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**JULIA CREEK  
PROJECT**

Vanadium  
Oil Shale

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## First Vanadium and Oil Extraction Results from Pilot Plant Test Program Delivers on Expectations

### Highlights

- **Testing successfully demonstrates pilot plant operation, achieving high oil and vanadium extraction rates at a much larger scale than previously possible**
- **Highly encouraging vanadium extraction results achieved from the first pilot plant test work**
  - Vanadium extraction efficiencies were 71.5% on shale ash leached by acid for four hours.
- **Impressive oil shale extraction results indicate oil yields were 142% of that reported under a Modified Fischer Assay (MFA)**
  - The increase in oil yield is made possible with the use of an innovative hydrogen donor solvent.
- **The pilot plant operated effectively, processing 6kg of Julia Creek oil shale, with key run targets for autoclave temperature and pressure achieved.**
- **Subsequent pilot runs will concentrate on optimising yields of both vanadium and oil and progressively improve and maximise the extraction processes, that will lead to the development of a Process Flow Sheet.**

**QEM's purpose statement: "Developing a critical minerals project utilising innovative and sustainable energy solutions"**

QEM Limited (ASX: QEM) ("**QEM**" or "**Company**") is pleased to announce vanadium and oil extraction results from the first test run of the Company's pilot plant test program.

After successfully commissioning the vanadium and oil shale bench-scale pilot plant at the Melbourne headquarters of HRL Technology Group Pty Ltd ("HRL"), (see ASX announcement dated 25 May 2022), the first test run was conducted with six kilograms of oil shale feed mixed with a hydrogen donor solvent.

**Sample Details**

Testing focussed on samples taken from two separate locations within the oil shale resource. A 3kg sample from each of the upper and lower bands (OSU & OSL) were provided by QEM from previously reported drill holes QEM2019 and QEM2020.

Samples were milled to a nominal top size of 2.36mm to facilitate subsequent chemical analysis and feed to oil extraction testing.

**Test Methodology**

The solvent extraction testing involved heating a slurry of oil shale and solvent in a batch autoclave at high pressure and a temperature typically in the range of 400°C to 450°C. Under these supercritical conditions the kerogen in the shale is converted to liquid and gaseous products. The solvent acts as a hydrogen donor solvent which assists the kerogen conversion.

The oil yield from solvent extraction tests is impacted by a range of factors including temperature, residence time, particle size, feed material properties, solids loading and solids / solvent ratio. The intention for the solvent extraction test was to demonstrate the effectiveness of solvent extraction for QEM's oil shale rather than optimising the different test conditions.

The volume of the oil shale feed utilised significantly expands on previous laboratory test work, which was conducted at the 8 grams to 12 grams range.

This subsequently enhances confidence in the potential viability of vanadium and oil shale extraction on a larger scale.

QEM Managing Director Gavin Loyden said both the vanadium and oil shale results had produced positive outcomes.

"Efficient extraction of both vanadium and oil shale at the Julia Creek project is critical for us to maximise the significant latent potential at the project and these results are a major step towards achieving this aim," Mr Loyden said.

"The first results demonstrate on a substantially larger scale that efficient extraction of these two commodities at the project is achievable.

"We will continue to optimise these great results in the coming quarters to further validate this innovative method of extraction for Julia Creek."

**Vanadium and Oil Shale Extraction**

The tests conducted by HRL indicate vanadium extraction of up to 71.5% based on a four-hour leaching time.

It is anticipated that by increasing leach time it will be possible to increase vanadium extraction. Further extraction tests will be undertaken over the coming quarters to optimise the vanadium results.



*QEM's pilot plant in action after being successfully commissioned in May.*

The latest results also indicate that the oil yields achieved from the first test work at the pilot plant were up to 142% greater than yields reported under a Modified Fischer Assay (MFA).

These enhanced yields were achieved via the use of a donor solvent during the extraction process.

The oil shale result is in line with expectations from previous laboratory scale work (see ASX announcement dated 21 July 2020).

However, the pilot plant result was conducted on a larger scale relative to the previous test work, whilst also accommodating for vanadium extraction, making the pilot plant result far more impressive.

**Opportunities to Improve Performance of the Pilot Plant**

During the first test run, there was a build-up of solid deposits (naphthalene) in the oil product collection equipment, and related pipework.

For subsequent tests, modifications have been implemented to the pilot plant operation to enable the collection of the oil product at a higher temperature in a liquid form and to prevent future build-up of solid material in the system.

These modifications are not expected to adversely impact extraction and yield recoveries.

The following changes will be implemented in the second test to increase the material processed and optimise the pilot plant yield:

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- Drying the feed oil shale prior to processing and purging inert gases to increase solvent partial pressure in the autoclave.
- Operate with an increased solvent to shale ratio to increase the amount of solvent available for oil extraction.
- Increasing the volume of shale processed to fully utilise the autoclave capacity.
- Increase the residence time at the target temperature in the autoclave.

Vanadium extraction testing following the oil recovery will assess longer leach times and further optimisation options, including alternative leaching processes that may be suited to the Julia Creek shale.

ENDS

*This announcement was authorised for release on the ASX by the Board of QEM Limited.*

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**ABOUT QEM**

QEM Limited (ASX: QEM) is a publicly listed company which is focussed on the exploration and development of its flagship Julia Creek Project, covering 250km<sup>2</sup> in the Julia Creek area of North Western Queensland.

The Julia Creek vanadium / oil shale project is a unique world class resource with the potential to utilise and deliver innovative and sustainable energy solutions, through the production of energy fuels and vanadium pentoxide. QEM strives to become a leading producer of liquid fuels and in response to a global vanadium deficit, also aims to become a global supplier of high-quality vanadium pentoxide, to both the nascent energy storage sector and the Australian steel industry.

This globally significant JORC (2012) Mineral Resource of 2,850 Mt @ 0.31% V<sub>2</sub>O<sub>5</sub> is one of the single largest ASX listed vanadium resources and represents a significant opportunity for development.

The tenements form part of the vast Toolebuc Formation, which is recognised as one of the largest deposits of vanadium and oil shale in the world and located less than 6km east of the township of Julia Creek. In close proximity to all major infrastructure and services, the project is intersected by the main infrastructure corridor of the Flinders Highway and Great Northern Railway, connecting Mt Isa to Townsville.

\*The information in this announcement that relates to the mineral resource and contingent resource estimates for the Company's Julia Creek Project was first reported by the Company in its IPO prospectus dated 20 August 2018 and supplementary prospectus dated 12 September 2018 (together, the "Prospectus") and the subsequent resource upgrade announcements ("Resource Upgrade") dated 14 October 2019 and 7 April 2022. The Company confirms that it is not aware of any new information or data that materially affects the information included in the Prospectus and Resource Upgrade, and in the case of estimates of Mineral Resources and Contingent Resources, that all material assumptions and technical parameters underpinning the estimates in the Prospectus and Resource Upgrade continue to apply and have not materially changed

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