



Minerals for a sustainable future



OAX: NOM

**NORDIC
MINING**

Engebø Rutile and Garnet

World TiO₂ Summit, Boston, October 2018

Ivar S. Fossum, CEO



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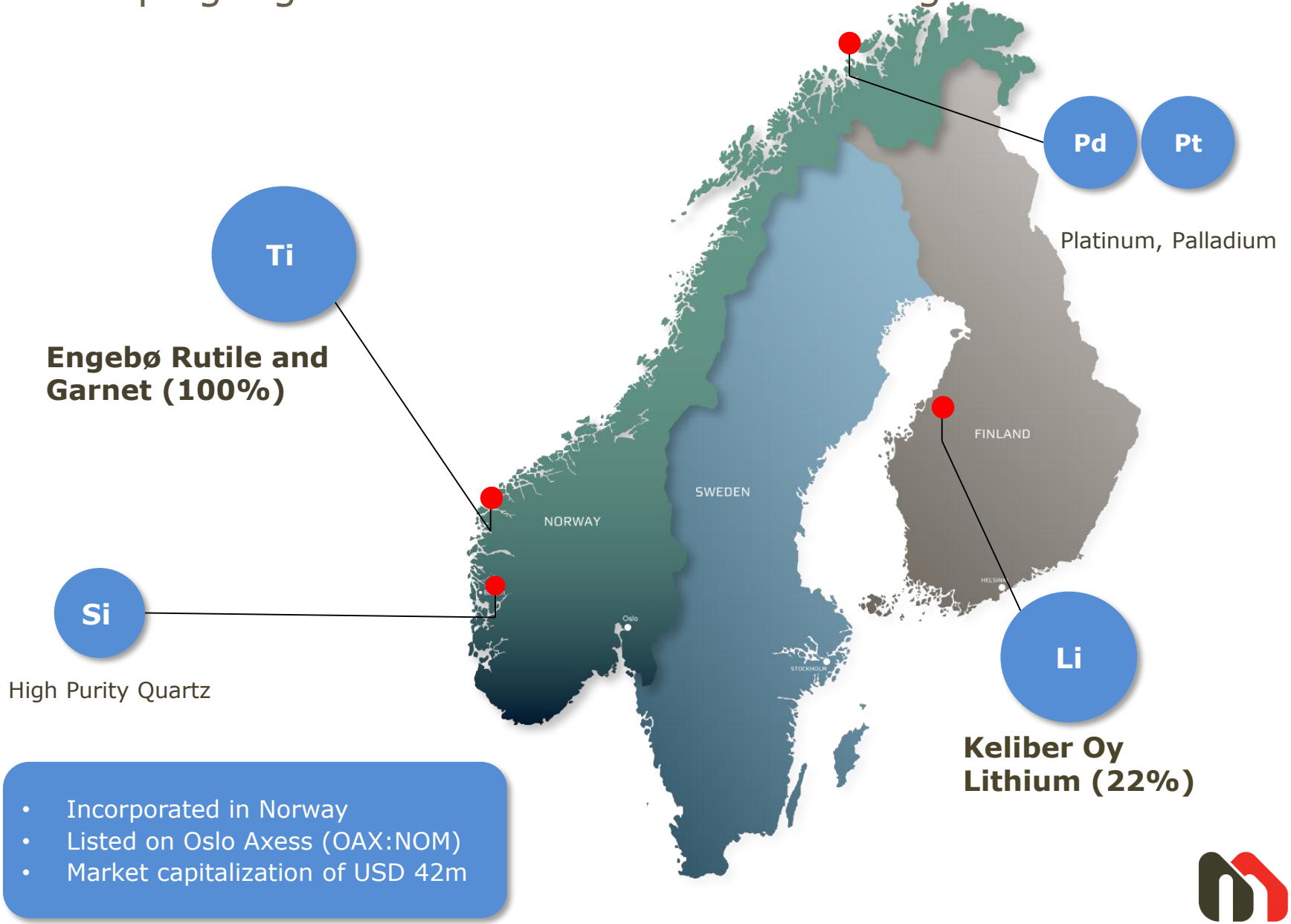


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Developing high-value assets in the Nordic Region



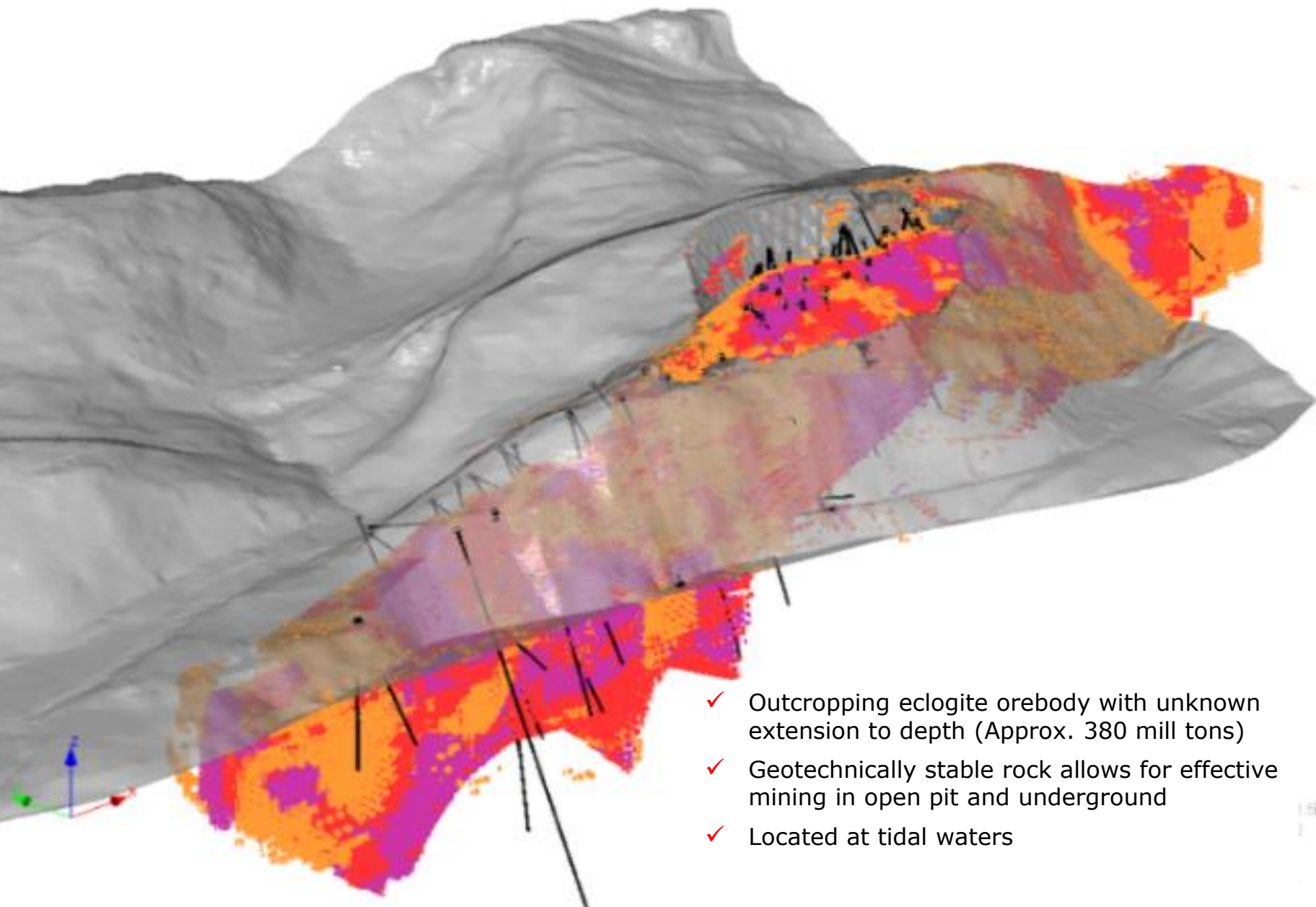
Engerbø Rutile and Garnet



Location: west coast of Norway close to the North Sea



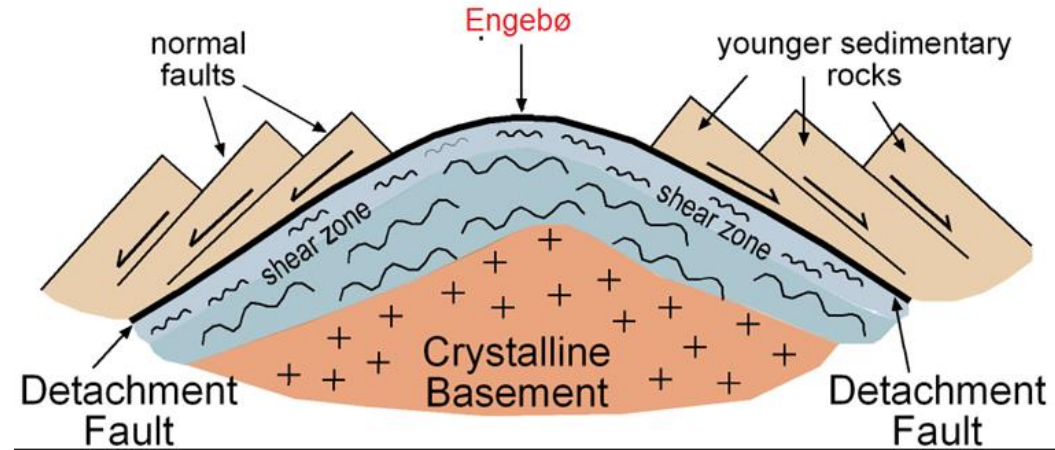




- ✓ Outcropping eclogite orebody with unknown extension to depth (Approx. 380 mill tons)
- ✓ Geotechnically stable rock allows for effective mining in open pit and underground
- ✓ Located at tidal waters

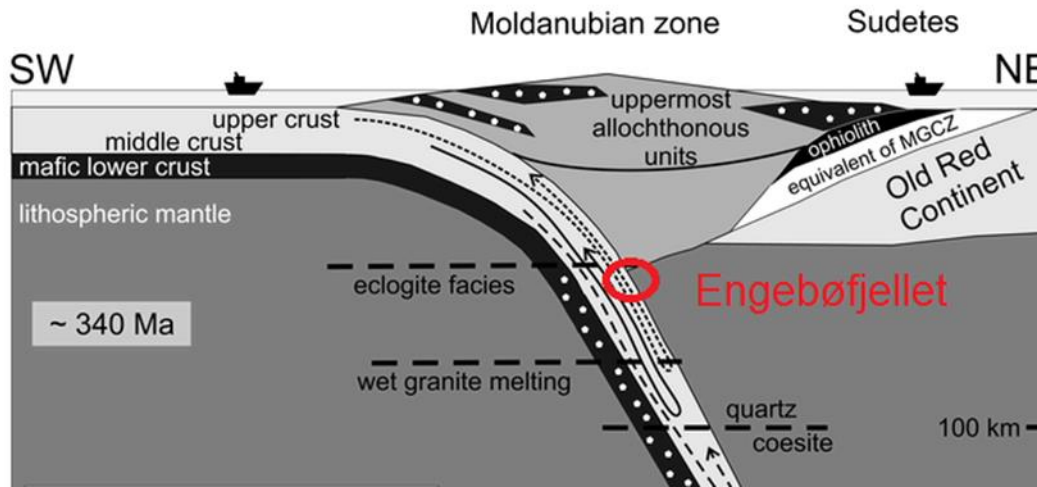
The Engebø eclogite, formed under high pressure and temperature

- Part of the Caledonian range
- Engebø came up from depth



America

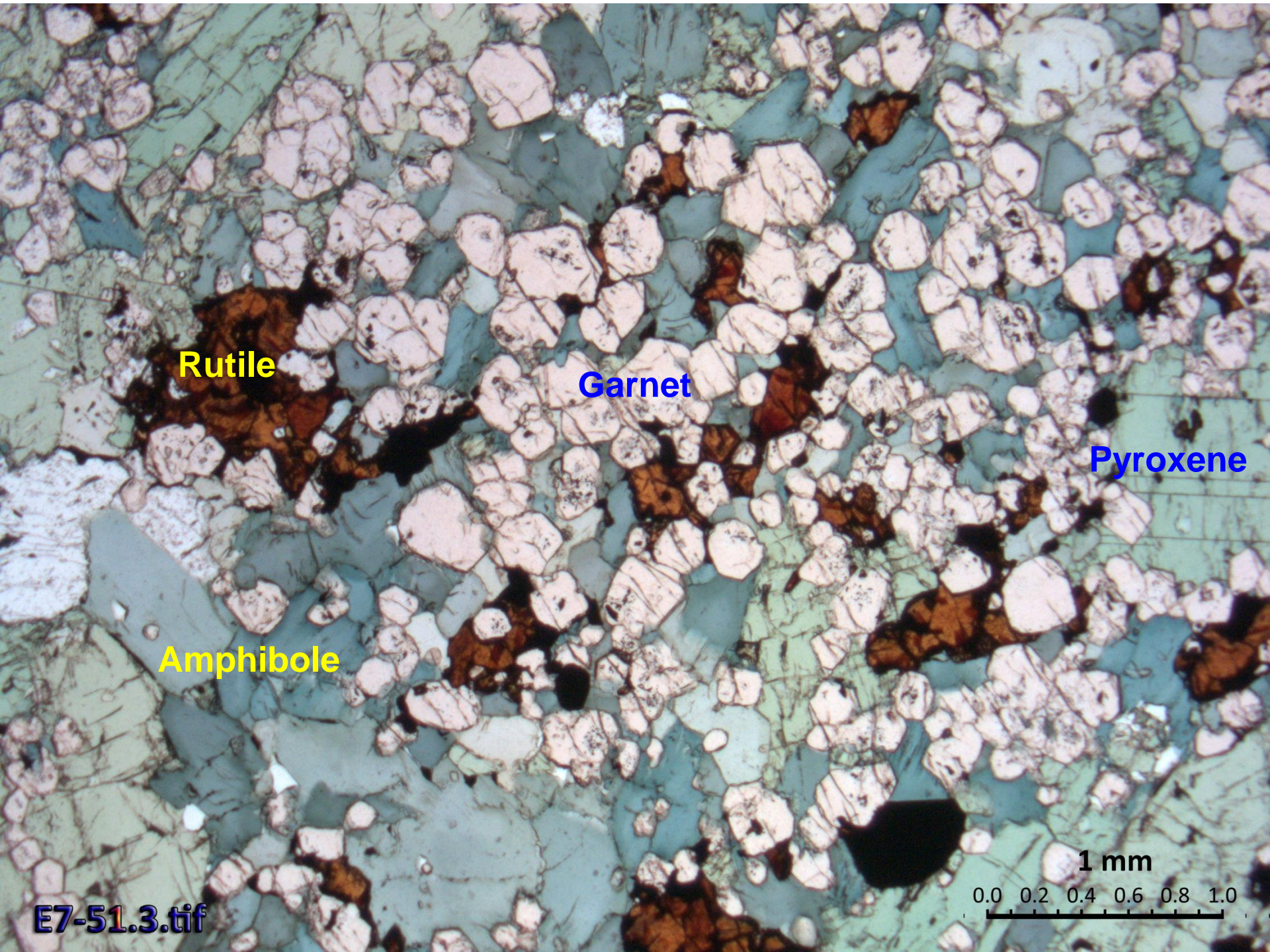
Europe



- 400 mill years ago
- At approx. 50 km depth
- High pressure
- High temperature
- Transformation of gabbro







Rutile

Garnet

Pyroxene

Amphibole

1 mm

0.0 0.2 0.4 0.6 0.8 1.0

E7-51.3.tif

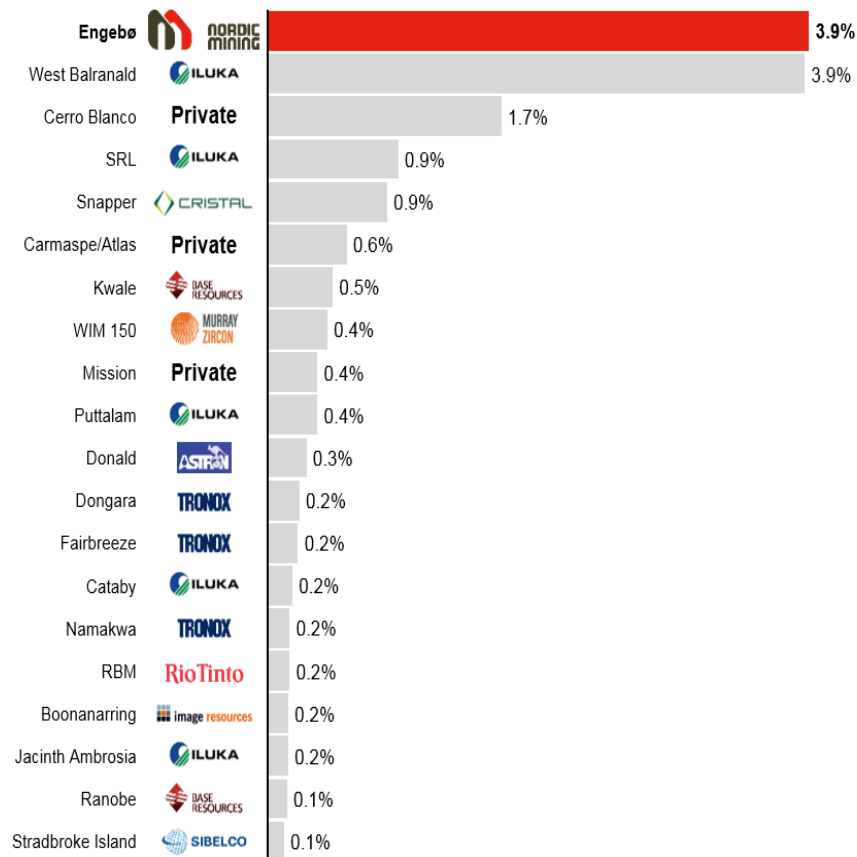
High grade rutile and garnet mineralisation

Mineral resource and reserve classifications*

	3% cut-off grade		
	Tonnage Mt	TiO ₂ %	Garnet %
Measured	15	3.97%	44.6%
Indicated	78	3.87%	43.6%
Measured & indicated	93	3.89%	43.7%
Inferred	138	3.86%	43.5%

	Ore reserves		
	Tonnage Mt	TiO ₂ %	Garnet %
Proven	10.194	3.81%	43.4%
Probable	31.702	3.35%	39.5%

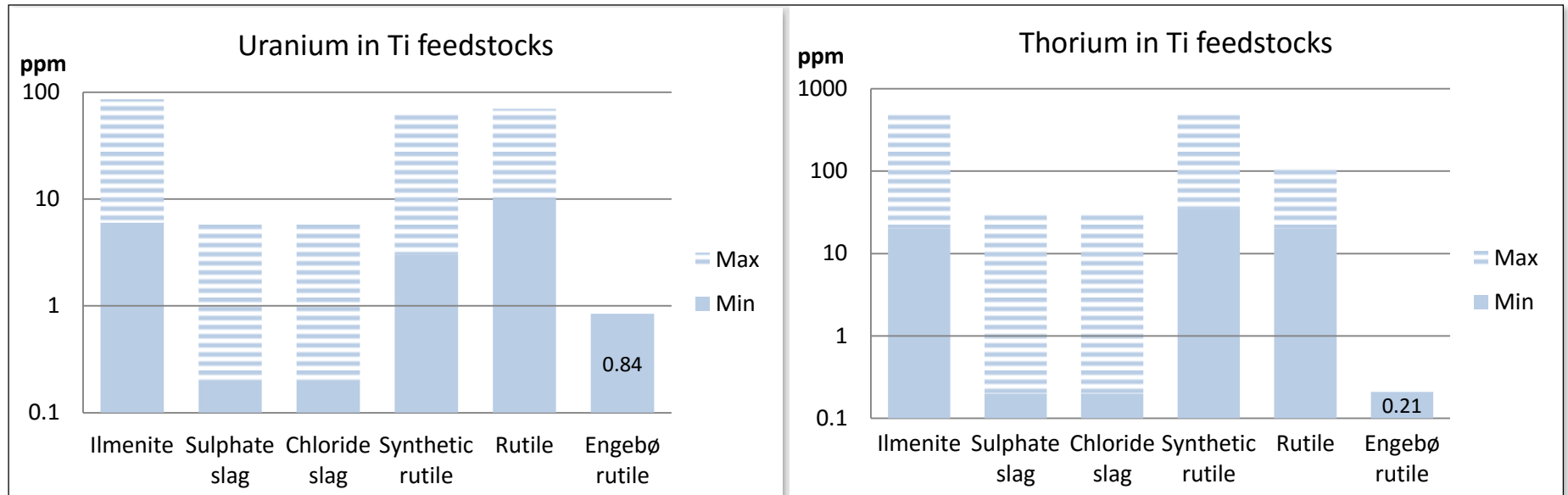
Among the highest rutile grades



* Resource estimates and reserve statement completed by Competent Person Adam Wheeler, corresponding to the guidelines of the JORC Code (2012 edition).



Low radioactive impurities vs other Ti feedstocks



Rutile and garnet - unique mineral properties

Rutile (TiO₂)

Current world production: ~ 0.8 million tonnes



PIGMENT



WELDING RODS



TITANIUM



Tests have demonstrated that Engebø can produce 95% TiO₂ rutile suitable for pigment and titanium production

Garnet

Current world production: ~ 1.4 million tonnes



WATERJET CUTTING



SAND BLASTING



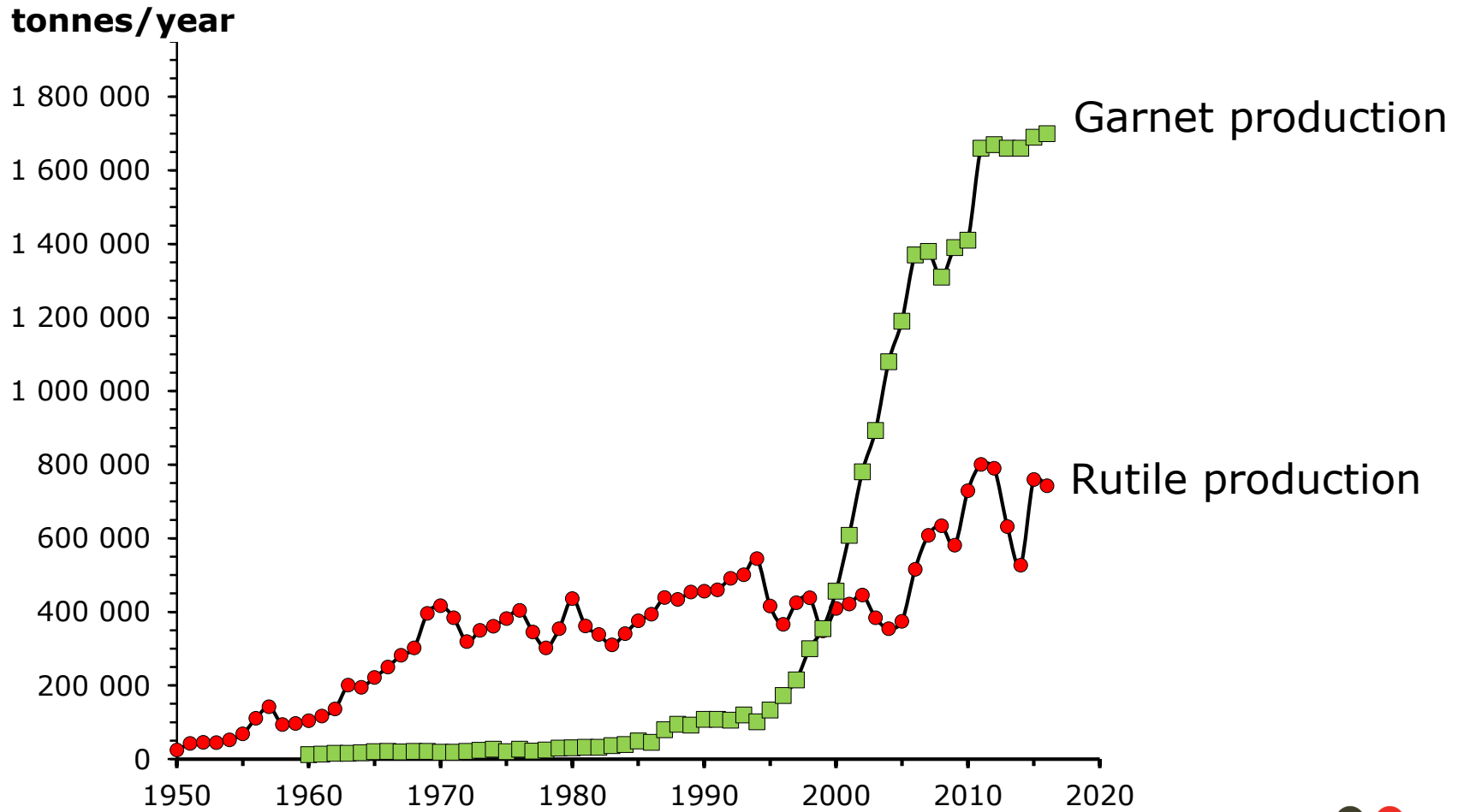
ABRASIVES



Tests have demonstrated that Engebø can produce coarse and fine garnet suitable for a broad range of applications



Historic development of Rutile production vs Garnet



Kilde: USGS



Ideally located for export sales to Europe and overseas markets



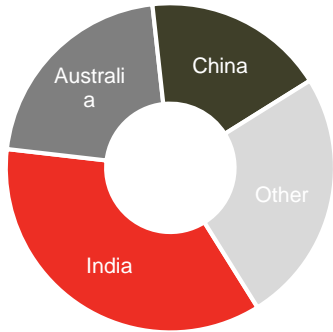
- ✓ The largest pigment manufacturers in Europe have chloride technology that benefits from high grade feedstock
- ✓ Several may consume Engebø's annual volume
- ✓ Plant-to-plant shipment
- ✓ Logistical and freight cost advantages



First European producer of industrial garnet

Garnet market and price assumptions

Current world production

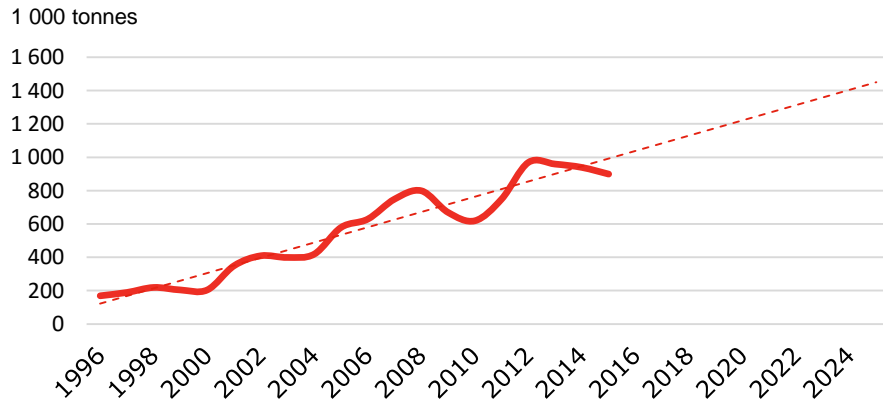


- Emerging mineral with strong growth in the waterjet cutting markets
- Currently no European production
- Engebø is one of few hard rock deposits with almandine garnet
- Engebø will produce commercial end-products:
 - 80 mesh waterjet
 - 100 mesh waterjet
 - 30/60 mesh blast market
- PFS garnet price assumption of USD 250/tonne in real terms based on a basket of the three products with roughly equal weighting

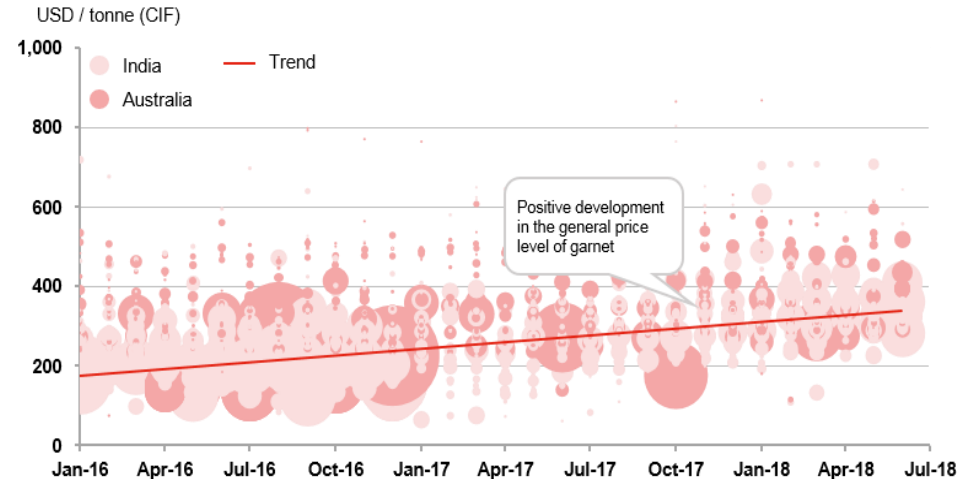
Estimated garnet price, Engebø PFS

Product / Case	Low price	High price
80 mesh waterjet	USD 267/t	USD 289/t
100 mesh waterjet	USD 267/t	USD 289/t
30/60 mesh grades	USD 289/t	USD 311/t
PFS garnet basket price	USD 250/t	

Estimated garnet consumption (excl. China)



Price trend for garnet



Cooperation with the US Barton Group for garnet

The Barton Group

- ✓ Barton, family owned and founded in 1878.
- ✓ Leading US garnet producer and distributor
- ✓ Leading player in developing waterjet cutting technology
- ✓ Operates a garnet mine in the state of New York
- ✓ Supplies high-performance garnet abrasives in Western Europe, South America, Southeast Asia and China

Heads of Agreement

Nordic Mining entered into a Heads of Agreement with Barton Group, on the following main principles:

- ✓ Offtake agreement for North America
- ✓ Joint-venture agreement for other markets
- ✓ Financing of pre-construction project development
- ✓ Construction financing



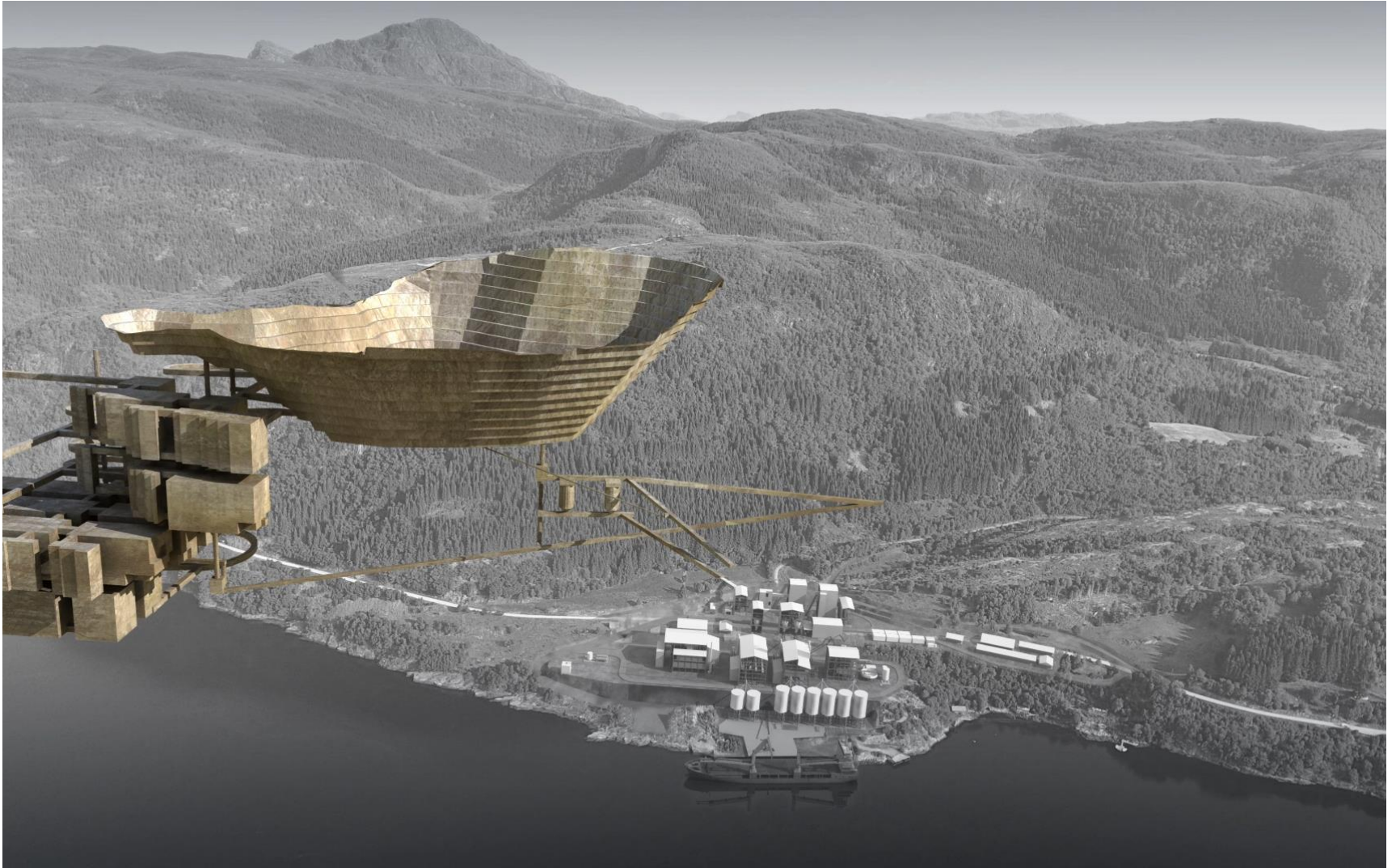
BARTON
Global leader in garnet abrasives



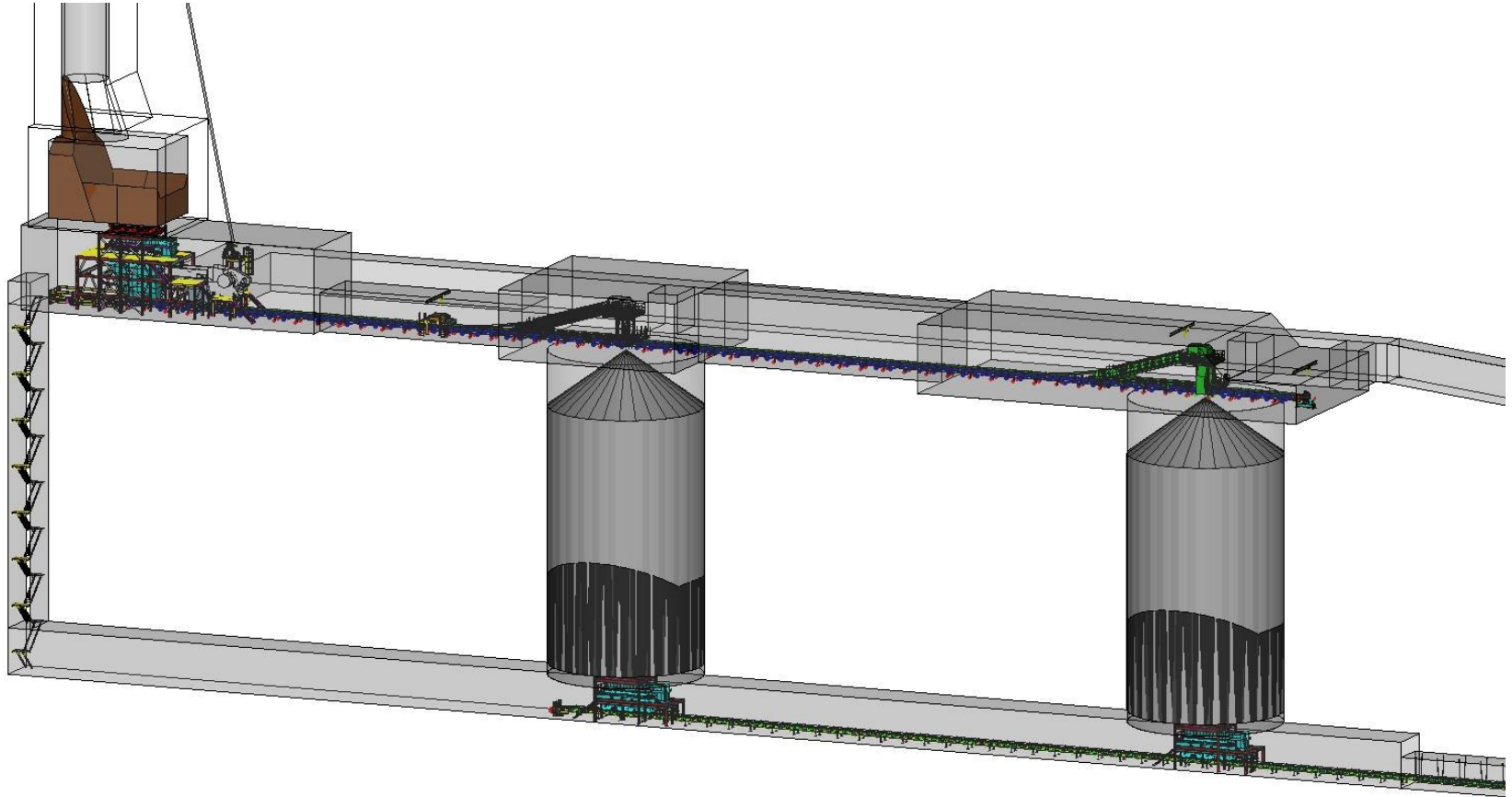
Favourable internal logistics, short haulage distance

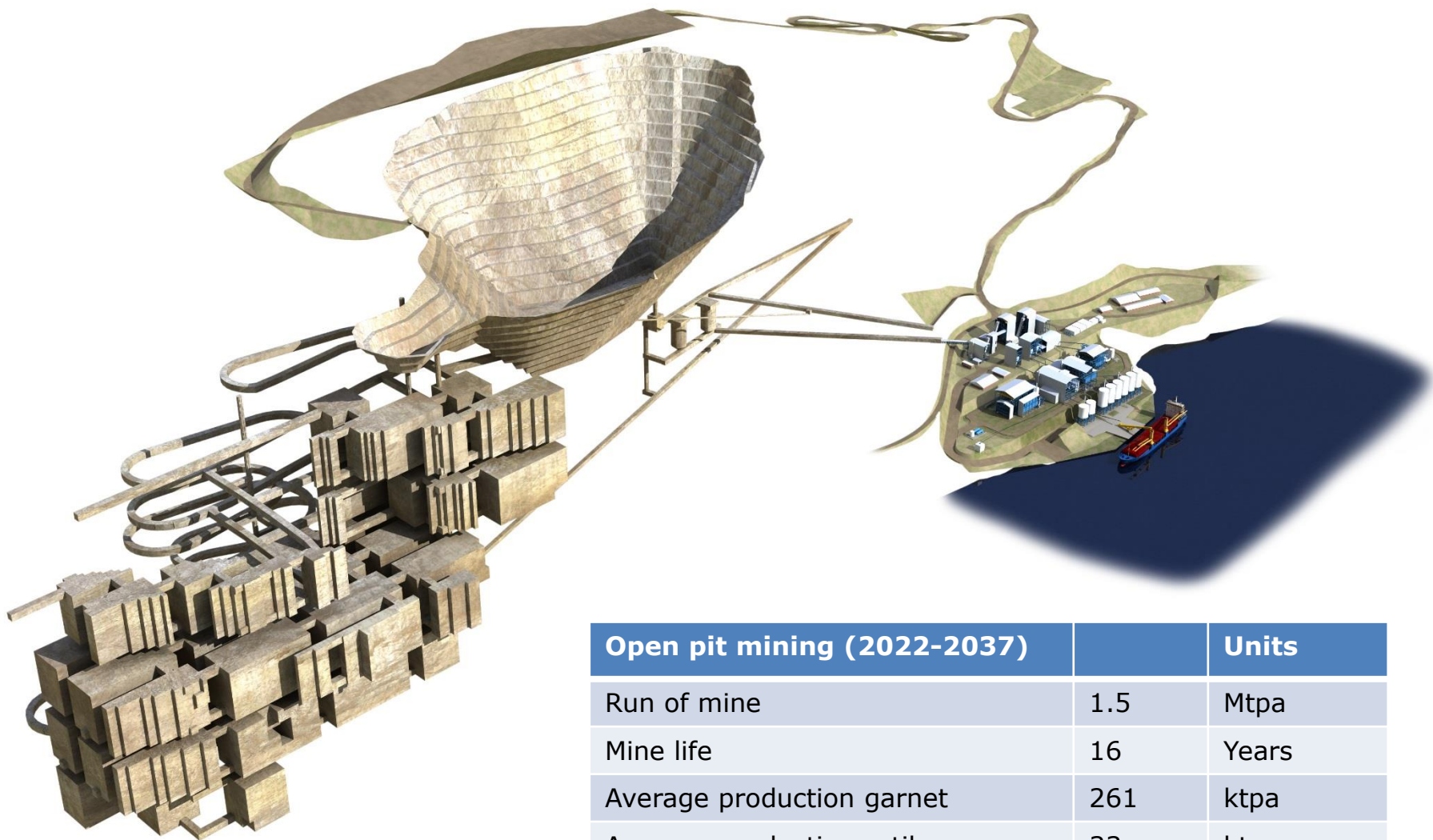


Favourable internal logistics, short haulage distance



Underground facilities for crushing, ore storage and conveying to process plant





Open pit mining (2022-2037)		Units
Run of mine	1.5	Mtpa
Mine life	16	Years
Average production garnet	261	ktpa
Average production rutile	33	ktpa
Strip ratio	1.34	Waste/ore



PFS process testwork with industrial scale equipment

- ✓ Comprehensive testwork has documented commercial products from rutile and garnet according to market specifications
- ✓ Testwork has demonstrated rutile recovery of approximately 60%



HATCH

ihc ROBBINS

JKtech
SMI
Technology Transfer

SGS

**MINTEK**

IMSV
ENGINEERING

CORE 

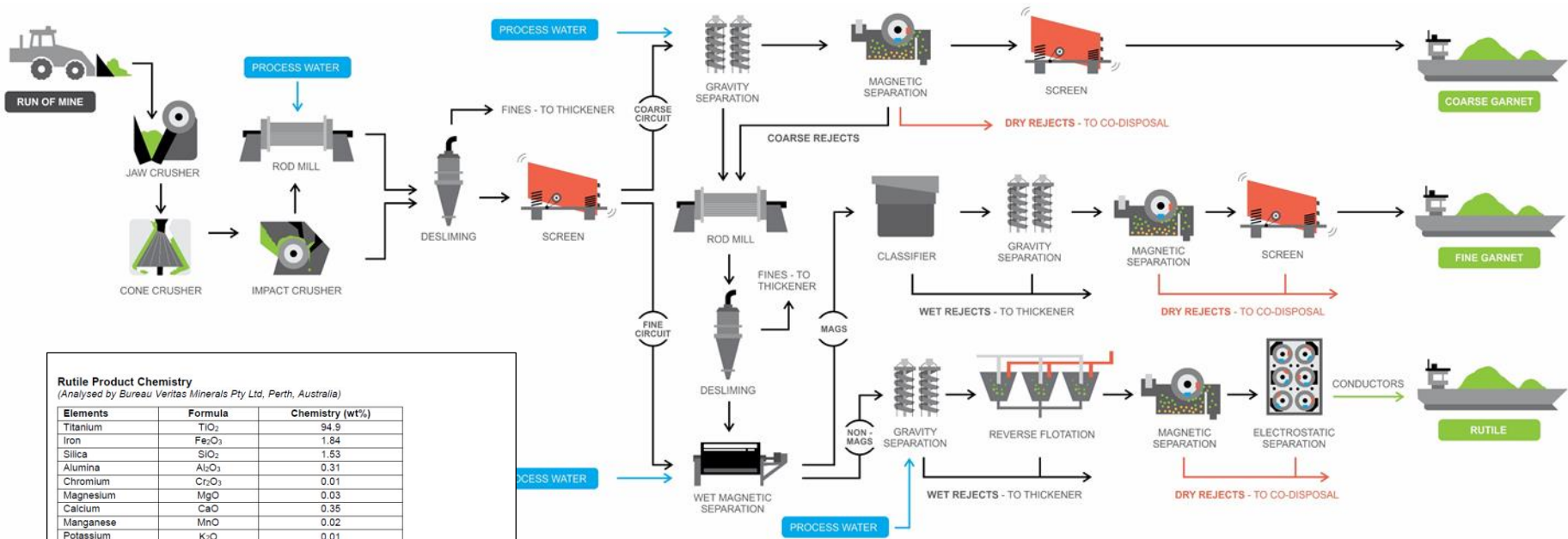
 **Mineral Technologies**
A Downer Company



Bulk sample test work ongoing in DFS study



Flowsheet of rutile and garnet process, PFS



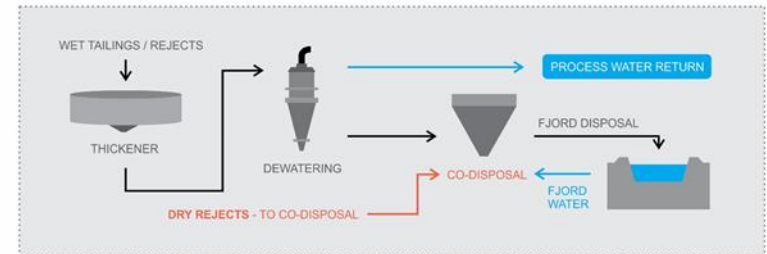
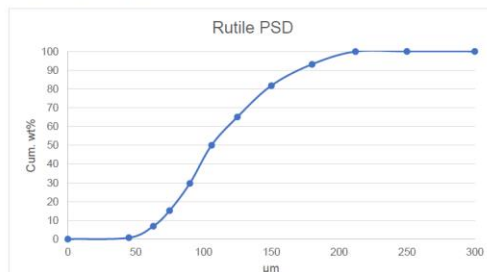
Rutile Product Chemistry

(Analysed by Bureau Veritas Minerals Pty Ltd, Perth, Australia)

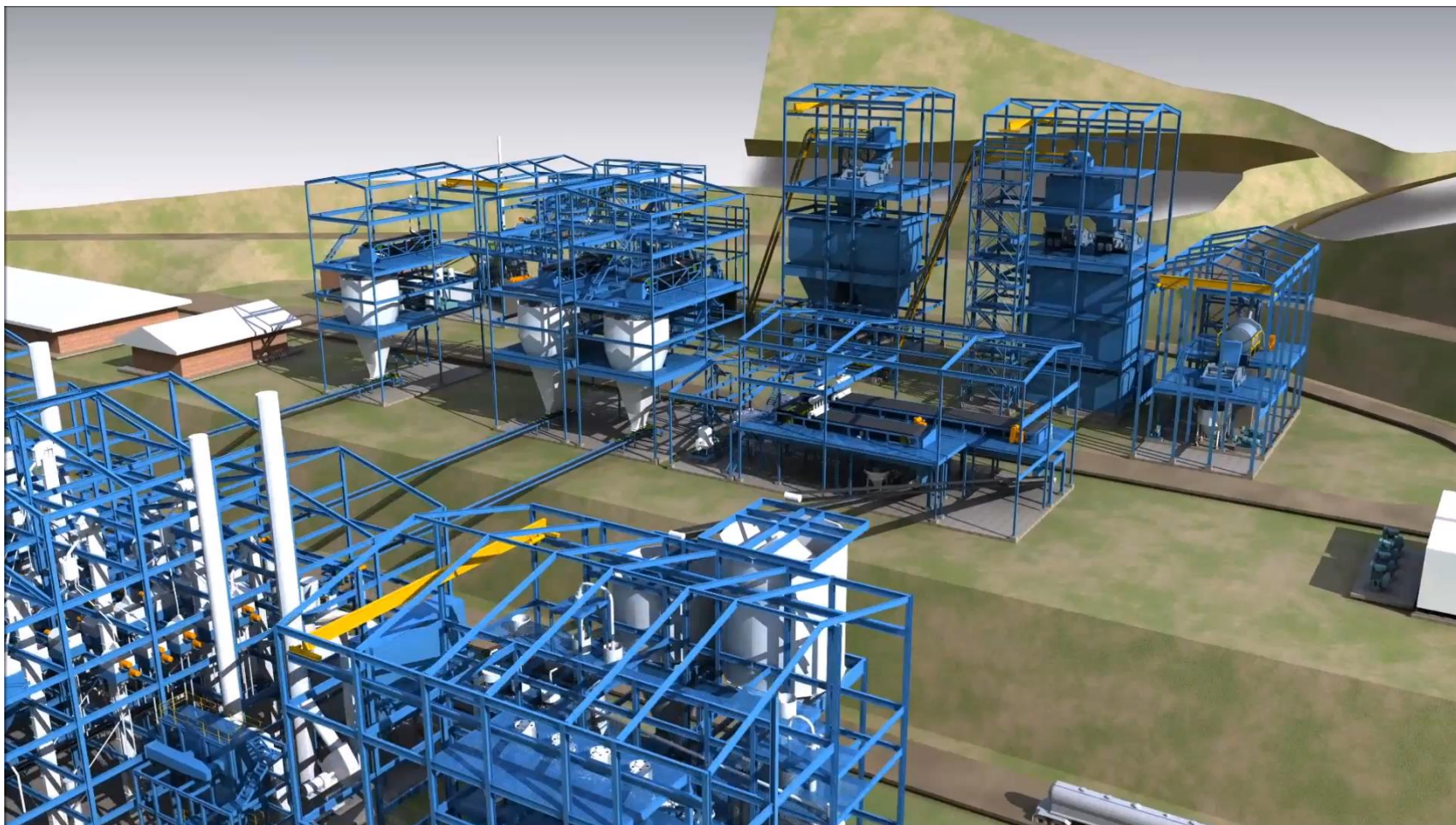
Elements	Formula	Chemistry (wt%)
Titanium	TiO ₂	94.9
Iron	Fe ₂ O ₃	1.84
Silica	SiO ₂	1.53
Alumina	Al ₂ O ₃	0.31
Chromium	Cr ₂ O ₃	0.01
Magnesium	MgO	0.03
Calcium	CaO	0.35
Manganese	MnO	0.02
Potassium	K ₂ O	0.01
Cerium	CeO ₂	nd.
Zircon	ZrO ₂	0.06
Sulphur	S	0.17
Vanadium	V ₂ O ₅	0.4
Potassium	P ₂ O ₅	0.01
Uranium	U (ppm)	<10
Thorium	Th (ppm)	<10
Niobium	Nb ₂ O ₅	nd.
Tin	Sn	<0.02

Rutile Product Particle Size Distributio

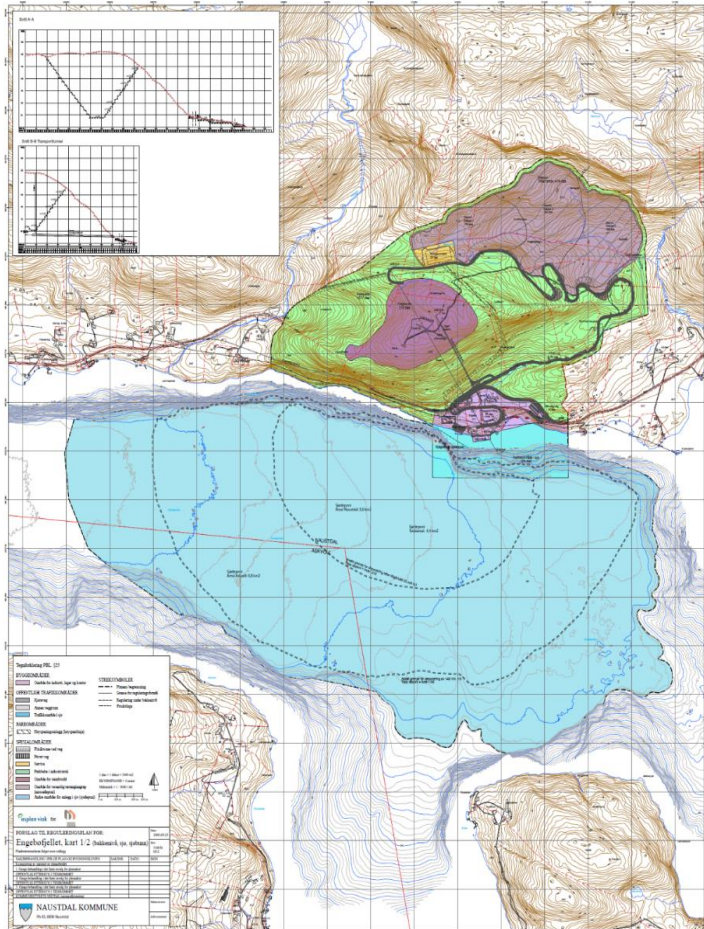
(Analysed by IHC Robbins, Brisbane, Australia)



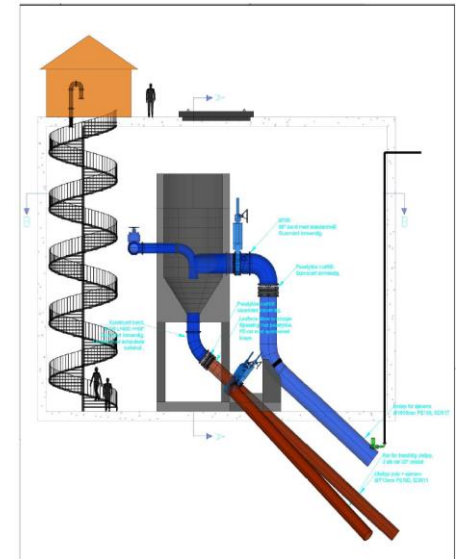
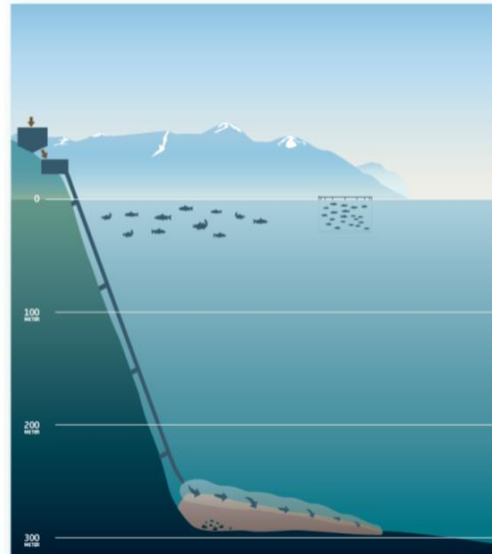
Well suited for modular construction



Zoning plan and environmental permit granted



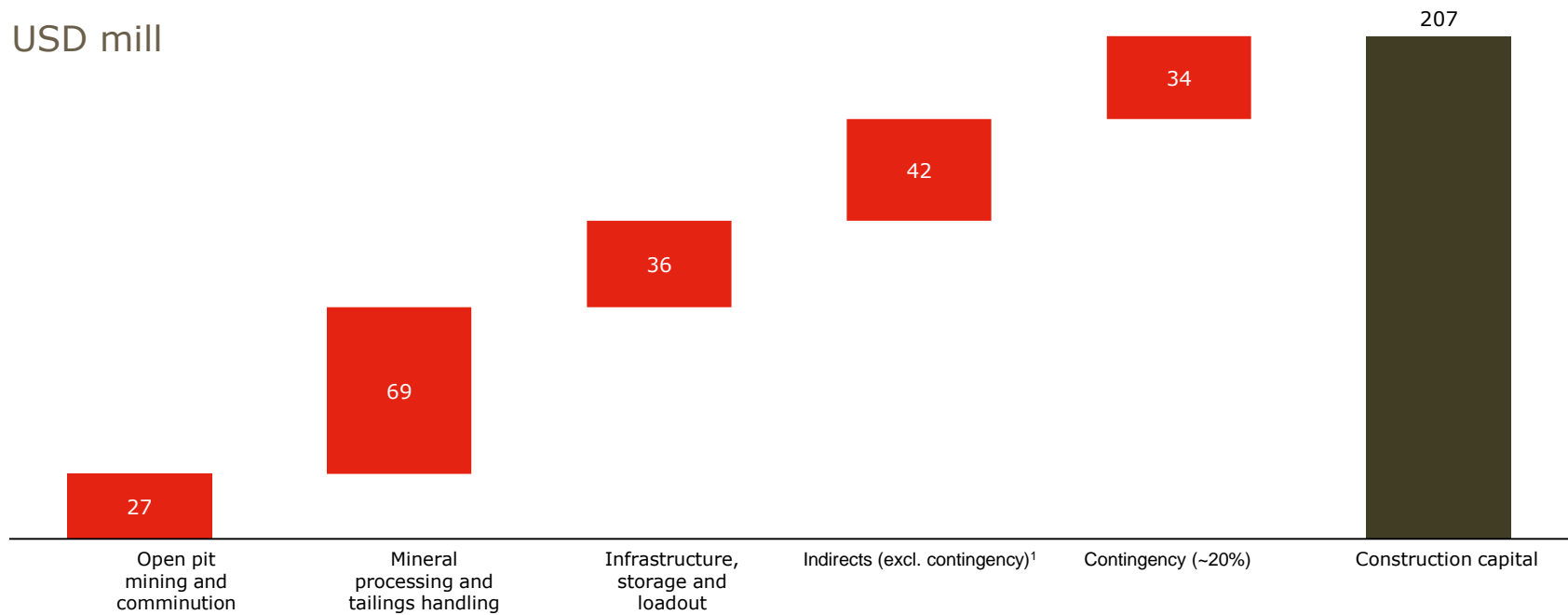
- The zoning plan and discharge permit for the Enggebø project are approved and final without possibility for appeals
- Deep-sea disposal offers safe and sustainable tailings solution
- The tailings will sediment within the regulated area
- The currents in the tailings area is moderate
- Continuous monitoring of the sea disposal will be implemented as part of permit conditions



Comprehensive measuring and monitoring program



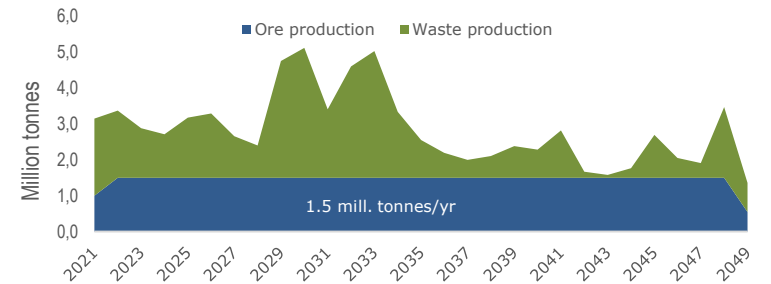
Limited capex for infrastructure and transportation



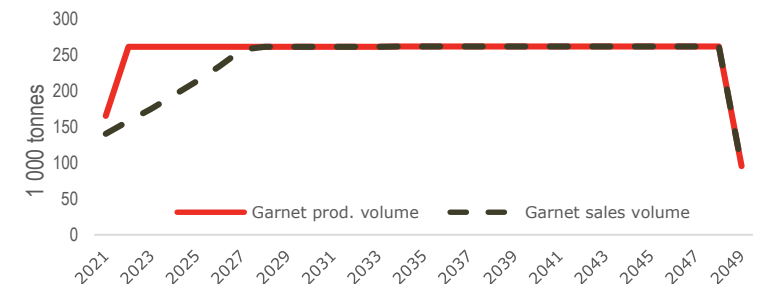
Key project assumptions, PFS

Assumptions	Value
Garnet price	USD 250/tonne
Rutile price	USD 1 070/tonne
Garnet sales (from ~2027)	261 000 tpa
Rutile sales (average)	32 500 tpa
Opex per sales tonne ¹⁾	USD 87 per tonne
Capex 2020-2022	USD 207 mill.
Open pit mining and comminution	26.8
Mineral processing and tailings handling	68.6
Infrastructure, storage and loadout	35.7
Indirects	41.8
20% contingency	34.2
Deferred capex 2034	USD 17 mill.
Underground mining and comminution	10.8
Indirects	2.7
25% contingency	3.4

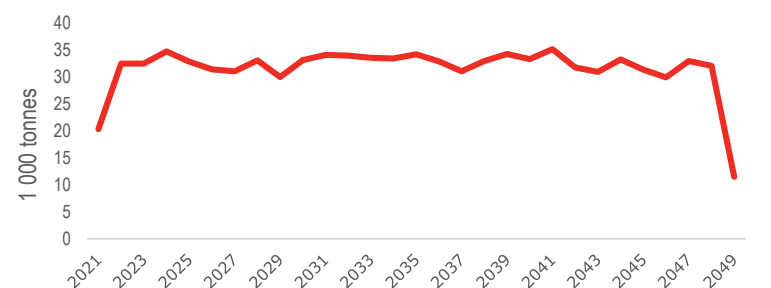
Mine production



Garnet sales and production volume



Rutile sales and production volume

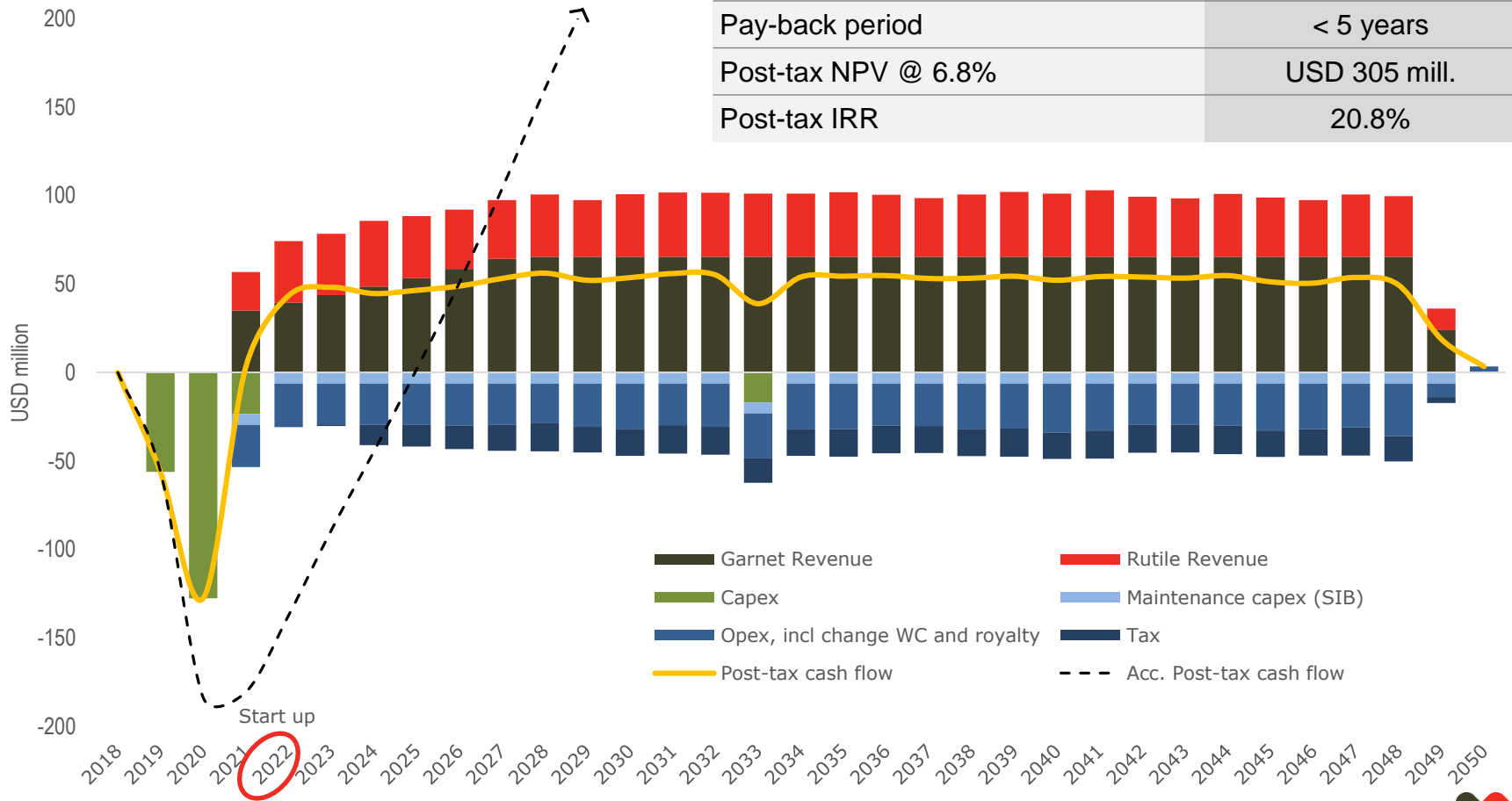


1) Based on total sales volume for rutile and garnet



Attractive project economics, PFS

Metric	Value
Pre-tax NPV @ 8%	USD 332 mill.
Pre-tax IRR	23.8%
Life of mine	29 years
Pay-back period	< 5 years
Post-tax NPV @ 6.8%	USD 305 mill.
Post-tax IRR	20.8%

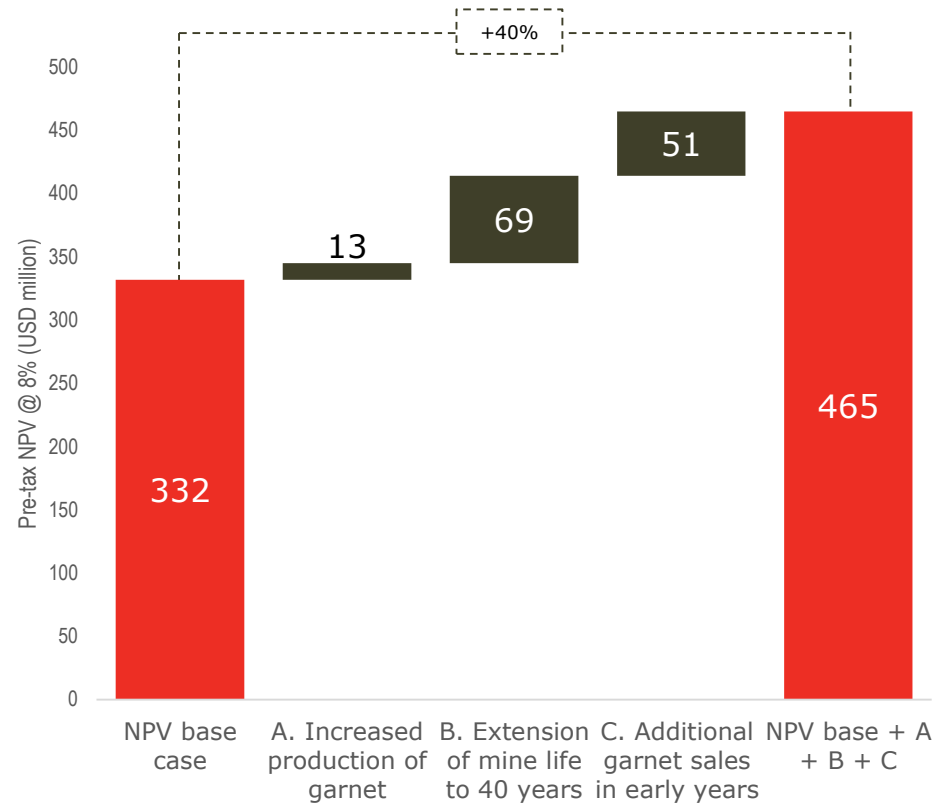


Post-tax cash margin of 55%



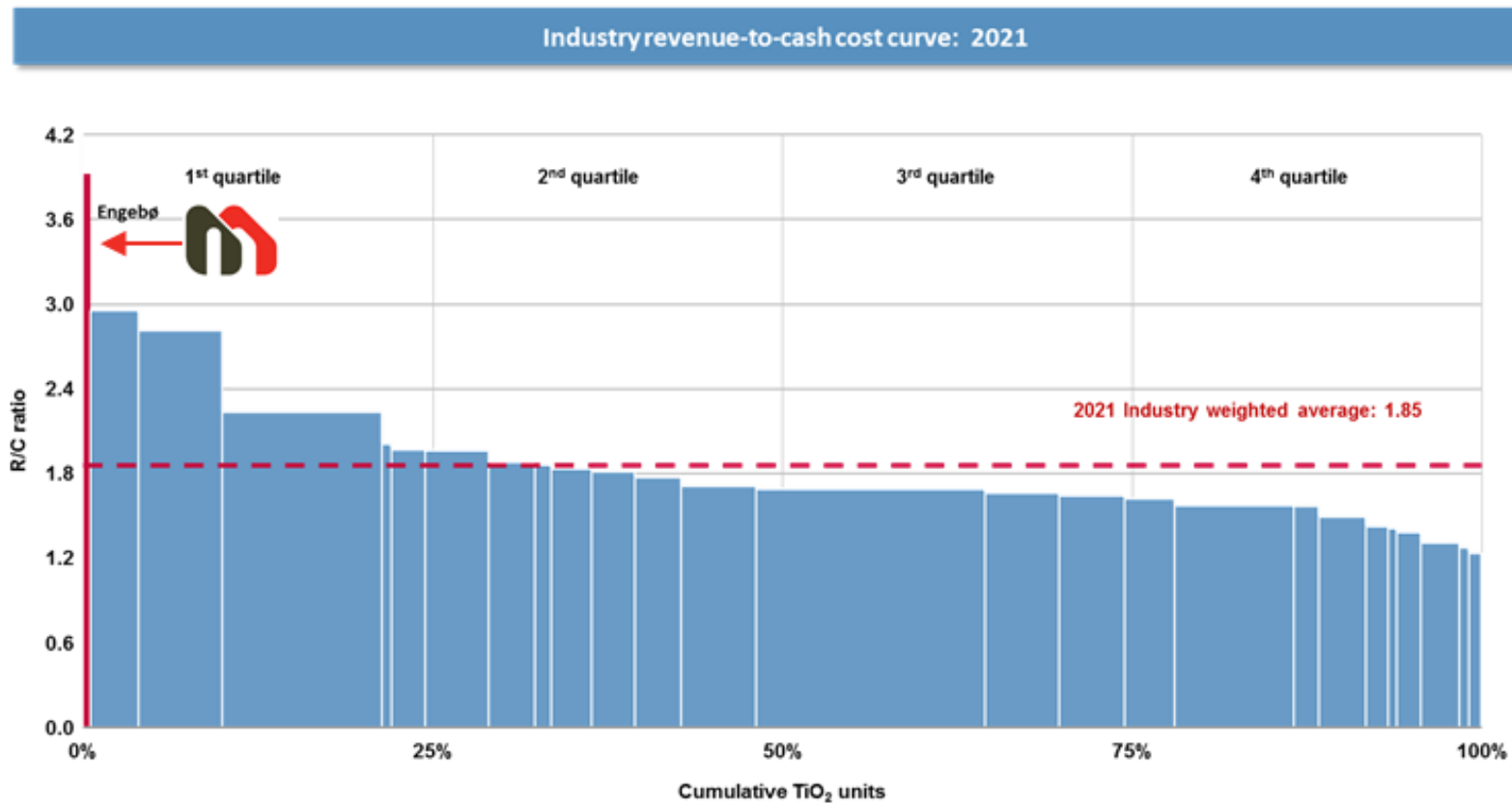
Project economy with upside potential

- A. Increased production of garnet
- B. Extension of mine life to 40 years by including Inferred Resources
- C. Additional garnet sales in early years



Competitive PFS rutile revenue-to-cash cost position

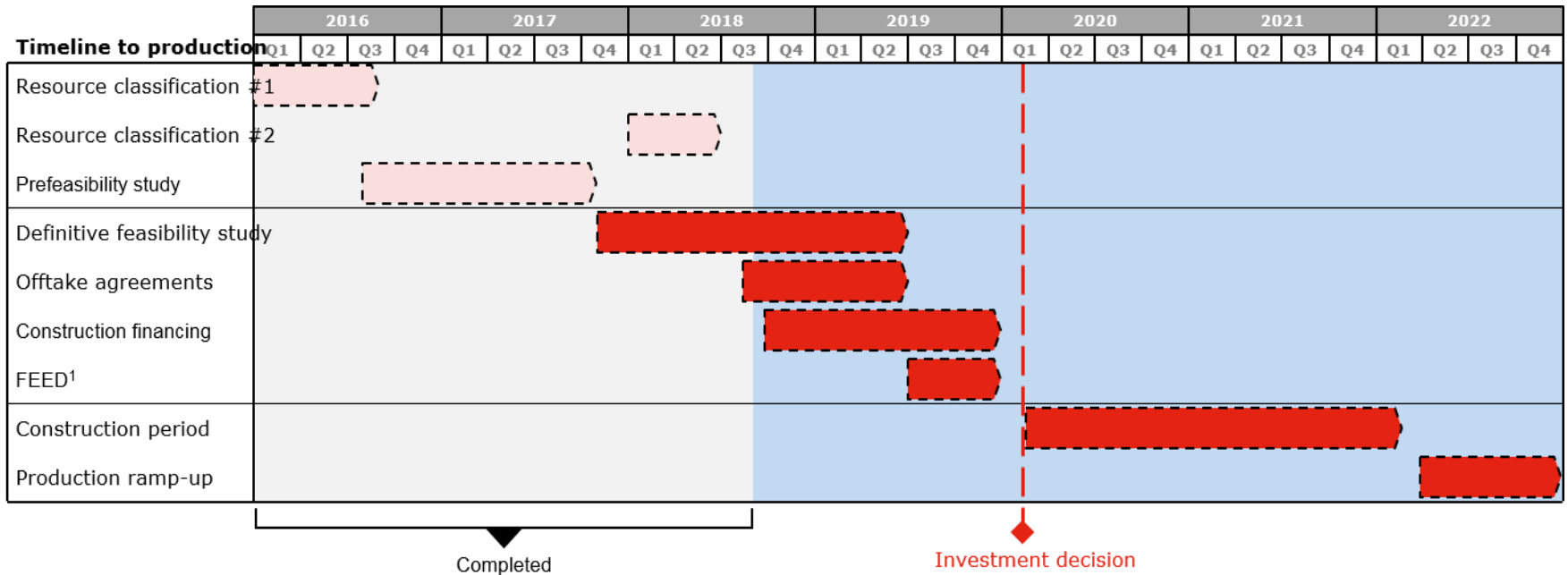
- ✓ The revenue-to-cash cost ratio is based on the first ten years of operations
- ✓ Engebø benefits from producing two high value products with low mining and processing costs



Source: TZMI



Timeline towards construction and production



*Responding to the need for sustainable
supply of strategic industrial minerals*

THANK YOU FOR YOUR ATTENTION!

Safety – Environment - Innovation



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