

ENERGY EFFICIENCY OPPORTUNITIES PUBLIC REPORT 2012

Cristal Australia Pty Ltd is a wholly owned subsidiary of The National Titanium Dioxide Company Limited (Cristal), a private company with headquarters in Jeddah, Kingdom of Saudi Arabia. In 2008, Cristal Australia Pty Ltd acquired all of the shares in Bemax Resources Limited (Bemax) and triggered participation in the Energy Efficiency Opportunity programme. Bemax was previously registered for EEO in it's own right. In 2012 Bemax Resources Limited was renamed Cristal Mining Australia Limited, though retaining the corporate history, ACN and ABN.

The company is one of Australia's premier mineral sands miners. Cristal's mining and mineral separation operations are located in two significant mineral sands provinces in Australia namely, the Murray Basin and south west Western Australia.

Historically, the company has grown through successful exploration and acquisitions, including the acquisition of the Western Australian based Cable Sands Group in May 2004, one of Australia's first Titanium minerals producers having commenced production in 1956. Cristal Mining West operations include the North Shore Mineral Separation Plant and the Gwindinup Mine site.

In late 2004 and early 2005, the company commenced construction of the Ginkgo Mine and Broken Hill mineral separation plant in the Murray Basin. The first heavy mineral concentrate production at the Ginkgo Mine was in December 2005 and commissioning of the Broken Hill mineral separation plant occurred in February 2006. Snapper, a new mine located a short distance from Ginkgo, was commissioned in 2011.

Part 1 - Corporation Details

Controlling Corporation

Cristal Australia Pty Ltd

Table 1.1 - Major Changes to Corporate Group Structure or Operations

Table 1.1 – Major Changes to Corporate Group Structure or Operations in the last 12 months

With exception of the name changes noted above, the structure of the group has not changed in the past 12 months.

Declaration

Declaration of accuracy and compliance

The information included in this report has been reviewed and noted by the board of directors and is to the best of my knowledge, correct and in accordance with the *Energy Efficiency Opportunities Act 2006* and *Energy Efficiency Opportunities Regulations 2006*.

Dominic Manganaro
Director Cristal Australia Pty Ltd

Date 27th December 2012

Part 2 - Assessment Outcomes

Table 2.1 – Assessment Details

Name of entity	North Shore Mineral Separation Plant (MSP)	
Total energy use in the last financial year	155,081	GJ
Total percentage of energy use assessed when assessments were undertaken	84	%

Description of the way in which the entity carried out its assessment

Cristal Australia contracted EnerVative Solutions, a specialist energy and climate change consultant, to facilitate the implementation of the Energy Efficiency Opportunity (EEO) at Cristal North Shore and Broken Hill plants. The approach taken was structured to meet the requirements of the EEO, while taking advantage of the existing engineering expertise at each site. The key activities for the North Shore MSP included:

1. Initial education of key staff on the requirements of the EEO.
2. An initial opportunity identification workshop was held involving a range of site and external personnel.
3. A gap analysis was undertaken in August 2008, to evaluate the 6 elements of the EEO against the current business practices, and provide recommendations.
4. Additional metering and upgraded process monitoring systems were installed to monitor energy use.
5. An energy mass balance has been prepared for the mineral separation plant.
6. Existing environmental management system (EMS) documentation has been updated and augmented as required to resolve the issues identified in the gap analysis.
7. In October 2011 a trial verification was undertaken by EnerVative Solutions to confirm the management system changes were successfully implemented.

In many cases smaller projects were directly implemented; larger projects were / are being further analysed and business cases developed.

Table 2.2 - Energy efficiency opportunities identified in the assessment

North Shore Mineral Separation Plant

Status of opportunities identified to an accuracy of better than or equal to ±30%		Total Number of opportunities	Estimated energy savings per annum by payback period (GJ)						Total estimated energy savings per annum (GJ)
			0 – 2 years		2 – 4 years		> 4 years		
			No of Opps	GJ	No of Opps	GJ	No of Opps	GJ	
Business Response	Implemented	4 ¹	4	3186					3186
	Implementation Commenced								
	To be Implemented								
	Under Investigation	11 ²			2	6,606	9	3,620	10,226
	Not to be Implemented	3 ²	1	607	1	385	1	500	1,492
Outcomes of assessment	Total Identified	18	5	3,793	3	6,991	10	4,120	14,904

Notes:

1. The total for implemented projects includes 2 projects that cover sub-metering and a new data storage system (Citect Historian).
2. Some projects previously categorised as “not to be implemented” are subject to additional review in consideration of changed circumstances (energy prices, technology etc). In addition new opportunities have been identified for analysis.

Name of entity	Gwindinup Mine
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Total energy use in the last financial year	141,857	GJ
Total percentage of energy use assessed when assessments were undertaken	55	%

Description of the way in which the entity carried out its assessment

Cristal Australia contracted EnerVative Solutions, a specialist energy and climate change consultant, to facilitate the implementation of the EEO at the Cristal Gwindinup mine. The approach taken was structured to meet the requirements of the EEO, while taking advantage of the existing engineering expertise on the site. Note that Gwindinup site was planned to cease mining production during the reporting period and commence the site rehabilitation phase. However while the mining activity was extended into the early part of the 2013 reporting period, the closure has influenced EEO activities. The contractor's diesel energy consumption has been highly variable from year to year due to the varying need for overburden removal. In 2010-11 contractor energy consumption was approximately zero, however in 2011-12 was significant, representing 45% of site total energy.

Most of the equipment from Gwindinup will be refurbished and relocated to the new mine at Wonnerup. The opportunities identified and lessons learned from the EEO analysis will be applied to the new mine at Wonnerup.

The key EEO assessment activities included:

1. Initial education of key staff on the requirements of the EEO.
2. An initial opportunity identification workshop was held involving a range of site and external personnel.
3. A gap analysis was undertaken in August 2008, to evaluate the 6 elements of the EEO against the current business practices, and provide recommendations.
4. Additional metering was installed to monitor energy use.
5. Commencement of energy analysis of the energy and material flows for the site associated with the material handling / pumping. This is an ongoing activity, which will be continued at the new mine site.
6. Existing EEO documentation prepared for the Cristal North Shore plant has been applied to the mine.
7. In many cases smaller projects were directly implemented; larger projects were / are being further analysed and business cases developed.

Table 2.2 - Energy efficiency opportunities identified in the assessment
Gwindinup Mine

Status of opportunities identified to an accuracy of better than or equal to $\pm 30\%$		Total Number of opportunities	Estimated energy savings per annum by payback period (GJ)						Total estimated energy savings per annum (GJ)
			0 – 2 years		2 – 4 years		> 4 years		
			No of Opps	GJ	No of Opps	GJ	No of Opps	GJ	
Business Response	Implemented	3	3	4,021					4,021
	Implementation Commenced								
	To be Implemented								
	Under Investigation								
	Not to be Implemented	8			7	250	1	390	640
Outcomes of assessment	Total Identified	11	3	4,021	7	250	1	390	4,661

Note that the Gwindinup mine, during the period covered by this report, was planned to cease mining activity and commence a rehabilitation phase. While the date for completion of mining was delayed, opportunities identified were viewed in this context. However the opportunities identified will be considered for the establishment of the new mine commencing during the 2013 reporting period.

Name of entity	Broken Hill Mineral Separation Plant
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Total energy use in the last financial year	55,029	GJ
Total percentage of energy use assessed when assessments were undertaken	80	%

Description of the way in which the entity carried out its assessment

Cristal Australia contracted EnerVative Solutions, a specialist energy and climate change consultant, to facilitate the implementation of the EEO at Cristal Broken Hill Mineral Separation plant. The approach taken was structured to meet the requirements of the EEO, while taking advantage of the existing engineering expertise at each site. The key activities included:

1. Initial education of key staff on the requirements of the EEO.
2. A gap analysis was undertaken in November 2008, to evaluate the 6 elements of the EEO against the current business practices, and provide recommendations.
3. An opportunity identification workshop was held in 2008 and revised in 2012, which involved a range of site personnel.
4. Ranking of the opportunities and developing business cases.
5. In many cases smaller projects were directly implemented by site; larger projects were / are being further analysed and business cases developed.
6. An energy mass balance (EMB) including technical analysis of data and opportunities was undertaken. The EMB was used to identify where the energy is used on site and uncover opportunities. The Broken Hill EMB is subject to additional ongoing analysis.
7. In January 2012 a trial verification was undertaken by EnerVative Solutions to confirm the management system changes were successfully implemented.

It's noted that a discrepancy in the 2011 LPG data was observed, which altered the total energy use for the 2011 reporting period. Measures are being undertaken to ensure the future data sets are accurate; this includes a new gas meter and an improved process for managing data.

Table 2.2 - Energy efficiency opportunities identified in the assessment

Broken Hill Mineral Separation Plant

Status of opportunities identified to an accuracy of better than or equal to ±30%		Total Number of opportunities	Estimated energy savings per annum by payback period (GJ)						Total estimated energy savings per annum (GJ)
			0 – 2 years		2 – 4 years		> 4 years		
			No of Opps	GJ	No of Opps	GJ	No of Opps	GJ	
Business Response	Implemented	11	11	21,934 ¹					21,934
	Implementation Commenced	3					3	6,811 ²	6,811
	To be Implemented								
	Under Investigation	15					15	2,400	2,400
	Not to be Implemented	1					1	100	100
Outcomes of assessment	Total Identified	30	11	21,934			19	9,311	31,245

1. The “implemented” opportunities total (21,934GJ) also includes opportunities, identified and implemented by Cristal MSP, which result in a 13,200GJ energy reduction by contractors with resultant financial saving flowing to Cristal. Cristal has operational control over the contractors.
2. The “implementation commenced” opportunities total (6,811GJ) include an opportunity, identified and being implemented by Cristal MSP through contract negotiations, which results in a 6,700GJ energy reduction by the contractor, with resultant financial saving flowing to Cristal. Cristal does not have operational control over this contractor.

Note the “implemented” opportunities total in the 2010 -11 Public Report included some management system type opportunities, which have been excluded from the 2011 -12 Public Report.

Name of entity	Ginkgo Mine
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Total energy use in the last financial year	323,556	GJ
Total percentage of energy use assessed when assessments were undertaken	55	%

Description of the way in which the entity carried out its assessment

Cristal Australia contracted EnerVative Solutions, a specialist energy and climate change consultant, to facilitate the implementation of the EEO at Cristal Ginkgo mine site. The approach taken was structured to meet the requirements of the EEO, while taking advantage of the existing engineering expertise at site. It's noted that 45% of the mine energy consumption is attributed to an earth moving contractor, which has changed during the reporting period. While some aspects of the contractor's activities which relate to mine planning have been assessed by Cristal, the remainder has been delayed due to other contractor issues.

The key activities included:

1. Initial education of key staff on the requirements of the EEO.
2. An initial opportunity identification workshop was held involving a range of site and external personnel.
3. A gap analysis was undertaken in August 2008, to evaluate the 6 elements of the EEO against the current business practices, and provide recommendations.
4. Additional metering and upgraded process monitoring systems were installed to monitor energy use.
5. The commencement of energy analysis, which is ongoing.
6. Existing EMS documentation has been updated and augmented as required to resolve the issues identified in the gap analysis.
7. In October 2011 a Gap analysis was undertaken by EnerVative Solutions to confirm the management system changes were successfully implemented.

In many cases smaller projects were directly implemented; larger projects were / are being further analysed and business cases developed.

Table 2.2 - Energy efficiency opportunities identified in the assessment

Ginkgo Mine

Status of opportunities identified to an accuracy of better than or equal to ±30%		Total Number of opportunities	Estimated energy savings per annum by payback period (GJ)						Total estimated energy savings per annum (GJ)
			0 – 2 years		2 – 4 years		> 4 years		
			No of Opps	GJ	No of Opps	GJ	No of Opps	GJ	
Business Response	Implemented	10	10	27,000 ¹					27,000
	Implementation Commenced								
	To be Implemented	5	4	1,800 ²			1	1,200	3,000
	Under Investigation	6					6	2,000	2,000
	Not to be Implemented	5					5	800	800
Outcomes of assessment	Total Identified	26	14	28,800			12	4,000	32,800

1. The “implemented” opportunities total (27,000GJ) also includes opportunities, identified and implemented by Cristal MSP, which result in a 4,300GJ energy reduction by a contractor with resultant financial saving flowing to Cristal. Cristal has operational control over the contractor.
2. The “to be implemented” opportunities total (1,800GJ) include an opportunity, identified and being implemented by Cristal MSP through contract negotiations, which results in a 1,400GJ energy reduction by the contractor, with resultant financial saving flowing to Cristal. Cristal has operational control over this contractor.

Table 2.3 - Details of significant opportunities identified in the assessment

Description of Opportunity No 1 – Gwindinup Mine Site (WA) Turn off part of the Attritioner Circuit when not required	Voluntary Information	
<p>Gwindinup mines mineral sands to recover valuable minerals such as rutile, leucoxene, zircon and ilmenite. The mineral rich sand is pumped to an initial mine based plant (the concentrator) to separate out the targeted minerals and undertake some cleaning before sending the high mineral material to a secondary plant in Bunbury for further processing.</p> <p>Analysis of the final stage of cleaning (the attritioner circuit) within the concentrator plant identified that when the quantity of mineral in the ore body being mined dropped below 10%, half of the attritioner circuit, which scrubs the clay off the grains, could be switched off. Switching off involved shutting a few valves and turning off 4 off 15kW motors, associated with the attritioners. No capital cost is involved.</p> <p>Implementing the project also required changes to the operational procedures to ensure the issue is considered by the mine planners and operators.</p>	Equipment Type	Pump / Motor drive
	Business Response	Implemented
	Energy saved (GJ)	670GJ
	Greenhouse gas abated (CO2-e)	153 Tonnes
	\$s saved	\$20,000
	Payback period	Immediate

Description of Opportunity No 2 – Gwindinup Mine Site (WA) Utilization of Clay Fines for Dust Suppression	Voluntary Information	
<p>Gwindinup mines mineral sands to recover valuable minerals such as rutile, leucoxene, zircon and ilmenite. The mineral rich sand is pumped to an initial mine based plant (the concentrator) to separate out the targeted minerals before sending the material to a secondary plant in Bunbury for further processing. One of the waste streams from the concentrator includes clay fines which have been scrubbed off the mineral grains. The clay rich waste water from the concentrator plant is pumped in to solar drying ponds. Once dry, which may take 2 years, the clay fines are then transported to the mined out ore body using electricity and diesel.</p> <p>An opportunity was identified to use the clay fines, sprayed onto the surface of some areas of exposed soil and tailings, to stabilise the soil and reduce the frequency of use of standard water carts for dust suppression, thus saving energy, labour and hire costs.</p> <p>Dust suppression on the mine site traditionally requires the hire of 5 diesel powered water carts that obtain their water from either the process water storage dam or the site production water bore. Electric pumps are also required to fill the water carts.</p> <p>Implementing the opportunity required the earthworks contractor to fit a slurry pump to one of the water carts and to modify the storage tank to enable the successful spraying of clay fines on the site.</p> <p>The project results in a reduction in equipment hire and labour costs, plus associated diesel and electricity used. Using the clay fines also allows a reduction in the solar drying pond volume required; further reducing equipment hire costs and diesel consumption.</p>	Equipment Type	Transport
	Business Response	Implemented
	Energy saved (GJ)	580 GJ
	Greenhouse gas abated (CO2-e)	40 Tonnes
	\$s saved	\$80,000
	Payback period	2 weeks

Description of Opportunity No 3 - Mineral Separation Plant (MSP) at Bunbury (WA) Installation of a Filter Belt	Voluntary Information	
<p>The Mineral Separation Plant (MSP) at Bunbury receives mineral carrying sand from local and interstate mines. One product type, classified as unwashed non-mags, requires washing and to be fully dry before it can be further processed in the dry circuit. Hence the ore enters a large rotating dryer where it is heated to 100 degrees Celsius to remove all remaining moisture. This process is energy intensive and to manage the use of energy, before entering a tunnel drier, the current activity is to store the ore in the yard for approximately 3 days until it has naturally dried to a sufficient level. This activity results in the material being double handled adding both delay to the process and adding cost.</p> <p>As a part of a larger improvement project an opportunity has been identified that will use filter belt technology to quickly remove the majority of moisture before entering the first process, taking away the need for air drying and cutting 3 days delay from the process. The inclusion of a filter belt in the process was identified as removing the need for double handling, cutting diesel fuel, reducing maintenance and labour costs, while at the same time improving the MSP throughput.</p>	Equipment Type	Transport / Material Handling
	Business Response	Under Investigation
	Energy saved (GJ)	6,400GJ
	Greenhouse gas abated (CO2-e)	440Tonnes
	\$s saved (potential)	\$200,000
	Payback period	This aspect, less than 6 months

Description of Opportunity No 4 – Ginkgo Mine Site (230 km from Broken Hill NSW) Replace Diesel powered light towers with photovoltaic / LED luminaire light towers	Voluntary Information	
<p>A major intersection on the mine haul road is lit at night to maintain safe operations. The existing 400W luminaires use metal halide lamps powered by a diesel generator. The existing equipment was hired from a local contractor; hence the existing running costs were high, including monthly rental, diesel and labour to regularly refill the fuel tank, plus ongoing maintenance on the engine and replacement of lamps. In addition to the costs, the risk of diesel spillage during daily filling of the fuel tank creates an environmental risk, which needs to be managed.</p> <p>A solution was identified to replace the existing diesel and 4,000W luminaire equipment with a 2 photovoltaic powered battery set each with new high efficiency 200W LED luminaire light towers.</p> <p>The new system was designed by the site team after investigating a range of issues including battery capacity and luminaires performance.</p> <p>The project demonstrated how LED luminaires and photovoltaic cells can successfully replace high cost and CO2e emitting diesel generator lighting systems. The solution is now being applied at other locations on the mine.</p>	Equipment Type	Lighting
	Business Response	Implemented
	Energy saved (GJ)	650GJ
	Greenhouse gas abated (CO2-e)	45 Tonnes
	\$s saved	\$55,000
	Payback period	5 months

Description of Opportunity No 5 – Ginkgo Mine Site (230 km from Broken Hill NSW) High Efficiency Impellers for Tails Pumps	Voluntary Information	
<p>The ore body at Ginkgo is below the water table; hence a dredge is used to extract the mineral sand and pump it to a concentrator. The concentrator is used to separate the high mineral content (HMC) material and return the process waste material to the pit via 3 600kW pumps. When the head feed grade (mineral content) drops, the process waste material increases, which means the 600kW pumps become overloaded and represent a restriction to production.</p> <p>An opportunity was identified to change the pump impellers to high efficiency thereby reducing the power drawn by 30% whilst still maintaining the same production. However while the energy saving is significant when running at the same <u>production</u> output, running the pumps at the same <u>power</u> draw allowed a 30% increase in production when the head feed grade is low. This also creates more flexibility to allow the operators to maintain production targets when the head feed grade (mineral content) drops. Hence the mine has increased operational flexibility while significantly improving one of the sites energy KPIs (HMC tonnes / GJ).</p>	Equipment Type	Pumping
	Business Response	Implemented
	Energy saved (GJ)	14,500GJ
	Greenhouse gas abated (CO2-e)	3,600 Tonnes
	\$s saved	\$500,000
	Payback period	6 months

Description of Opportunity No 6 – Mineral Separation Plant (MSP) Broken Hill NSW Reduction of Moisture Content in Material when transported	Voluntary Information	
<p>The Mineral Separation Plant (MSP) receives mineral sand from the Ginkgo mine, which is located 230km from the MSP. The process of extracting and removing unwanted material (trash) from the mineral sand leaves the mineral sand wet. Historically the material was then loaded and trucked the 230km to the MSP for additional treatment, with the moisture content historically ranging from 4% to 14%. It is also noted that when the moisture content is above 10%, the risk of the material sticking in the haulage truck tray when tipping off the load is increased, which has resulted in the haulage truck tipping over during unloading at the MSP. A high moisture content in material entering the plant results in more gas required in the initial phase at the MSP, where the first step is to dry the material.</p> <p>Analysis of the MSP energy and material flows identified the impact of the moisture content on the MSP's energy consumption, resulting in further analysis of the supply chain. Several process changes were undertaken, however this opportunity is the creation of a procedure to measure the moisture content of the material at the mine and load only when the moisture content is below 6%. As the moisture content is lower, the haul trucks can hold more mineral sand and still remain within weight limits. This resulted in less haul trips per year with significant reduction in energy, CO2e emissions and costs. In addition the safety risk is now managed.</p>	Equipment Type	Transport
	Business Response	Implemented
	Energy saved (GJ)	1,280GJ
	Greenhouse gas abated (CO2-e)	88 Tonnes
	\$s saved	\$130,000
	Payback period	Immediate

Description of Opportunity No 7 – Mineral Separation Plant (MSP) Broken Hill NSW Sale of the Tailings	Voluntary Information	
<p>The Mineral Separation Plant (MSP) receives mineral sand from the Ginkgo mine, which is located 230km from the MSP. The MSP separates out the target minerals from the high mineral content material leaving a significant quantity of by-product (mostly sand) which is returned to the mine for disposal.</p> <p>An opportunity was identified to sell the sand for use by other businesses in the Broken Hill area, which also avoids the need to freight the material 230km back to the Ginkgo mine and obtains a small commercial value for the sand.</p> <p>Cristal's contracts team identified a local company that needed the material and negotiated a contract of sale that included appropriate safeguards to ensure correct use. The project created a new product and revenue stream and had significant energy and cost saving through the removal of the need to transport the material back to the mine.</p>	Equipment Type	New Product
	Business Response	Implemented
	Energy saved (GJ)	227 GJ
	Greenhouse gas abated (CO ₂ -e)	15 Tonnes
	\$s saved	\$103,000
	Payback period	Immediate