modelling for a helium project to exploit the Mbebele resource returns annual project cash-flow of ~US\$240M after taxes and royalties, and a project NPV of US\$960M, and returns an IRR of 55%.

These model outcomes are un-risked, and don't account for the numerous variable factors such as helium price, development costs, operating costs, financing costs and timing that could drive the figure lower, or higher.

The upside is large but there is a lot of de-risking to occur first.

Our un-risked value of a future project equates amounts to ~\$3.60 per share, which demonstrates the leverage in the event of success, however, this is an un-risked figure and does not take into consideration dilution that is likely as NHE forms the capital base to move into a development, as well as numerous commercial, financial, engineering and geological risks that exist at this time.

Our base case valuation shown in Figure 8, applies a 15% risk factor to project NPV, which we think is realistic ahead of an exploration program, where probabilities of geological success (PoG) are typically in the order of 10-20%. Further, we note the NSAI resources detailed in the prospectus are un-risked, and PoG are listed in the 10-16% range.

If NHE is successful, de-risking will drive our base-case valuation higher. These events could be:

- Exploration & appraisal results, and conversion of prospective resources to reserves.
- Progress on commercial studies to confirm key engineering and capital costs, usually from the introduction to the project of specialist plant engineering companies or other partners.
- Clarification of funding to de-risk a construction phase.
- Confirmation off helium offtake agreements.

Figure 8: SoP Valuation

Asset Value (A\$M)	Risk	Volume-PJ (Mean)	\$/mcf	A\$M	Basis
North Rukw a Basin					
Initial development - Mbebele	15%	15.7	13.7	215	DCF Risked at PoG
Other prospects		160	0.4	64	
Total Helium assets				279	
Cash				4	At June 30, 2023
Capital inflow 18 August 2023				12	Proforma before costs
Drilling payables- 3Q 2023				-12	Drilling budget
Total equity value				283	
Shares on issue				358.826	
Value Per share				0.79	

Source: MST Access.

Secondary measures: equity market valuations

There are several pure-play Helium companies listed in Australia, the UK, USA and Canada and we list them in figure 9. These companies are all in the exploration phase, or pre-development phase. Some publicise their prospective resources for helium, but not included in this is the proportion of valuable other products, if any, such as methane or food-grade CO₂. Simple arithmetic on the market value of resources in-the-ground generates a very wide range of figures. We adopt a volume weighted A\$0.40/mcf for prospects and apply this to NHE's total prospect inventory.

Figure 9: Peer group EV/mcf of Helium (A\$/mcf)

Company	Location	EV (A\$M)	2U (Bcf) (He)	EV/2U A\$/Mcf	EV/2U -Total Mol. A\$/Mcf
Noble Helium -Ex Mbebele	Tanzania	65	160	0.41	0.41
Blue Star	USA	37	13.4	2.79	2.79
Regergen	South Africa	287	32	8.96	0.29
Grand Gulf	USA	16	13	1.17	1.17
Helium One	Tanzania	97	138	0.70	0.70
Desert Mountain Energy	USA	29	2	14.50	14.50
Avanti Energy	Canada	47	1.4	33.38	0.33
Royal Helium	Canada	79	2	39.34	0.43
First Helium	Canada	13	0.6	21.92	1.00
Total		670	363		0.402
Excluding NHE		604	203	2.98	0.401
Median					0.70

Source: MST Access, assembled from individual company reports and investor presentational material. EV's as at EOT, May 5, 2023.

Risk Factors

There are several risks in our opinion, including but not limited to:

- **Exploration and geology.** NHE's acreage has very little historical well data, and the geological understanding to now is derived from surface samples, aeromagnetic and gravity surveys, and interpretation of 2D and seismic surveys, as well as two "conventional" oil and gas wells drilled in the 1980's. Drilling, and the application of the latest well-data measurement and interpretation tools is required to confirm the geology and presence of helium in sub-surface traps.
- **Helium prices.** The Helium market is small, and over the past 10 years there have been periods of oversupply and under supply and volatile prices. Prices currently at record highs, and there is significant downside risk if the spate of new entrants, including NHE, find too much Helium and glut the market.
- **Sovereign risk.** Tanzania is a developing nation and previous administrations have not been as open to foreign investment and mining as the current. Fiscal terms could change.
- **Economics.** Compared to the USA or Canada, mobilising equipment and operating in Tanzania is higher cost. There are not many established oil and gas service providers, the inland is remote and well costs, process plant capital costs, and operating costs are likely to be higher than those in North America.
- **Capital availability.** NHE is a small company, does not have an income stream and will need ongoing support from equity investors and joint venture partners for continuity of operations through the exploration phase. External funding may be difficult and / or expensive to source.
- **Operational risk.** NHE has not previously developed a helium project and has no historical operational experience.

Background geology: unique but understood

The EARS and its sedimentary basins extend 5000 Km from Ethiopia to Mozambique.

Seismic and wells along the EARS have identified numerous thick sedimentary sequences within the EARS basins of Tanzania, which are overlying and abutting 2–3-billion-year-old crystalline basement rocks. Refer to figure 10. These basement rocks are rich in radioactive elements which have generated and stored vast amounts of helium through radioactive decay over 2 billion years.

Through the active rifting and heating of the globally unique EARS, this large inventory of stored helium is being released from basement and into overlying sediments at high rate. Sealing rocks where present, may provide the necessary trap to retain the helium in underground layers for commercial production, just like conventional petroleum gas which has been discovered to the north in EARS basins of Uganda and Kenya.

Where sealing rocks are either not present or too broken-up to retain gas, the helium produced deep in the earth can leak through the overlying sediment to the surface. In Tanzania, this leakage to surface has been measured in hot springs at up to 17.9%, which is significantly higher than the onshore USA commercial cut-off of 0.3%.

Having helium generated by ancient rocks that can be accessed at reasonable depths, in concentrations that have not been diminished by Helium leaking away, and from reservoirs with high-rate production potential is rare. However, this is the setting in Tanzania's rift basins and the high success rate of oil and gas discoveries since 2006 suggests that the potential for success is real.

Basin margin fault trapping geology proven along the EARS for oil and gas.

Since the first oil discoveries in 2006, 38 exploration wells have discovered 4 billion barrels of oil and gas in the EARS basins. Fourteen of these discoveries were in Basin Margin Fault traps with a 100% success rate demonstrating the effectiveness of Basin Margin Fault seals.

NHE have the benefit of deep knowledge of the EARS fairway and have identified several basin-margin traps in North Rukwa, while historic wells confirm the sedimentary sequences that NHE is likely to encounter. A key determinant will be competency of sealing rocks above the porous sediments, to contain Helium and other gases.

Thus, the upcoming exploration activity, will be pivotal in informing the sub-surface geological model, and if successful will de-risk future exploration.

Figure 10: East Africa Rift in Tanzania



Source: <https://geology.com/articles/east-africa-rift/figure1.jpg>

About Helium

It's very valuable, and naturally occurring helium is very rare.

Helium (elemental symbol He2) is a "Noble" gas with a range of unique properties. It is an input to many "hi-tech" industries, with demand driven by global innovation in aerospace, medicine, and electronics.

Key attributes which differentiate it from other gases are

- It is chemically inert and does not bond with other periodic elements. It is non-flammable, and non-toxic, and non-corrosive. It is colourless, odourless, and tasteless, doesn't burn or conduct electricity,
- It is the "coldest" material known, never freezes into a solid, and is gaseous at temperatures down to -268.9 Degrees Celsius. Absolute zero is -273. Helium readily absorbs heat, and so it is used in hi-tech applications where "super-cooling" is required.
- It is lighter than air, and very hard to capture and store (I.e, leaky) so is widely used in lighter-than air lifting applications and leak detection.
- Helium's small elemental size (second smallest after Hydrogen), light weight, and inert properties give it a range of properties required in manufacturing of semi-conductors and fibre-optics, or any manufacturing processes while require a "sterile" environment.
- In the many applications the Helium is used for, it cannot be substituted.
- Helium cannot be manufactured from other gases. It occurs naturally in the earth as a result of radioactive decay of Uranium. This occurs deep in the earth's crust, but Helium is so "leaky" that most of it escapes through the overlying strata. Helium is commonly detected in oil, gas or water wells but in minuscule quantities, and in conjunction with other gases or fluids.
- Naturally occurring Helium in concentrations high enough to justify economic extraction, is rare, and requires a unique set of geological circumstances. Currently, naturally occurring helium is produced as a by-product of conventional gas production, where the Helium concentration is very low (<1%) and with value of the co-products (methane) is economically important.

What is Green Helium ?

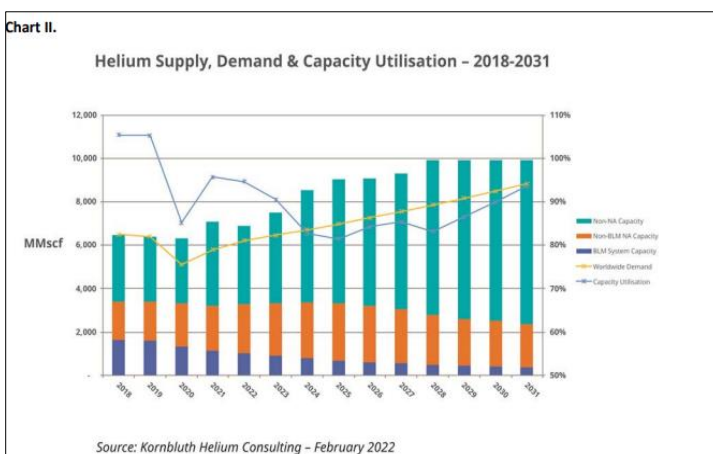
Currently 95% of all Helium is sourced from LNG production, and LNG production (from natural gas) is fossil fuel production and comes with a CO₂ footprint. In contrast, naturally occurring Helium is "greener" if it is produced naturally in tandem with other non-greenhouse gases, specifically Nitrogen.

NHE's prospects are theorised to be very low in greenhouse gases such as CO₂ or methane, with none of these detected in soil gas surveys over its leads or prospects. The composition of gases in NHE's sub-surface targets is to be determined.

Helium Demand

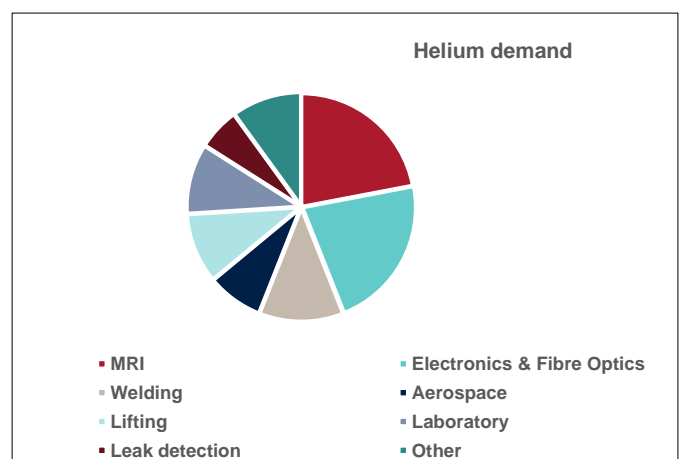
Global demand in 2022 was ~6.2 Bcf. CAGR projections we have sighted for demand over 2023-2031 are in the 6-8% CAGR range. The Helium market is a niche market in terms of volume and is very small compared to natural gas and LNG which are important co-products in the helium production chain.

Figure 11: Helium supply & demand history



Source: NHE Prospectus, April 2022

Figure 12: Helium demand by segment



Source: NHE prospectus, April 2022

The largest demand for Helium is to cool superconducting magnets in MRI scanners. This application accounts for 22% of Helium demand, and this segment is growing at ~10% p.a.

The second largest market is the semi-conductor manufacturing market, where Helium's unique properties are required to manufacture the semi-conductor wafers. This segment has been growing very strongly over many years, driven by chips needed in cell phones and laptops. Currently around 19% of demand is for the semi-industry. Major manufacturers of semi-conductors in Taiwan have announced expansion plans.

Reports we have reviewed show cagr demand over the next 10 years in the 6-8% p.a. range, driven by aerospace, semi-conductor medical sectors. The Annexures in the NHE Prospectus are more conservative at 4%, even so this would require new supply each year of 240 MMcfd of Helium.

Helium Supply

- Naturally occurring Helium can be produced from wells drilling into sympathetic geology, but unique geologies and high concentrations are required to make this commercial.
- There are ~16 Helium plants in the world, 7 in the USA and Canada and most of the rest in Russia and the Middle East.

NHE is exploring for naturally occurring helium without associated carbonising gases, which is termed "green" helium, as distinct from 95% of the global supply which is a by-product of gas production.

According to a USGS World Report on Helium published in 2019 (Figure 13) the Tanzanian Rukwa Basin has potentially 354 Bcf, behind the USA and Qatar but these latter countries are producing helium as a by-product of fossil fuel production. NHE occupies the Rukwa Basin with other industry participants.

Figure 13: Global distribution of Helium proved and prospective resources. (USGS: 2019)

Country	Reserves	Resources (Bcf)			Total
		BcF	Probable	Possible	
USA (Ex Cliffside)	138	188	209	180	716
Qatar	0	357	0	0	357
Rukw a Basin	0	0	0	354	354
Algeria	64	290	0	0	353
Russia	60	240	0	0	300
Canada	0	71	0	0	71
China	0	39	0	0	39

Source: USGS 2019 World Helium Reserves and Resources. NOTE: NHE shares Rukwa Basin acreage with other companies.

Due to its very small molecular size, Helium is very "leaky" and trapping it in sub-surface rocks requires a combination of unique geological settings.

The majority of Helium supply is from LNG production in Qatar, Algeria and prospectively, Russia. Helium is present in very low concentration in natural gas feedstock, and the capture of Helium from raw gas feeding LNG plants is part of the cryogenic process in LNG production. In this process, other gases such as methane, oxygen and CO₂ are condensed out of the gas stream, with Helium extraction a by-product.

Helium produced as a by-product of natural gas accounts for about 95% of production, and outside the USA supply is dominated by Qatar, Algeria, and potentially Russia after 2025.

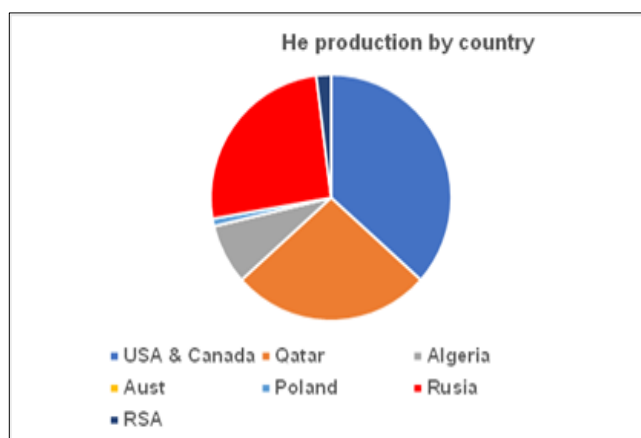
Production of naturally occurring green Helium from wells with only nitrogen is rare, and accounts for less than 5% of global supply.

For most of the 20th century, naturally occurring Helium was produced from a small number of Helium-enriched natural gas fields located onshore USA, which accounts for about 40% of the world supply, with one field, the LaBarge field in Wyoming (operated by ExxonMobil) accounting for 22%. Other locations of natural Helium production are Canada, and most recently South Africa.

Naturally occurring Helium in sub-surface reservoirs is mixed in with other gases, predominantly methane (which has economic value), or CO₂ which can have some economic value, or nitrogen which is worthless but is not a pollutant.

Helium concentration in the gas mix is deemed commercial down to 0.1%, but this "cut-off" depends on location, value of other gas by-products and the amount of processing required to distil the Helium from all these other constituents. In any event, concentrations are typically a few -percent, and figures as high as 17% reported by NHE are the highest recordings in the world.

Figure 14: Helium supply by country



Source: USA Energy Information Agency.

Capacity additions are underway, in the USA, Canada, South Africa, and Russia. By far the largest is in Russia however recent geopolitical events and a withdrawal of major western sponsors have put that source of supply at risk.

In the USA and Canada, there are public companies with new projects in the development phase, which we have reviewed. Individually, each is small (production < 0.1 Bcf p.a.) and collectively, the volumes proposed for development are not enough to meet demand growth, and in addition, these are natural-gas co-projects.

Prices

Helium is immensely more valuable than natural gas, driven by the niche markets it supplies into, which are typically highly value added. There is no traded market for Helium, and prices are opaque and usually a bil-lateral arrangement.

Major industrial gas companies loom large as aggregators and distributors to end users, and this part of the value chain is concentrated in the hands of a few very large industrial gas companies such as Air Liquide, Linde Industries and other specialist companies. Thus analysis of prices needs to be referenced to the point of sale, either ex-plant or to the consumer.

Historically in the USA, the Bureau of Land management (BLM) managed an inventory of Helium called the "Federal Helium Reserve" and for decades set a helium price based on paying off the Reserve debt of US\$1.5b by the time of depletion.

The BLM auctioned off volumes to end-users, but this activity ceased in parallel with the depletion of fields supplying it in 2019, and since then the transition to privately held helium from producing natural gas fields has seen the market tightening, driving prices higher.

Helium prices are in an uptrend driven by strong demand for hi-tech applications, while a key supplier, the USA, is declining leaving consumers increasingly reliant on supply from Qatar and Russia. New sources of supply are needed, and green helium has strategic importance in a de-carbonising world

Quality differentials

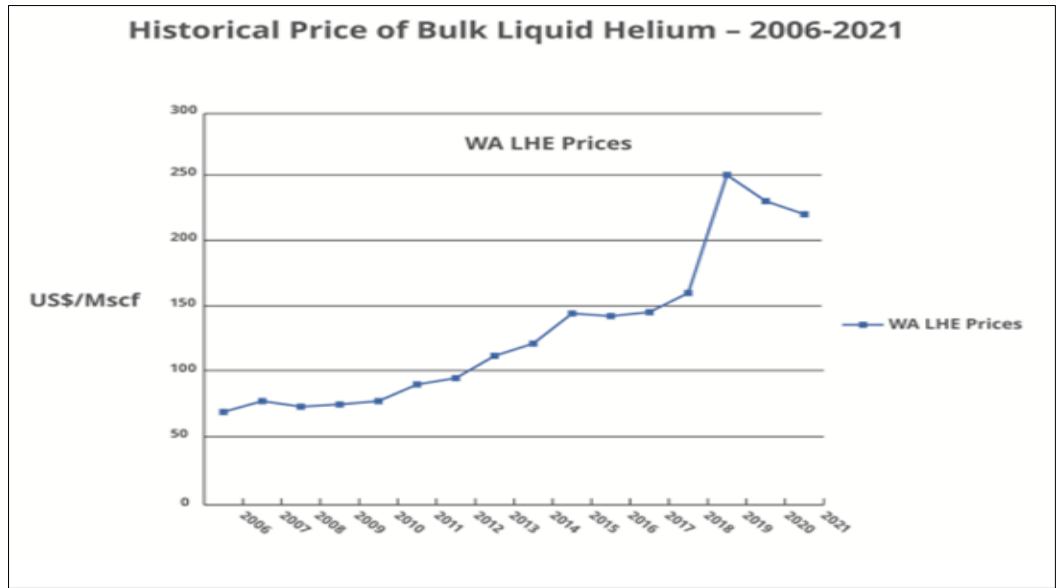
Prices also reflect the purity of the Helium stream. For most hi-tech applications, purity must be >99.9995% Helium, so called "5-nines", and these highest grades command premium prices because of the extra processing required to extract all the contaminants from the Helium mix, such as Oxygen, Nitrogen, CO2 or any other gases. Lower grades, <99% are termed "party balloon" grade and are command lower prices.

We have reviewed several corporate presentations which document Helium contract and spot prices rising from ~US\$200/mcf in 2017, to >US\$1000/Mcf in 2023. With supply growth expected over the outlook, it's likely that prices will moderate from high levels over the outlook period.

However, the helium market can be quite volatile due to its small size, and limited flex in the supply chain due to reliance on a small number of producers, some of which are located in geo-politically risky regions.

NHE show in ASX presentations "Long term bulk helium pricing" of US\$450/Mcf. This is consistent with investor presentational material we have reviewed from peer companies Blue Star, Helium One, and Grand Gulf Energy). Our cash-flow models assume US\$450/Mcf for helium ex-field.

Figure 15: Bulk Helium price history



Source: From NHE prospectus, April 2022

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