ASX ANNOUNCEMENT **24 August 2022**

KEY TESTWORK SHOWS LIQUEFACTION MAKES ALPHA SUITABLE FOR PRODUCING BITUMEN

The recently completed liquefaction test program provides Greenvale's management team with an effective processing pathway for the Alpha Torbanite Project whilst significantly reducing potential carbon emissions.

Highlights

- **Liquefaction test program generates the heavy oil fractions required for bitumen production**
- **The highly favourable results provide 'proof of concept' for the liquefaction processing route**
- **Significantly reduced gas by-product enhances the environmental profile of the Alpha Project**
- **Refined liquefaction testing program that will underpin pilot plant design and Prefeasibility study now underway**

Greenvale Mining Limited (ASX: **GRV**, "**Greenvale**" or "the **Company**") is pleased to announce a major breakthrough in the development of its Alpha Torbanite Project in Queensland, with pivotal test work finding that the Liquefaction process is suitable for bitumen production.

The results of the first round of Parr Reactor test work demonstrate that liquefaction can be used effectively to generate oils within the heavy oil fractions (boiling > 300C) necessary to produce or can be added to bitumen blends.

In addition, the tests found that liquefaction generates significantly less gas by-product from the torbanite shale compared with the more traditional pyrolytic retorting process.

Greenvale Mining Executive Director Mark Turner said: "These are exceptional results which help to demonstrate the strong technical and commercial outlook for the Alpha project.

"The findings are a major breakthrough because they show that the preferred liquefaction processing route will make Alpha suitable for bitumen production while producing less carbon dioxide than the traditional pyrolytic method.

"Further tests will be undertaken at higher temperatures, also trialling a more targeted catalyst, to find the optimum conversion settings and improve the percentage of heavy oil fractions."

The test program, undertaken by PROCOM Consultants Pty Ltd, focused on determining if liquefaction of subcrop samples of the torbanite and cannel coal from Mine Gully could be achieved successfully and if more severe conditions could provide greater conversion of solids to liquids. Once proven at the next level of testing to better define yields, samples from logged

and preserved drill core will be studied to demonstrate representativity. Indication from ongoing resource definition studies is that these samples are representative of the main seams for initial testing of the liquefaction concept.

The tests were conducted in a Parr Reactor–with samples of the resultant gas, liquids and remaining solids taken to Bureau Veritas Laboratories in Brisbane, Adelaide and Mackay.

The analysis of the samples sent to Bureau Veritas Laboratories demonstrated that the liquefaction process undertaken by PROCOM was successful in deriving the desired heavy oil fractions without the relative amounts of associated gaseous waste materials present in the previous pyrolytic retort program. The quality and quantification of the heavy oils produced will be further investigated in the next round of testing in suitably qualified heavy oil laboratories. The quality and quantity will be affected by catalysts and the processing temperatures hence the ongoing program will focus on suitable material for bitumen and blends.

Processes for the recovery of products and the remnant solids from the produced and recycled oils are available and demonstrated in similar projects. The elements of the processes were demonstrated in the laboratory separations for this study.

The current yield profile is based on the assumption that the reduction of the mass of the solids processed was only converted to gas and liquids for this first round of testing as the system was fully enclosed in a leak-proof system, noting subsequent studies will improve the elements of the mass balance. The water balance will also be important and drying of the shale a consideration in the feed preparation. The processes are simple (wet milling using recycled oil) and reasonably well practised. Tests will be conducted to demonstrate feed preparation to achieve the desired consistency together with the utilisation of waste heat.

The ability to produce heavy oil fractions suggests that the liquefaction process can be utilised in the eventual production of commercial bitumen products. As bitumen is a loosely defined mixture with certain specific properties, it accommodates a breadth of different feed compositions to achieve a final desired blend. Tailoring the features attractive to the industry will require testing to quantify the target properties. Therefore, further work will be completed to refine the process and understand the nature of the residues and processes for managing all products to develop a final commercial processing pathway for Alpha.

The processes required to be demonstrated in a pilot plant are apparent from the work completed in this program. Design data for a pilot plant will be assembled from the results of the completed program and refined with the planned, scaled test program results.

The results of the pilot plant will become the basis of the Alpha pre-feasibility study.

PARR REACTOR TEST PARAMETERS

The Parr Reactor is an agitated reaction vessel that can be heated indirectly through a jacket. The temperature and pressure of the reagents can be closely measured, allowing for tighter temperature controls.

For each test, the Parr Reactor, which has approximately a 7-litre capacity, was partly filled with a base lubricating oil plus the cannel coal, torbanite, or a blend of both. The feed samples were ground to sub 200 microns by Stratum Laboratories and were stored in a sealed container until the time of testing. The resultant mixture was purposefully a pumpable slurry. The optimum feed particle size and the maximum solids concentration were not within the tested parameters of this program and will look to be optimised in subsequent testing.

The Parr Reactor was then heated to the required temperature at a maximum heating rate of approximately 2 degrees Celsius per minute, with the pressure in the reactor rising with the temperature. Gas samples of the vapour were taken at either peak temperature or after the reactor had cooled down. Once the maximum temperature had been reached, heating was turned off and the temperature of the reagents cooled down at approximately 2 degrees Celsius per minute to below 160C.

The reactor was then allowed to cool further before the system was depressurised, the oil and other contents removed and then stored in sample bottles with a nitrogen overpressure. The samples were then sent to the Bureau Veritas Laboratories in Brisbane.

The test program was limited to 5 tests to understand the potential for this liquefaction concept.

The derived oils were collected and preserved for each run. The oils on standing separated into two phases, a lighter oil which could be decanted and the remnant solids which attracted more predominantly heavier oil fractions. The solids were washed with hexane to recover the heavy oil and the hexane was removed by applying vacuum and gentle heat. The solids were dried to remove traces of hexane. The two liquids and the solids were then subjected to standard GC and volatility analyses and compared to the base oil and the initial feeds.

Table 1: Parr Reactor Test Matrix

Sample	Symbol	Temperature °C	Pressure kPa	Catalyst
Cannel Coal	B1	340	3,500	#1, 1.5wt%
Torbanite	F1	290	1,750	#1, 1.5 wt%
Torbanite	F2	345	3,500	#1, 2 wt%
Mixed 50/50 Coal: Torbanite	MFB1	349	3,500	#1/2, 1.5 wt%
Mixed 70:30 Coal: Torbanite	MFB2	340	3,500	#2, 0.8 wt%

Note: Two different catalysts were used and are designated #1 and #2.

The testing matrix (Table 1) allowed for the following data comparisons:

- Performance of coal vs torbanite under similar conditions
- Performance of torbanite under increasing severity – temperature and pressure
- Performance of different blends of coal and torbanite under similar conditions, including the proportions in the overall mine
- Indication of the impact of two similar catalysts at varying concentrations

TEST RESULTS

The torbanite and the cannel coal broke down to varying degrees during the liquefaction trials. Little reacting solid was converted to gaseous hydrocarbons from torbanite but increasingly more is generated from cannel coal.

Over 35% of a torbanite sample was converted to liquids in this test program. This is achieved at a temperature 100 degrees lower than that required for pyrolysis reactions to achieve this weight loss. A lower reaction temperature to achieve this breakdown directionally results in less gas generation and higher relative yields of heavy oil from the torbanite. The highest amount of gas in the vapour space of the reactor at high temperature was for the torbanite F2 sample, where an amount of hydrogen gas estimated 6 grams of the 716.3 grams added as feed was converted to gas or less than 1% by weight.

The primary source of gas production is the cannel coal, with more CO_2 liberated from the coal relative to the Torbanite – this is the nature of the different feed types.

The results are presented in **Table 2** for each of the different phases against each of the five different test runs on the Parr reactor.

Table 2: Summary of estimated balances

Comment	B1 HT	B1 LT	F1 LT	F2 HT	MFB1 HT	MFB2 (Note 1)
Feed Total (grams)	716.3	716.3	716.3	716.3	716.3	716.3
Solids separated from reactants (grams)	555.7	555.7	592.7	455.8	615	587.1
Overall conversion of solids (%)	22%	22%	17%	36%	14%	18%
Solids converted total (grams)	160.6	160.6	123.6	260.5	101.3	129.1
Solids to waste gas (grams)	48.01	23.40	4.29	9.49	36.83	-
Solids converted to Hydrocarbons (grams)	112.59	137.20	119.31	251.01	64.47	-
Solids converted to Hydrocarbons (%)	16%	19%	17%	35%	9%	-
HC Gas (grams)	0.17	0.56	0.50	6.29	1.32	-
HC Liquid (grams)	112.42	136.64	118.82	244.71	63.15	-

Note 1: no gas sample was taken for analysis for the MFB2 sample hence conversion data is not available.

CONCLUSIONS & FURTHER WORKS

The test results are encouraging and provide a good basis for developing a subsequent laboratory scale program aimed at improving liquid yields and maintaining them at a high-temperature range between 400 - 450C.

Subsequent tests should be completed in a shorter timeframe as the Parr Reactor is now operating well and may be re-rated to achieve higher temperature trials. Laboratories and test procedures are established and are all experienced in the tasks at hand. More emphasis will be placed on completing the mass balances between solids loss and hydrocarbon generated and the quality of the oils produced. While the initial conceptual work will continue to be undertaken on the bulk sub crop samples, confirmatory testing will be undertaken on the preserved core once the optimum conditions for the tested samples are determined to enable comparisons.

The catalysts trialled are normally used in industry to break down heavy oil and reduce its molecular weight, as in a catalytic cracker in a refinery. Further tests will be undertaken with the publicly recorded catalysts typically used for coal liquefaction to improve the conversion of solids. For future tests, several catalysts are under consideration.

Having determined that both the cannel coal and torbanite will liquify to varying extents, more emphasis will be focused on studying the liquefaction of typical mine blends of Torbanite and Cannel Coal. Using a typical mine blend will simplify the mining and feed preparation operations.

The spent feed quality from a liquefaction process is yet to be determined, but by design intent, it will be adequately processed to ensure it is suitable for placement into the mine with backfill following the removal of hydrocarbons.

The data from this initial program will be expanded in subsequent studies to demonstrate a range of processing detail such as feed preparation requirements to allow the design of a pilot plant which will accept the expected feed quality range over the life of the mine and provide bulk samples for testing and design data for the demonstration of the liquefaction technology, subsequent production and separation of bitumen and blend stocks and processing of the resultant waste and by-product streams. The capacity of the pilot plant will be determined to optimise learning and minimise costs with the preference to use existing pilot plants or equipment to reduce the delivery time frame.

Data derived from the operation of the pilot plant plus a range of support studies can then be applied to the design of the production facility and to refine project costs and timeframe with more certainty.

Authorised for release

This announcement has been approved by the Board for release.

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COMPETENT PERSON'S STATEMENT:

The information in this report that relates to Exploration Results is based on information compiled by David Cavanagh, a Competent Person who is a Member of The Australasian Institute of Mining and Metallurgy AusIMM Member number 112318

David Cavanagh is a full-time employee of Core Resources.

David Cavanagh has sufficient experience that is relevant to the style of mineralisation and type of deposit under consideration and to the activity being undertaken to qualify as a Competent Person as defined in the 2012 Edition of the 'Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves'.

David Cavanagh consents to the inclusion in the report of the matters based on his information in the form and context in which it appears.

JORC Code, 2012 Edition – Table 1 Report

Section 1 Sampling Techniques and Data

(Criteria in this section apply to all succeeding sections.)

Criteria	JORC Code explanation	Commentary
Sampling techniques	• *Nature and quality of sampling (e.g. cut channels, random chips, or specific specialised industry standard measurement tools appropriate to the minerals under investigation, such as down hole gamma sondes, or handheld XRF instruments, etc). These examples should not be taken as limiting the broad meaning of sampling.* • *Include reference to measures taken to ensure sample representivity and the appropriate calibration of any measurement tools or systems used.* • *Aspects of the determination of mineralisation that are Material to the Public Report.* • *In cases where 'industry standard' work has been done this would be relatively simple (e.g. 'reverse circulation drilling was used to obtain 1 m samples from which 3 kg was pulverised to produce a 30 g charge for fire assay'). In other cases more explanation may be required, such as where there is coarse gold that has inherent sampling problems. Unusual commodities or mineralisation types (e.g. submarine nodules) may warrant disclosure of detailed information.*	• Refer ASX announcement 8 October 2021
Drilling techniques	• *Drill type (e.g. core, reverse circulation, open-hole hammer, rotary air blast, auger, Bangka, sonic, etc) and details (e.g. core diameter, triple or standard tube, depth of diamond tails, face-sampling bit or other type, whether core is oriented and if so, by what method, etc).*	• Not applicable to this announcement

Drill sample recovery	• *Method of recording and assessing core and chip sample recoveries and results assessed.* • *Measures taken to maximise sample recovery and ensure representative nature of the samples.* • *Whether a relationship exists between sample recovery and grade and whether sample bias may have occurred due to preferential loss/gain of fine/coarse material.*	• Not applicable to this announcement
Logging	• *Whether core and chip samples have been geologically and geotechnically logged to a level of detail to support appropriate Mineral Resource estimation, mining studies and metallurgical studies.* • *Whether logging is qualitative or quantitative in nature. Core (or costean, channel, etc) photography.* • *The total length and percentage of the relevant intersections logged.*	• Refer ASX announcement 8 October 2021
Sub-sampling techniques and sample preparation	• *If core, whether cut or sawn and whether quarter, half or all core taken.* • *If non-core, whether riffled, tube sampled, rotary split, etc and whether sampled wet or dry.* • *For all sample types, the nature, quality and appropriateness of the sample preparation technique.* • *Quality control procedures adopted for all sub-sampling stages to maximise representivity of samples.* • *Measures taken to ensure that the sampling is representative of the in situ material collected, including for instance results for field duplicate/second-half sampling.* • *Whether sample sizes are appropriate to the grain size of the material being sampled.*	• The bulk sample was taken in substantial quantities of over 50 kilograms and of both torbanite and cannel coal portions of the subcrop. Samples were held by Stratum and Subsampling for this exercise was undertaken by Stratum Laboratories. • Pulverisation to sub-200 micron was undertaken by Stratum Laboratories • A 716.3g sample split was taken of pulverised Torbanite or Cannel Coal for each Parr Reactor test
Quality of assay data and	• *The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total.* • *For geophysical tools, spectrometers, handheld XRF*	• Samples were stored under nitrogen and transferred to Bureau Veritas laboratories who uses standard techniques to separate solids and oil fractions, then performed standard analyses on the different splits.

laboratory tests	*instruments, etc, the parameters used in determining the analysis including instrument make and model, reading times, calibrations factors applied and their derivation, etc.* • *Nature of quality control procedures adopted (e.g. standards, blanks, duplicates, external laboratory checks) and whether acceptable levels of accuracy (i.e. lack of bias) and precision have been established.*	
Verification of sampling and assaying	• *The verification of significant intersections by either independent or alternative company personnel.* • *The use of twinned holes.* • *Documentation of primary data, data entry procedures, data verification, data storage (physical and electronic) protocols.* • *Discuss any adjustment to assay data.*	• Not applicable to this announcement
Location of data points	• *Accuracy and quality of surveys used to locate drill holes (collar and down-hole surveys), trenches, mine workings and other locations used in Mineral Resource estimation.* • *Specification of the grid system used.* • *Quality and adequacy of topographic control.*	• The sample was taken from a subcrop of Torbanite and Cannel coal in a tributary known as 'Mine Gully'. Although yet to be formally surveyed, the approximate location of 483520 E and 7333321 N in Coordinate system MGA55 GDA94 datum is expected to be accurate to +/- 30m
Data spacing and distribution	• *Data spacing for reporting of Exploration Results.* • *Whether the data spacing and distribution is sufficient to establish the degree of geological and grade continuity appropriate for the Mineral Resource and Ore Reserve estimation procedure(s) and classifications applied.* • *Whether sample compositing has been applied.*	• Not applicable to this announcement
Orientation of data in relation to geological structure	• *Whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type.* • *If the relationship between the drilling orientation and the orientation of key mineralised structures is considered to have introduced a sampling bias, this should be assessed and reported if material.*	• Not applicable to this announcement

Sample security	• *The measures taken to ensure sample security.*	• Refer ASX announcement 8 October 2021
Audits or reviews	• *The results of any audits or reviews of sampling techniques and data.*	• Not applicable to this announcement

Section 2 Reporting of Exploration Results

(Criteria listed in the preceding section also apply to this section.)

Criteria	JORC Code Explanation	Commentary
Mineral tenement and land tenure status	• *Type, reference name/number, location and ownership including agreements or material issues with third parties such as joint ventures, partnerships, overriding royalties, native title interests, historical sites, wilderness or national park and environmental settings.* • *The security of the tenure held at the time of reporting along with any known impediments to obtaining a licence to operate in the area.*	• Mineral Development Lease 330 was granted to Alpha Resources Pty Ltd on the 27th of August 2007 and an extension of a further five years has now been granted ending 31/01/2027.
Exploration done by other parties	• *Acknowledgment and appraisal of exploration by other parties.*	• Refer ASX announcement 8 October 2021
Geology	• *Deposit type, geological setting, and style of mineralization.*	• The deposit is a Torbanite and Cannel coal formation which is formed in a sedimentary environment.

Drill hole Information	• *A summary of all information material to the understanding of the exploration results including a tabulation of the following information for all Material drill holes:*
	  ○ *easting and northing of the drill hole collar*
	  ○ *elevation or RL (Reduced Level – elevation above sea level in metres) of the drill hole collar*
	  ○ *dip and azimuth of the hole*
	  ○ *down hole length and interception depth*
	  ○ *hole length.*
	• *If the exclusion of this information is justified on the basis that the information is not Material and this exclusion does not detract from the understanding of the report, the Competent Person should clearly explain why this is the case.*
		• Not applicable to this announcement

Data aggregation methods	• *In reporting Exploration Results, weighting averaging techniques, maximum and/or minimum grade truncations (eg cutting of high grades) and cut-off grades are usually Material and should be stated.* • *Where aggregate intercepts incorporate short lengths of high grade results and longer lengths of low grade results, the procedure used for such aggregation should be stated and some typical examples of such aggregations should be shown in detail.* • *The assumptions used for any reporting of metal equivalent values should be clearly stated.*	• Not applicable to this announcement
Relationship between mineralisation widths and intercept lengths	• *These relationships are particularly important in the reporting of Exploration Results.* • *If the geometry of the mineralisation with respect to the drill hole angle is known, its nature should be reported.* • *If it is not known and only the down hole lengths are reported, there should be a clear statement to this effect (eg 'down hole length, true width not known').*	• Not applicable to this announcement
Diagrams	• *Appropriate maps and sections (with scales) and tabulations of intercepts should be included for any significant discovery being reported These should include, but not be limited to a plan view of drill hole collar locations and appropriate sectional views.*	• Not applicable to this announcement
Balanced reporting	• *Where comprehensive reporting of all Exploration Results is not practicable, representative reporting of both low and high grades and/or widths should be practiced to avoid misleading reporting of Exploration Results.*	• Not applicable to this announcement
Other substantive exploration data	• *Other exploration data, if meaningful and material, should be reported including (but not limited to): geological observations; geophysical survey results; geochemical survey results; bulk samples – size and method of treatment; metallurgical test results; bulk density, groundwater, geotechnical and rock*	• The subsamples of torbanite, cannel coal and two different blends (50/50 and 63/37) were supported by a base lube oil free or additives and then jointly subjected to pressure and temperature under a hydrogen atmosphere with either of two different industry catalysts.

	characteristics; potential deleterious or contaminating substances.	• The results showed that the torbanite suffered a weight reduction in the test procedure from 17 to 35% w/w under increasing temperature (289 – 345^{o}C) and (1750 – 3500 kPa) pressure. • Less than 1% w/w of the torbanite was converted to hydrocarbon gas at 345^{o}C • Cannel coal weight loss was more influenced in the loss through the production of CO and CO_2 with much lower conversion to hydrocarbon liquids (about 17% w/w (results at 16 and 19% for samples taken at different temperatures) at the higher temperature of 348^{o}C.
Further work	• *The nature and scale of planned further work (eg tests for lateral extensions or depth extensions or large-scale step-out drilling).* • *Diagrams clearly highlighting the areas of possible extensions, including the main geological interpretations and future drilling areas, provided this information is not commercially sensitive.*	• The announced results form a basis for developing a subsequent laboratory scale program aimed at improving liquid yields and maintaining them at a high-temperature range between 400 - 450C. • Trial of other catalysts will be undertaken with a view to optimising yields • Increased focus on liquefaction at various blends of Torbanite and Cannel Coal • Establish quality of spent feed • Eventual design of pilot plant

Table 1: Historical exploration work undertaken at Alpha

Company	Work	Year	Remarks
Local Syndicates	Shaft	1939-1945	Prospecting, not systematic and not recorded
Queensland Department of Mines	Series QDM drilling	1942-1944	Government geological supervision; 15 holes
International Mining Corporation (IMC)	Series GA/ RDH drilling	1979-1981	McElroy Bryan & Associates; supervision 16 holes
JFH Murray & Associates	Survey	1980	Establish benchmarks and survey for drilling
Greenvale Esperance	GE 1-8	1980-1984	Resource definition with geological supervision
Queensland Nickel	Analyses	1981	Oil shale as chemical reductant in nickel ore processing
Petrobras Brasil	Analyses	1981	Retorting studies on 100 kg sample
Tosco USA	Analyses	1981	Retorting studies on 100 kg sample
BKS Surveys	Survey	1983	Benchmark survey and drill collars for ARL
Rankin & Hill	Resource estimation	1984	Engineering study
Greenvale Esperance	GE 9-38	1985-1987	Resource definition with geological supervision
Coal and Carbon Industries	Analyses	1987	Retorting studies produced gasoline, kerosene,
Bitumen Study	Market study	1987	Used for road surface, Alpha deposit could supply Queensland's Annual requirements
CSIRO	Analyses	1988	Bench-scale retort tests
Inland Oil Refineries	Microstill	1989	Mini refining concept for remote fuel supply
Daniel Madre	Open pit study	1990	10-year preliminary mine plan to produce 200,000 Barrels oil/year
Northlake Industries Inc.	Analyses	1992	Retorting tests
University of Kentucky	Analyses	1994	Production potential for activated carbon

Source: Madre, D A, 2016. EPM25795 Annual Report of Exploration Work from 22 December 2014 to 21 December 2015, report prepared for Alpha Resources Pty Ltd (internal report)