ADDITIONAL INFORMATION #1

regarding

PROPOSAL

The Development of Cellular (Foam) Glass Products Utilising Waste Glass and Specific Industrial Waste Materials

COMMERCIAL IN CONFIDENCE

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1. Overview

This additional information document was formulated following discussions with Mr. Andrew Pickering, Investment Manager, Centre for Energy and Greenhouse Technologies (CEGT) on Wednesday, June 1, 2005 and is in direct response to a range of questions raised by CEGT in relation to the original cellular glass proposal.

2. Raw Materials Definitions

In order to properly determine those raw materials which can be applied to this technology we need to first define the term "glass". In essence, glass can be defined as a supercooled liquid which forms a non-crystalline solid.

This not only includes common glass (which is sometime referred to as lime-soda glass) but also a range of other materials which have undergone some type of a vitrification (glass forming) process. The distinct advantage of these materials is that they are almost always waste products and as such represent a low or no-cost, readily available raw material source.

The types of raw materials that can be considered as potential feed materials for this foaming process include:

i. Waste Glass – glass is obviously the primary raw material utilised in foam or cellular glass applications and as such its use will be foundational to this project, especially in the area of gassing agent selection. Any waste glass material can be utilised in the cellular glass process and there will be no requirement for pre-conditioning other than reducing the glass to the most appropriate grain size for optimum foaming (this has already been determined).

As with Mineral Strategies other extensive materials technology developments it is highly likely that a range of **hybrid** foam glass products will also be developed (investigated). This will involve the incorporation of waste glass (i.e. coloured and non-coloured, container glass, plate glass and specialty glass) with a slag or other glass-like waste material to produce a specific foam glass product. These hybrid products are important as they often provide very specific properties and can help to utilise materials that may not get used in their own right.

ii. Slags – derived from the metallurgical and mineral processing industries, slags are often "managed" in such a way that they exhibit "glass-like" physical properties (i.e. heating and cooling profiles) even though they do not exhibit "glass-like" chemical properties. If the chemical make-up of these materials can be satisfactorily managed (i.e. no leaching or reactivity issues) then most will be amenable to a foam or cellular glass process.

For example, the "black sand" generated as a result of the lead (Pb) smelting process at Zinifex's Port Pirie (SA) operation, has great potential for conversion into a foam glass *product. The “Black Sand” does not comprise anything akin to common glass chemistry but it has been through a vitrification-style process and as such it exhibits glass-like behaviour in terms of its physical characteristics. To this end the “Black Sand” can potentially be used as the primary raw material for foam glass manufacture instead of being relegated to a large, open waste dump which currently receives 250,000 tonnes of this material every year. One other characteristic of the black sand which is highly beneficial is the fact that it comprises a considerable percentage of minus 100 micron material and as such would necessitate only minor additional processing (i.e. milling).*

The Environmental Superintendent at Zinifex’s Port Pirie Operation, Mr. Rob Hosking, has indicated his interest in having their “black sand” incorporated into a foam glass investigation.

Various “waste” materials are generated right across the manufacturing and industrial sectors via smelting, sintering, fuming and similar processes and some of these certainly have the physical properties that would make them amenable to a foaming process. Certain fly-ash materials would almost certainly be amenable to this process.

iii. Natural Products – there are natural products such as obsidian (volcanic glass) and rhyolite (an extrusive igneous rock) which by their very nature of formation comprise a major glassy component. Some of these volcanic rocks are exploited to produce insulating materials and fire retardant products (i.e. some types of rock wool). However, whilst some of these materials are available they do not represent an energy or waste minimisation opportunity as they are mined and processed specifically for the aforementioned applications.

3. Finished Products & Applications

Cellular / foam glass products can be used for a wide variety of applications, such as:

- wall panels – both external and internal applications,
- flooring systems,
- ceiling systems (as small panels),
- blocks (virtually any shape is achievable),
- pipes (both underground and above-ground),
- vessels and storage tanks,
- specific shaped products,
- insulation applications (pipe lagging, roof insulation etc),
- render applications,
- aggregates for light weight concrete,
- aggregates for ground stabilisation and foundations, and
- architectural products.

As far as this proposal is concerned **the primary focus** for end use application is in the development of **external and internal walling / cladding systems** for both domestic and commercial construction.

This would place the foam glass product into a burgeoning market place where it would be able to readily compete, on both a price and performance basis, with the current market leader in lightweight panel systems.

The current market leader in lightweight panel systems is CSR with their Hebel lightweight concrete panel product. The Hebel product is essentially a lightweight concrete made from a mixture of sand, cement and lime combined with a gas forming agent, aluminium paste, which is then steam cured in an autoclave. It is often referred to as Autoclaved Aerated Concrete (AAC) or Autoclaved Lightweight Concrete (ALC).

Sand is ground to the required fineness in a ball mill prior to being automatically weighed out with the cement and lime components. Water and aluminium paste are added and following a specified mixing time the cementitious slurry is poured into a mould. The aluminium paste reacts with the alkaline elements in the cement and lime and forms hydrogen gas.

The liberated gas expands the mixture forming extremely small, finely dispersed air spaces. The product is removed from the moulds after a few hours and transported to a cutting machine (wire cutting).

The final curing of the product takes up to 12 hours under steam pressure in an autoclave. For reinforced panels, corrosion protected steel reinforcing mesh is placed in the mould prior to the cement mixture being added.

According to CSR's Product Manager, Paul Mooney (press release September, 2004), CSR Hebel has doubled in size in the last five years and is forecast to grow at 10 – 15% per annum for the foreseeable future, with much of this growth predicted to come from the residential construction market.

CSR has virtually no competition in the market place for lightweight panel products and given the excellent growth forecasts this represents the best entry point for a product which will out-compete the Hebel product in both price and performance terms.

4. Worked Completed To Date

Whilst some minor experimental work has been completed to date the bulk of the work has been investigatory in nature.

Mineral Strategies has undertaken considerable research in relation to cellular glass, via:

- the internet,
- direct contact with companies involved in cellular glass manufacture, and;
- literature searches.

Specifically, Mineral Strategies has undertaken research into the following:

- raw material types and availability,
- gassing agents – specific properties and availabilities,
- market dynamics in the civil construction market including barriers to entry,
- industry trends including vested interest groups,
- intellectual property issues, and;
- opportunities for joint venture / partnering arrangements etc.

From a practical perspective Mineral Strategies has conducted minor furnace work to test some of its hypotheses and these have proven to be correct. Further experimental work has not been conducted due primarily to time and cost constraints and the fact that a more appropriate furnace will be required to hone the initial results.

To date, Mineral Strategies has conducted approximately 185 hours of self-funded research and investigation (includes all on and off-line research, meetings, discussions etc.) which at its current hourly consulting rate amounts to an expenditure of A$32,375 (ex-GST).

Mineral Strategies is convinced in relation to the technical feasibility of this process (as is evidenced by similar operations in Europe and the United States) and believes that the next steps should involve targeted development work on 2 or 3 specific waste materials and 2 or 3 specific gassing agents with a view to developing the most cost effective, high performance, lightweight wall panel product possible.

5. Market Development

The civil construction market presents itself as a bitter-sweet opportunity in that it is experiencing consistent, high level growth but it is also largely dictated to by a small number of major vested-interest companies.

Nevertheless, CSR has been highly successful in moving its Hebel Panel product into the market place over the last 16 years (built a A$34 million plant in Somersby, NSW in 1989) and is still experiencing double digit (15%) growth currently.

A cellular glass panel product will be able to readily compete with the CSR Hebel Panel product due to the following:

- its lower unit cost of around A$250 /$m^3$ as compared to CSR Hebel panel ranging from A$400 – A$600 /m^3,

- its lower density of around 225 kg/m^3 as compared to CSR Hebel densities ranging from 470 kg/m^3 to 650 kg/m^3,

- its lower Coefficient of Thermal Expansion of 9×10^{-6} as compared to CSR Hebel at 10×10^{-6},

- its chemically inert nature as opposed to CSR Hebel which needs to be protected against high concentrations of carbon dioxide, sulphates, chlorides and strong acids,

- its dimensionally stable nature as compared to CSR Hebel with a long term shrinkage of 0.2 mm per metre of length,

- its comparable to superior compressive and flexural strength, acoustic properties and fire retardant properties,

- it doesn’t produce hydrogen gas (explosive over wide concentration ranges with oxygen on sparking) as the CSR Hebel process does,

- it doesn’t require the lengthy curing times need for CSR Hebel (up to 12 hours),

- it is able to utilise a number of gassing agents whereas the CSR Hebel product is dependent on aluminium paste which is very expensive.

Given that the cellular glass product has the potential to wrest market share away from CSR Hebel as well as displace other traditional construction products (i.e. bricks, blocks, tilt-up concrete panels etc.) it is considered of strategic importance to understand the potential for joint venture or partnering arrangements when assessing market entry.

A number of companies (i.e. MSP Group Pty Ltd, Premix Concrete (SA) Pty Ltd and Global Finance and Trading Pty Ltd) have indicated their interest in the end-use application of the cellular glass products but of these, the MSP Group – a vertically integrated, civil construction company turning over A$130 million p.a. – is the one which is most able to facilitate the introduction of these products into the market place.

This would occur both through its highly developed network (eg. the same family owns the largest building firm in SA, Fairmont Homes which turns over A$500 million per annum and a highly successful boutique building company called Rendition Homes) as well as its ability to utilise these products in its own right (i.e. manufactures concrete products including tilt-up panels from its own concrete business, Hallett Concrete).

If the MSP Group (via their MD and sole shareholder Mark Pickard) decides to get involved in the development of this cellular glass product it will also benefit from the fact that the MSP Group has one of the best transport and logistics subsidiaries in the State providing a virtually seamless channel into the market place.

Direct head-to-head competition with major players such as CSR, Boral, Rocla etc. is unlikely to be successful and as such a step-wise approach to market capture will be undertaken with a focus on steady, long-term growth. Other niche markets such as architectural panels, shaped panels and special purpose panels (i.e. long span) will provide avenues for further market exposure and revenue generation without off-siding the major players.

Our vast experience with these companies (directly) over time has also shown that a successful entry into the market place is likely to culminate in a buy-out offer and depending on the way in which the company is structured (investor profile) this could present itself as a highly lucrative opportunity in the longer term.

In addition, one of the management team, Peter Graham, mentioned in the original proposal operates a highly successful civil engineering firm which has an extensive network (nationally) in the engineering, architectural and design sectors in both the residential and commercial markets. Peter is often called upon to make recommendations in relation to material selection on large projects and has already indicated that he would be strongly endorsing a product such as the cellular glass should it deliver the desired results.

In addition, we have already been involved in a number of projects where we have been required to provide environmental expertise in relation to new building projects being developed in line with the Green Building Council of Australia's Green Star Manual. This recognises and awards points to construction companies based on the incorporation of environmentally friendly practices in construction materials selection and waste management. Virtually all of the major construction companies across Australia are now signatories to the Green Star Code of Practice.

6. Financial Considerations

Based on the minor amount of direct "experimental" work conducted to date it is difficult to assign absolute costs to the development of such a product. In addition, there are some economies of scale that come into consideration with this product meaning that a larger plant will deliver a better unit cost per cubic metre but this must be tempered by the actual size and nature of the market place (including growth forecasts).

The costs outlined in the original proposal, based on information gleaned from the UK Government's WRAP (Waste and Resources Action Programme) Group, are the best large scale cost indications that we currently have available. These costs, in turn, are based on information released to the WRAP Group by cellular glass manufacturers in Europe and the United States of America.

A plant capable of processing 50,000 tonnes of waste glass per annum was deemed to have the best return although plants of a much smaller size (down to 10,000 tonnes per annum) were also shown to be financially robust. The costing information outlined on page 8 of the original proposal is the best that I currently have in hand.

It should be noted that a plant capable of processing 10,000 tonnes of waste glass (or glass-like material) will be able to produce around 44,400 cubic metres of foam glass per annum (based on a density of ~225 kg/m^3).

For an average sale price equivalent to CSR Hebel panel of A$65 /$m^2$ (for a 100 mm thick panel) a cellular glass plant processing 10,000 tonnes of waste glass will be able to generate a revenue of at least A$28.9 million per annum at a cost of around A$4.7 million per annum (based on A$105 /$m^3$ to take into account the poorer unit cost for a small scale plant).

Note: the value of A$105 /$m^3$ is based on a 50% increase in the base cost of A$70 /$m^3$ as released to the WRAP Group from one of the cellular glass manufacturers in the United States. The 50% increase is simply there to accommodate for the increase in unit cost in moving from a 50,000 tonne to a 10,000 tonne per annum operation.

7. Funding Considerations

The following sections outline our position in relation to research and development work (as interpretations differ somewhat) and to provide a breakdown of the funding value outlined in the original proposal.

i. Research Versus Development

Whilst the original proposal made reference to research work it does not make up a significant proportion of this particular project (poor use of terminology).

Mineral Strategies has conducted enough work to determine that the cellular glass process (as we would like to develop it) is robust, with the primary exception being the “black sand” at Zinifex which will require a furnace temperature slightly higher that what we have been able to access to date.

As an aside, the only appropriate furnace set-up we have been able to locate for the black sand aspect is located at the University of SA (Mawson Campus) and this is no longer available to us as the Mining, Metallurgy and Minerals Processing Schools have been closed and the equipment has come under the control of an on-site Co-operative Research Centre. In addition, getting access to the right milling equipment has been difficult as the University of SA under the recommendation of this same high profile Co-operative Research Centre will not contract out their equipment or services to us or enable us to lease any lab space (as we were very hopeful of and alluded to in the original proposal).

Given that it has been difficult to get access to specific process information from the cellular glass manufacturers overseas (despite the fact that we will use different gassing agents and potentially different raw feed materials) we are assuming that there will be development costs associated with getting the heating and cooling profiles exactly right (as these will dictate bulk density, strength, permeability, thermal and acoustic properties etc.).

This comes down to the issue of what is deemed as research and what is deemed as development work. We believe that true research makes up only a small percentage of the proposed program of work (10-15%) and the remainder is based on developing our understanding of how we will manage and ultimately commercialise our specific product stream. Of course, this will require that a substantial number of samples be produced in order to test our heating and cooling hypotheses, gassing agent blends and ultimately the ideal final blend.

Note: If all of this aforementioned work is deemed as research work we estimate that in order to self-fund the remainder of this work (from the funds generated via other consulting projects) we would not be in a position to re-apply for funding through CEGT for approximately 2 years.

ii. Funding Breakdown

In the original proposal the requested funding was estimated at around A$350,000. A breakdown of this funding is outlined below.

Note: If any CEGT funding protocols have been overlooked or omitted from this section it is entirely unintentional and we would welcome any adjustments accordingly. We haven't made any assumptions in relation to GST and will need to receive advice from CEGT as to how this is managed.

In relation to the three individuals involved in the management team, as outlined in the original proposal, they currently operate at different rates and as such it was agreed that we would use a standard base rate for all of our work in relation to this project. The standard consulting rates (ex-GST) that are currently used by each person are:

David Graham	A$250 / hour
Andrew Graham	A$175 / hour
Peter Graham	A$125 / hour

It was agreed that we would base all of our costs for this project around the lowest rate currently being used which is A$125 per hour.

As outlined in the original proposal the total hours allocated for the management team is:

Andrew Graham	1,080 hours (development work)	
David Graham	432 hours (process control & development work)	
Peter Graham	216 hours (market development work)	
Total	**1,728 hours @ $125 / hour**	**= $216,000**

Product testing (not product development) to determine strength, permeability, thermal conductivity, acoustic properties, reactivity etc. will need to be undertaken to properly characterise the foam glass prior to commercialisation. There are numerous NATA approved laboratories that can undertake this type of work. Some tests are conducted on a hourly basis and others on a flat fee basis.

Given that the number of tests required is not absolutely known at this stage we have asked these laboratories to give us as estimate of their hourly rate and have allocated what we consider to be the maximum number of hours to fully complete the test work.

AMDEL Limited and ANCON Beton have nominated rates of A$200 per hour (ex GST) whilst the University of SA has nominated a rate of A$150 per hour (ex GST).

As outlined in the original proposal the total hours allocated for the test work is:

AMDEL Limited	250 hours	
ANCON Beton	100 hours	
Sub Total	**350 hours @ A$200 / hour (ex GST)**	**= A$ 70,000**
UniSA	100 hours	
Sub Total	**100 hours @ A$150 / hour (ex GST)**	**= A$ 15,000**

As far as the major raw materials (i.e. waste glass, slags etc.) are concerned the primary cost will be the transport component and the cost of preparation (i.e. milling costs). For the gassing agents there will be the cost of purchase, transport and milling but given that the gassing agent will constitute no more than 4% by weight of the total product this will be a relatively small cost component.

If we utilise 15 tonnes of raw materials during this development phase we will require no more than 600 kilograms of gassing agent which may or may not need to be further processed (in most cases this will not be necessary).

The milling costs required to reduce waste glass from a coarse fraction to a 100 micron product have been nominated at approximately $250 per tonne (still to be confirmed) and would comprise a two stage process involving primary hammer milling and secondary ball milling (grinding). This function can be undertaken by AMDEL if required.

The costs allocated for the raw material purchase, transport, preparation and storage are:

Primary raw material	15.0 tonnes @ A$275 / tonne	= **A$ 4,125**
Gassing agent(s)	0.6 tonnes @ A$355 / tonne	= **A$ 213**

In order to undertake the development work a reasonable sized laboratory or pilot-plant furnace will need to be accessed on either a dry-hire basis or possibly as a capital purchase. If capital purchases cannot be made under this grant program but it is deemed more appropriate to purchase than hire a unit then Mineral Strategies will consider this purchase.

To hire a reasonable sized furnace for this project (which is capable of attaining 1,200 ºC) would cost in the region of **A$5,000** for the project period.

Mineral Strategies current laboratory facility is too small to undertake this project and as a result it is likely that additional space will need to be leased. It is estimated that around 120 square metres of space will be sufficient (includes storage space) and at a commercial leasing rate of A$65 per square metre (including outgoings) this would amount to around **A$7,800** per annum (if a 2 year lease is required Mineral Strategies would continue with the lease after this project was completed).

The funding can be summarised as follows:

Professional fees (ex GST)	= A$ 216,000
Test work (ex GST)	= A$ 85,000
Raw materials	= A$ 4,338
Lease of a furnace (if applicable under this grant)	= A$ 5,000
Lease of lab space (if applicable under this grant)	= A$ 7,800
Sub Total	**= A$ 318,138**
Contingency (5%) of Sub Total	= A$ 15,907
Total	**= A$ 334,045**

This amount falls short of the A$350,000 outlined in the original proposal but some leeway was made because we were unsure about how the GST affected grant funding. In addition we didn't know whether contingencies would form part of a grant funding cost proposal but these have been added in just in case (we will default to CEGT's advice in this regard).

8. Final Comments

The sections outlined above have been formulated in direct response to questions raised by Mr. Andrew Pickering, Investment Manager for CEGT following his review of the original proposal. This document is meant to be read in conjunction with the original proposal and is not a replacement for it.

Every attempt has been made to access the most up to date information and to present that information in a transparent manner.

If there are any further questions arising from this documentation they will be addressed in a subsequent report labelled "ADDITIONAL INFORMATION #2".

Andrew Graham