

## Revisiting Halocell and Perovskites Solar Cell Technology

The correction we were looking forward to at the end of January was based on analysis of stocks on the ASX. When it commenced there were many share prices that were surprisingly resilient within longer terms uptrends, but that changed rapidly when the implications of the Iranian War became apparent. It required analysis of a real world disruption as opposed to a market analysis. The immediate direction of markets became dependent upon geopolitical pragmatism. All previous expectations were put on hold as investors were trying to make sense of where we might end up.

On Monday morning the "expert" commentary was mostly saying the heavy correction in the gold price was not all bad. It was seen as a consolidation move. Chinese were reported to still be buying gold aggressively such that there was a shortage of the physical commodity. So, it was being rationed. There seemed to be a consensus that the professionals were still in control of the gold market.

The gold price was pushed down lower in the first couple of days of the week and then it started to recover somewhat once the panic selling abated. However, there is still no end to the Iranian conflict in sight and the markets will continue to be soft until we get some good news on the ending of hostilities. Maybe then we can get back to resuming positive thoughts about the future direction of mining stocks.

### *Halocell Perovskite Technology Coming Back into Focus*

We have previously covered the unlisted company, Halocell (previously called Greatcell), showing it as a leading but early stage perovskite solar cell photo-voltaic (PV) company. Back then it was advancing its low-light modules for use indoors in products like remote control units for TVs and labels on supermarket shelf labels. However, more recently it has been looking at more exciting defence and aerospace initiatives.

### *Perovskites are the future of solar - we know that*

Perovskite solar cells have achieved efficiency levels comparable to that of silicon cells so that they are now starting to attract more attention. Silicon cells took 50 years to get to where they are now, but perovskite cells have caught up in just over 10 years. Perovskite industry promoters are saying that they represent a dramatic technological upgrade for green energy, with the technology continuing to evolve and improve rapidly. Indications are that they could be produced at 1/3 of the cost of silicon cells once economies of scale kick in. Perovskite solar cells (PSC) have lower material cost, lower labour cost, lower equipment costs and lower energy costs. Silicon cells are very energy intensive to make. Energy payback is 2.5 years, whereas PSC payback is only two months.

### *What are perovskites?*

Perovskites are a class of compounds, or mixtures of metals and chemical materials that share the same crystal structure as  $ABX_3$ . Perovskites have exploded into one of the most versatile material platforms in modern science, with applications spanning energy, electronics, sensing, and even neuromorphic computing.

Some occur naturally but there are literally thousands of compounds that have been engineered with their own crystal structure, that provide for a wide range of functions. Many of them do not have any commercial application yet. For the purposes of this note we will only consider those relevant to solar power activities. Even within this limited subset, the development of particular perovskites through chemical engineering is a very proprietary process. Trade secrecy will be more commercially effective than patenting the IP.

Perovskites have been used in sonars since 1950. In 2009, certain types were found to be highly efficient at absorbing sunlight and converting it into electricity. The chemistry can be tuned to better absorb any kind of light including UV, visible, IR, LED's, fluorescent and indoor light. They perform better than silicon on cloudy days. Perovskites film can even be layered onto silicon cells (PSC-Si) to make them up to 30% more efficient or made as tandem Perovskite (PSC-PSC).

### *Achieving a commercially competitive product*

New technology can be very alluring and exciting, but history shows that it always takes longer to commercialise and you never know what competing companies are approaching from over the horizon. There are other companies in the sector but they will all have company proprietary technology to protect and promote. There is going to be a range of competing products, some better than others. Brand reputation will be important.

Halocell has been pioneering the efficient, scaleable roll-to-roll production methodology for near term applications. It has joined forces with First Graphene (FGR) to develop a carbon back contact with metal functionalised graphene to achieve 30.5% efficiency levels for their low light modules.

### *High-tech and aerospace applications*

Large-scale adaptation of perovskite technology will gradually become a reality, but in the meantime there is a push for higher value uses such as power for drones and satellite technology. Halocell is targeting these high-value markets that are less price sensitive, but more sensitive to weight and form requirements (drones) and the capability to operate in space (satellites).

Specifically, Halocell products can extend flight times of drones by 3x by charging batteries while in flight. They may even enable drones to remain in the air 24/7, with potential military applications. They also offer much more economic

alternatives to gallium-arsenide-dependent equipment in space flights. PV used in space is very expensive and has long lead times, and is dependent upon Chinese supply chains. Cheaper and more readily available PSC have significant opportunities in powering satellites, so much so that several have already been in touch with Halocell, including two Australian companies.

### *The Bottom Line*

Perovskites offer the next generation of solar technology but the most exciting avenues are in the rapidly expanding development of drones and space defence capabilities that are of considerable interest to defence departments.

Halocell's space modules have already passed five of the required seven tests for space applications, and they will provide a much lower cost alternative to gallium-arsenide PV used in satellites.

As a private, unlisted company, there is no ability to buy Halocell shares on-market. The company still needs to be funded. It continues to receive useful grants from governments but that alone is not enough. That means that there will be periodic opportunities for longer-term investors of participate in capital raisings. Eventually there will be liquidity in the shares when Halocell gets to the IPO stage, but there is no firm timeline to this event yet so investors will need a level of patience. A trade sale could be a possibility if a major company wants to buy the technology.

*Disclosure: Interests associated with the author own shares and options in Halocell and First Graphene and the author is a director of First Graphene.*

### *Generally, technology takes time*

It is almost a golden rule that new technology takes much longer to develop than anyone expects. There can be great enthusiasm from the outset and share prices can perform impressively, but inevitably the share prices falls apart due to the inability of investors to maintain their enthusiasm for the very long term. The harder the shares run, the harder they fall. Eventually, some years down the track, the companies have to reignite the enthusiasm some how ... assuming they have survived.

### *Titomic is an example*

An example of this is Titomic (TTT), a 3D printing and additive manufacturing company that raised \$6.5m in September 2017, giving a \$22m market capitalisation. The shares performed wonderfully, rising 6x to \$1.24 by May of the following year, but then reality started to bite and the shares commenced a multi-year downtrend to bottom out at 14¢ a share in September 2023. More recently the shares have recovered to 24¢, but the market capitalisation has grown dramatically to reach \$380m. The number of shares have blown out to 1.6 Bn as the Company continually had to raise funds.

I saw a presentation last week that was impressive in describing how advanced its products are, but it was notable that it still has not made a profit. That is not a criticism. It is just an observation. Technology takes time.

I'm not picking on Titomic here. There are many examples like this one. The main objective for similar companies in the technology space is to stay alive along the journey, much like an exploration company in pursuit of the

company making orebody. It doesn't always have a happy ending to the story.

### *MetalsGrove - early stage in Côte d'Ivoire.*

Continuing with our exposition of gold companies in Côte d'Ivoire, we cover MetalsGrove Mining (MGA) this week. The chairman is Peter Ledwidge, a geologist with great West African experience and previously the managing director of Mako Gold, a company taken over by Aurum Resources.

### *Early, unimpressive history of the Company*

MetalsGrove IPO'd in July 2022, raising \$6.4m at 20¢. It had the mandatory suite of properties needed to justify a listing, including lithium, tin, tantalum and rare-earth exploration projects, but nothing to turn the market on. Subscribers were under water from day one, with the shares opening up at a 50% discount to the IPO price. The shares bottomed at 2.6¢ in March 2024, but have been showing better performance in recent months, courtesy of a Côte d'Ivoire initiative .

### *Just getting started on the Central West Gold Project*

MetalsGrove is just getting started in Côte d'Ivoire. It is earning into four licences in two separate corporate transactions that cover two granted licences and another two applications. All come under the heading, Central West Gold Project. This is located on the Abujar-Napié gold trend within the Birimian Oumé-Fetekro greenstone belt. There are 75 km of favourable host rocks lying between the 3.8 Moz Abujar Gold Mine to the SW, and the 0.9 Moz Napié Gold Project to the NE.

### *The Stellar JV Terms - can go to 80%*

This granted licence covers the Zuénoula permit that is currently being explored using early soil sampling, regolith mapping and LIDAR surveys. Earn-in terms are;

- spend US\$150,000 before MGA can withdraw,
- spend US\$1m by July 2027,
- spend cumulative US\$3m by April 2029, to complete a 50% earn-in
- Stellar can contribute from this point, or
- MetalsGrove may spend another US\$3m to get 80%
- the Government will later get a 10% free carried when an exploitation licence is applied for

Thus, the earning terms are fairly standard.

### *The Gemica JV Terms - can go to 80/90%*

This deal came via a local private group which has had an association with a top ASX gold producer over the years. The Vavoua licence was granted last December, and the Company is awaiting the granting of two more; Kounahiri West and Vavoua West. Soil sampling has commenced on the granted licence.

MetalsGrove can progressively go to 40%, 60% then 80% by spending A\$200,000, A\$425,000 and A\$750,00 respectively on the Vavoua licence. Terms for earning 90% in Vavoua West and Kounahiri West are less onerous, being \$125,000 each minimum, then joint venture expenditure on 90:10 equity terms thereafter.

### *The Bottom Line*

MetalsGrove is just getting set in the projects now. It has the ground tied up with earn-in arrangements and it has raised initial exploration funds. Time will tell whether the



## Detailed Chart Comments

*NB. Only the bold comments have been updated. Comments in grey type are from previous weeks and will be less relevant. Please note that this list is a cross section of the market. It IS NOT a list of recommendations.*

Indices	Code	Trend Comment	
All Ordinaries	XAO	down	
Metals and Mining	XMM	down	
Energy	XEJ	rising	
Stocks	Code	Trend Comment (updated comments in bold)	Main Interest
Aguia Resources	AGR	breached downtrend	phosphate, gold
Akora	AKO	testing uptrend	iron ore
Alkane Resources	ALK	off its high	gold
Alicanto Minerals	AQI	holding support line	base metals, silver, gold
Alligator Energy	AGE	down	uranium
Almonty Industries	All	surge to new high	tungsten
Alpha HPA	A4N	down	HPA
American Rare Earths	ARR	down	rare earths
American Tungsten & Antimony	AT4	down	antimon
Anax Metals	ANX	heavy pullback	copper
Andean Silver	ASL	down	silver
Arafura Resources	ARU	shallower uptrend	rare earths
Ardea Resources	ARL	testing support line	nickel
Ark Mines	AHK	down	rare earths
Astral Resources	AAR	down	gold
Aureka	AKA	weaker	gold exploration
Auric Mining	AWJ	testing uptrend	gold
Aurora Energy Metals	1AE	down	uranium
Aurelia Metals	AMI	improving	copper + base metals
Aurum Resources	AUE	correcting lower	gold exploration
Australian Gold and Copper	AGC	testing support line	base metals, silver, gold
Australian Rare Earths	AR3	collapse through support	rare earths
Australian Strategic Materials	ASM	down	rare earths
BHP	BHP	testing uptrend	diversified, iron ore
Ballard Mining	BM1	pullback	gold
Ballymore Resources	BMR	down	gold exploration
Barton Gold	BGD	down	gold exploration
Beach Energy	BPT	pushing higher	oil and gas
Beetaloo Energy	BTL	surge higher	gas
Bellevue Gold	BGL	down	gold
Besra Gold	BEZ	off its highs	gold
Black Cat Syndicate	BC8	down	gold
Boab Metals	BML	heavy correction	silver/lead
Brazilian Rare Earths	BRE	heavy pullback	rare earths
Brightstar Resources	BTR	down	gold


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Caravel Minerals	CVV		breached support line	copper
Carnaby Resources	CNB		falling	copper
Castile Resources	CST		down	gold/copper/cobalt
Catalyst Metals	CYL		down	gold
Cazaly Resources	CAZ		down	rare earths
Centaurus Metals	CTM		new high	nickel/cobalt/HPA
Challenger Gold	CEL		testing support line	gold
CNG Resources	CGR		down	gold exploration
Cobalt Blue	COB		down	cobalt
CuFe	CUF		pullback	bismuth
Cyprium Metals	CYM		down	copper
Emmerson Resources	ERM		new high	gold
EQ Resources	EQR		strongly higher	tungsten
Estrella Resources	ESR		rallying	manganese
Evolution Mining	EVN		down	gold
Felix Gold	FXG		down	gold exploration, antimony
Finder Energy	FDR		surge through downtrend	oil/gas
First Graphene	FGR		down	graphene
Flagship Minerals	FLG		new high	gold
Genesis Minerals	GMD		down	gold
Globe Metals and Mining	GBE		spiked higher	niobium
Gold 50	G50		down	gold exploration + gallium
Golden Horse	GHM		down	gold exploration
Great Boulder Resources	GBR		down	gold exploration
Green360 Tech	GT3		slump to lows	kaolin
Hamelin Gold	HMG		down	gold exploration
Hawk Resources	HWK		testing downtrend	scandium
Heavy Minerals	HVY		down	garnet
Hillgrove Resources	HGO		down	copper
Iltani Resources	ILT		down	antimony
Iluka Resources	ILU		rising again	mineral sands
Investigator Resources	IVR		falling	silver
Jupiter Mines	JSM		breached uptrend	manganese
Kairos Minerals	KAI		good recovery	gold
Kaiser Reef	KAU		correcting	gold
Kingfisher Minerals	KFM		rising	copper expl.
Kalamazoo Resources	KRZ		down	gold
Kalina Power	KPO		down	data centre power
Koba Resources	KOB		still in downtrend	uranium
Larvotto Resources	LRV		testing uptrend	gold, antimony
Litchfield Minerals	LMS		down	copper exploration
Lindian Resources	LIN		rising	rare earths + bauxite
Lode Resources	LDR		down	antimony, silver
Lotus Resources	LOT		longer term downtrend	uranium

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Lynas Corp.	LYC		surge higher	rare earths
Mammoth	M79		down	gold exploration
Many Peaks	MPK		sideways	gold exploration
Marmota	MEU		down	gold/uranium exploration
Matsa Resources	MAT		down	gold
Meeka Gold	MEK		down	gold
MetalsX	MLX		down	tin, nickel
Meteoric Resources	MEI		on support line	rare earths
Metro Mining	MMI		sideways	bauxite
Midas Minerals	MM1		down	lithium
Mithril Silver & Gold	MTH		down	silver, gold
Native Mineral Resources	NMR		turning down	gold
New Murchison	NMG		down	gold
New World Resources	NWC		rising	copper
Nexgen Energy	NXG		breaching uptrend	uranium
Novo Resources	NVO		placement & heavy correction	gold exploration
Omega Oil	OMA		rising	oil
Pacific Gold	PGO		down	gold exploration
Pacific Lime & Cement	PLA		sideways	renewables, cement
Paladin Energy	PDN		down	uranium
Pantoro Gold	PNR		heavy fall	gold
Patriot Battery Metals	PMT		down	lithium
Peninsula Energy	PEN		heavy correction	uranium
Perseus Mining	PRU		down	gold
PolarX	PXX		down	gold exploration, base metals
QMines	QML		down	copper
QPM Energy	QPM		down	gas power station
Regis Resources	RRL		down	gold
Revolver Resources	RRR		softer	copper
Richmond Vanadium	RVT		spiked higher	vanadium
RIO	RIO		down	diversified, iron ore
Rox Resources	RXL		testing uptrend	gold
RTG Mining	RTG		testing uptrend	copper
Rumble Resources	RTR		rising	zinc, gold, tungsten exploration
S2 Resources	S2R		down	gold exploration
Santana Minerals	SMI		correcting lower	gold
Santos	STO		rising	oil/gas
Sarytogan Graphite	SGA		down	graphite
Scorpion Minerals	SCN		softer	gold exploration
Siren Gold	SNG		down	gold exploration
Skylark Minerals	SKM		down	gold exploration
Somerset Minerals	SMM		back to support line	copper exploration
Southern Palladium	SPD		down	PGMs
Stanmore Coal	SMR		heavy slump	coal

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St George Mining	SGQ		testing uptrend	rare earths, niobium
Stellar Resources	SRZ		on support line	tin
Sun Silver	SS1		down	silver
Sunrise Metals	SRL		heavy correction	scandium
Talga Resources	TLG		down	graphite
Tamboran Resources	TBN		rising	gas
Theta Gold	TGM		breaching downtrend	gold
Toro Energy	TOE		testing uptrend	uranium
Torque Metals	TOR		surge on management changes	gold exploration + lithium
Toubani Resources	TRE		rising, gently	gold
Verity Resources	VRL		testing downtrend	gold
Vertex Minerals	VTX		down	gold
Waratah Minerals	WTM		testing uptrend	gold exploration
Westgold Resources	WGX		down	gold
West Wits Mining	WWI		correcting lower	gold
Whitehaven Coal	WHC		rising	coal
White Cliff Minerals	WCN		down	copper exploration
WIN Metals	WIN		down	gold
Yandal Resources	YRL		down	gold exploration
Totals	26%	37	Uptrend	
	54%	77	Downtrend	
		142		

### Guides to Chart Interpretations

- Charts usually go pass from one trend (up or down) into the other via a period of indecision and uncertainty during which the trend can either recover or change. This period is signified by the orange colour. The orange represent both the greatest risk and greatest reward possibilities.
- Once a chart is in confirmed up or downtrends it is not uncommon for 10-20% of that trend to have already transpired.
- There are trends within trends. The focus of this chart review is the immediate trend that affects the sentiment i.e. it can be a downtrend within a long-term uptrend.
- Not every chart warrants a new comment every week. The new comments are in bold type. Grey type comments may be dated.
- Individual charts provide a single view. It is valuable to look at charts of other companies in similar commodities, and the overall sentiment is also very valuable. Not many stocks can swim against the tide.
- We periodically add or delete charts, some times for obscure reasons. If a chart consistent gives poor signals or is very erratic, we may delete it. Sometimes we add a chart because we want to see what all the fuss is about. We do have a preference for charting stocks that we cover in our research as well.
- Errors and omissions may occur from time to time, especially in fast moving markets.

Amber Lights in Tables: Just a reminder if when the amber light is used in the table – it is when the charts are ambiguous or when there is a change of trend taking place. If a chart is breaching a downtrend it can either be a positive sign or a trap. Only once it has done more work can it be confirmed as a new uptrend. Maybe it is a new uptrend (or conversely a new downtrend); the risk takers can decide to jump on board early (or sell). They will maximise their profits (or minimise their losses if indeed it is the start of the new uptrend (downtrend). More risk-averse investors should wait a little longer, being prepared to give up some of the gains in return for greater certainty.

Weightings of Sectors Represented in the Company Charts			
Sector	No. of Companies	Weighting	
Gold	34	23.9%	
Gold Exploration	25	17.6%	
Copper	14	9.9%	
Rare Earths	11	7.7%	
Uranium	8	5.6%	
Oil/Gas/Hydrogen	6	4.2%	
Silver	6	4.2%	
Iron Ore/Manganese	5	3.5%	
Antimony	4	2.8%	
Lithium	2	1.4%	
Graphite/graphene	3	2.1%	
HPA/Kaolin	2	1.4%	
Nickel	2	1.4%	
Scandium	2	1.4%	
Tungsten	2	1.4%	
Tin	2	1.4%	
Coal	2	1.4%	
Bismuth	1	0.7%	
Niobium	1	0.7%	
Potash/Phosphate	1	0.7%	
Vanadium	1	0.7%	
PGMs	1	0.7%	
Mineral Sands	1	0.7%	
Bauxite	1	0.7%	
Cobalt	1	0.7%	
Other	4	2.8%	
Total	142		

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