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FAR EAST CAPITAL
The Mining Investment Experts

Weekly Commentary

30 January 2021 *On Friday's Close* Analyst : Warwick Grigor

Hazer is one of our more advanced juniors in the hydrogen space

The market vented steam last week. It was more about profit taking as there was no news that encouraged buying. Traditional fundamental signals were softer, leading to weak markets overseas and this flowed down to the Australian market. The alternative energy frenzy was less aggressive, so traders were inclined to take some money off the table as this sector continued to be strong. With many charts either resting on support lines, or just penetrating them, it is either the perfect time to buy for a bounce and a resumption of the bull, or the bear might be in its ascendency. Sounds like fence sitting astrology doesn't it? We need a crystal ball.

Hazer is progressing its hydrogen technology

Hazer Group (HZR) was IPO'd in November 2015, after successfully raising $5m with the objective of researching and developing a novel hydrogen production technology. At the time the graphite market was still strong so the Company went to some length to promote its high purity graphite that comes as a by-product. Times change, and the company now seems to be getting more traction from the hydrogen side of the business.

The Hazer Process is a green technology

Hazer purchased the IP to technology developed by The University of WA that enabled the production of hydrogen gas from methane (natural gas) with negligible carbon dioxide emissions, and co-production of graphite. Key to the process was the use of iron ore as a process catalyst. Recovery of carbon as graphite rather than an uncontrolled carbon dioxide by-product enables the hydrogen to be classified as "clean", which today is referred to "green".

The process operates at temperatures of 800-900^{0}C and pressures of 0-1 bar. Hydrogen gas and solid carbon are formed in the ratio of 1:3 (by mass). The thermo-catalytic decomposition of methane (TCDM), also referred to a natural gas "cracking", works pursuant to the following equation.

$$CH_4 \xrightarrow{\text{Catalyst, Heat}} C_{(s)} + 2H_{2(g)}$$

Using iron ore as a catalyst lowers the activation energy needed for this endothermic reaction, thereby reducing the temperature needed and it also influences the type of graphite produced.

The Hazer Process can be contrasted with the Steam Methane Reforming (SMR) method of making hydrogen, which converts 75% of the methane feedstock into CO_2 waste. SMR techniques typically produce 10-12 tonnes of CO_2 for every tonne of hydrogen. SMR is currently the dominant process.

At the time of the IPO Hazer was strong on the promotion of its ability to make carbon nano-onions, carbon nano-tubes, carbon-micro shells and graphene, but this tended to confuse the story. Its sales pitch for these products was largely theoretical at the time and lacked substance.

Collaborations and commercial agreements

Subsequent to listing, Hazer announced collaboration agreements with Sydney University and the University of Western Australia. By mid-2016, it boasted that it had commissioned a "large scale" static bed reactor and a fluidised bed reactor, but the size didn't match the rhetoric. One kg per day, the amount of graphite being made, was only bench-top scale.

By July 2017, Hazer had scaled up to a pre-pilot size plant in Western Sydney. Results from this semi-continuous plant were used in the design and construction of a commercial prototype. At the same time it continued to promote the ability to produce synthetic graphite with purity levels of 99.95% TGC and iron content of less than 50 ppm. Suitability of the material for batteries was being tested, with favourable results.

A number of collaborations and MoUs have been entered into over the years with a range of institutions and companies as Hazer sought both deeper appreciation of its process and early leads to commerciality. Typically, some have been one night stands with little outcome while others have been more productive.

A non-binding MoU with Texas-based Pan American Hydrogen Inc., to look at building a pilot plant capable of producing 100 kg/day of hydrogen seems to be an example of the former. Similarly, an offtake agreement with BOC Ltd, was not consummated. A binding agreement with Minerals Resources to examine the viability of a commercial synthetic graphite production facility of at least 1,000 tpa lasted longer, but that company realised that the graphite market wasn't one that it wanted to pursue long term, and that agreement was terminated in November 2020.

Probably the most commercially useful agreement so far is that signed a year ago with Chiyoda, a Japanese company that has been an industry leader in the LNG market. A strategical alliance has been formed to collaborate on the development of a commercial development of the process for Japan. There has been little news flow on this front but we have been assured that conservative progress is being made.

Favourable economic study released in 2018

The hydrogen side of the business gained greater attention in February 2018, when Hazer announced that process modelling and comparative economic analysis suggested that the Hazer Process could deliver 75% net commodity cost reduction compared to the SMR method of making hydrogen, with a 70% reduction in CO_2 emissions. For the first time we are able to put some numbers around the economics. It is likely that the economics have further improved since then.

The study also compared the Hazer Process to electrolysis-based hydrogen production, which requires a significant external power source. Modelling showed that power derived from renewable energy sources resulted in negligible CO_2 emissions from the Process (though this should be obvious). The productivity was 6x better than electrolysis in producing hydrogen, and the cost could be 50% cheaper (85% cheaper if the graphite could be sold at $500 pt).

Interestingly, when the results of this study were released, the shares continued to fall lower in a downtrend. The market was obviously not focused at the time.

Progression to a demonstration plant

Thereafter Hazer continued to gently advance its process, eventually appointing Primero Group to undertake early design work for a commercial demonstration plant in July 2019. It took until mid 2020 for the 100 tonne p.a. demonstration plant to be approved, with a $17m budget. Due for commissioning to be completed in 12 months, the plant is designed to have a life of up to three years. Hazer has recently secured sufficient capital to fund this stage of the development.

Graphite possibilities are still being investigated

Progress on the hydrogen front will result in increasing attention being given to the secondary product, graphite. This material is crystalline in nature rather than amorphous, so there will be a number of marketing opportunities ranging from use in battery materials through to conductive materials, lubricants, refectory markets and even water treatment. With a typical size of 40-80 μm with this resulting from agglomeration of particles down to 20 μm in size, it is 3D as opposed to 2D. The earlier talk of it being able to be converted to graphene no longer features in the rhetoric as it doesn't offer any competitive advantages over other feedstock to the graphene process.

The use of iron as a catalyst will lead to some contamination of the graphite but this can mostly be removed with conventional technology that employs thermal treatment and acid, though Hazer is developing alternative methodology. Whatever, there is a defined route to lift the purity to 95.5%, which should be commercial.

What about competing technologies ?

Investors must appreciate that there will always be competing technologies but are they available to be invested in through an ASX pathway? Are they with larger, slower companies or are they controlled by entrepreneurs? Technology frontiers change rapidly and it is difficult to be fully aware of what is out there.

Nevertheless, the process of registering for patents is one way of flushing out the competition. Hazer has not had any objections so far, so we can assume that there is nothing out there that is exactly the same. Though, there could be variations that provide distinctions.

So where does that leave the Company today?

The extraordinary performance of Hazer's share price since the withdrawal of Mineral Resources may be anomalous, rising from 58¢ to a recent high $1.88, giving a market capitalisation of $272m, but that is what happens when FOMO starts to affect the hydrogen stocks.

It has taken more than five years of testing and scaling up the process to this point, and it is still a number of years from commerciality. There is not much more that can be said until the commissioning and the proving of the demonstration plant, later this year. Its three stage fluidised beds process has been described as being at the Technology Readiness Level of 3 (on a scale of 1 to 10), according to an article in ChemBioEng Reviews, "*State of the Art of Hydrogen Production via Pyrolysis of Natural Gas*". Though, the Company would will tell you it is now at 5. So, there is still plenty of work to do. Nevertheless, it is a legitimate player in the junior hydrogen sector.

More notes on hydrogen

As we go up the learning curve on hydrogen by doing heaps of research, I will share some of my findings so that you may be better educated.

The nature of the hydrogen market today

Demand for hydrogen is about 70 Mtpa which in energy terms is about 330 Mt of oil equivalent. That is larger than the energy supply of Germany. It is mostly used in oil refining and for the production of fertilisers using ammonia, and it is almost entirely supplied from natural gas and coal.

There is <u>nothing</u> environmentally friendly about current hydrogen production. It is responsible for CO_2 emissions of 830 Mtpa, equivalent to emission of the UK and Indonesia combined.

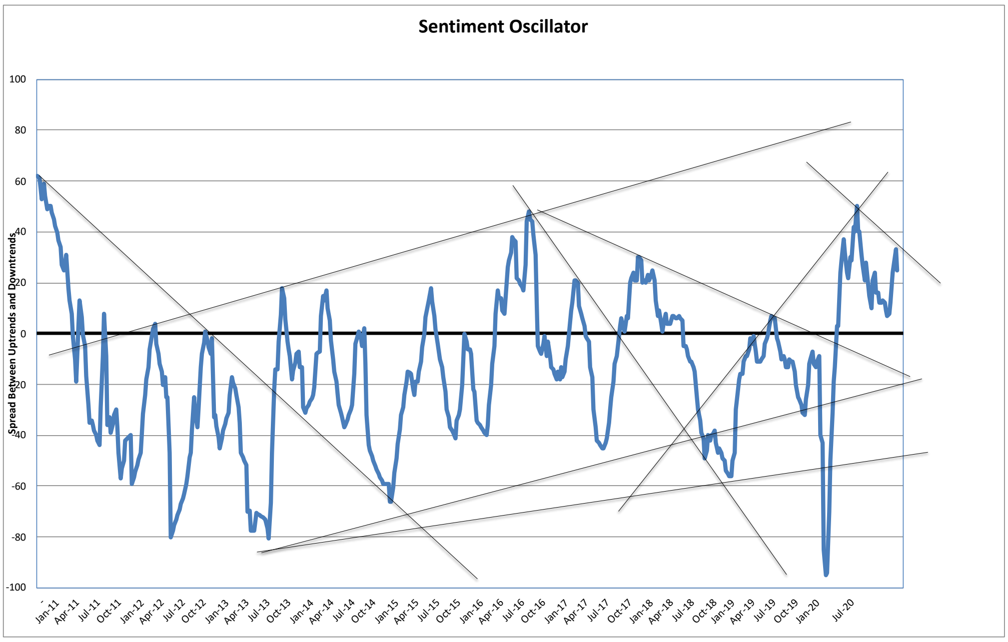
What is "green" hydrogen?

The role of hydrogen in a land of lower CO_2 emissions is dependent on producers being able to capture carbon at the same time, thereby qualifying for the "green" tag. When we look at hydrogen we should be looking at the new technologies that can do this. Use of renewable energy sources is one such path.

What makes this cycle different? (beyond fuel cells)

In previous cycles of enthusiasm for hydrogen the focus has been on the use of fuel cells using natural gas, mostly for the transport sector at a time when internal combustion engines were more acceptable and the oil price had a greater impact on economics. This time around the uses of hydrogen are likely to be more diversified and more mainstream with politics and subsidies for decarbonisation being major influences in many countries. Green hydrogen trade offers the path for storage of wind and solar power that would overcome seasonal differences.

Economics still dictate final decisions, even with subsidies, but the trends are moving in favour of hydrogen. Utility-scale solar capital costs are now 75% lower than in 2010, and onshore wind power capital costs are 25% lower.



Sentiment Oscillator: Sentiment came off last week. There were 50% (56%) of the charts in uptrend and 25% (23%) in downtrend on Friday's close. Looking at the chart, we could be seeing a pattern like what happened late in 2017, when the recovery in sentiment was terminated and the market continued to fall - but this is not a prediction.

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		correcting lower	
Metals and Mining	XMM		correcting lower	
Energy	XEJ		pullback	
Stocks	**Code**		**Trend Comment (updated comments in bold)**	**Main Interest**
Alpha HPA	A4N		back above support line	HPA
Adriatic Resources	ADT		testing uptrend again	zinc, polymetalic
Aeon Metals	AML		testing downtrend	copper + cobalt
Alkane Resources	ALK		breached uptrend, heading down	gold, zirconia
Alicanto Minerals	AQI		breached downtrend, then slump	base metals, silver, gold
Allegiance Coal	AHQ		surge through downtrend, then pullback	coking coal
Alliance Resources	AGS		down	gold predevelopment
Alto Metals	AME		testing downtrend	gold exploration
American Rare Earths (was BPL)	ARR		breached downtrend (COB holding)	rare earths
Apollo Consolidated	AOP		down	gold exploration

Arafura Resources	ARU		new high again	rare earths
Aurelia Metals	AMI		down	gold + base metals
Australian Potash	APC		holding shallower uptrend	potash
Auteco Minerals	AUT		new uptrend	gold exploration
BHP	BHP		breached trend line	diversified, iron ore
Base Resources	BSE		testing uptrend	mineral sands
Beach Energy	BPT		slump	oil and gas
Beacon Mining	BCN		sideways	gold production
Bellevue Gold	BGL		down	gold exploration
Blackstone Minerals	BSX		rising	nickel
Blue Star Helium	BNL		spike through downtrend	gas, helium
Boab Metals	BML		named change from Pacifico Minerals	silver/lead
Breaker Resources	BRB		testing downtrend	gold exploration
Buru Energy	BRU		uptrend	oil
Calidus Resources	CAI		down	gold
Capricorn Metals	CMM		holding shallower uptrend	gold
Caravel Minerals	CVV		steeply higher	copper
Celsius Resources	CLA		on support line	uptrend
Central Petroleum	CTP		rising gently	oil/gas
Chalice Gold	CHN		back to support line	nicklel, copper, PGMs, gold exploration
Chase Mining	CML		rising from lows	nickel/copper/PGE
Chesser Resources	CHZ		down now	gold exploration
Cobalt Blue	COB		pullback	cobalt
Cyprium Metals	CYM		pullback	copper
Dacian Gold	DCN		strongly higher	gold
Danakali	DNK		steeply higher	potash
Davenport Resources	DAV		on support line	potash
De Grey	DEG		shallower downtrend	gold
E2 Metals	E2M		correcting lower, ST downtrend	gold exploration
Ecograf (was Kibaran)	EGR		pullback	graphite
Element 25	E25		new high	manganese
Emerald Resources	EMR		new high again	gold
Euro Manganese	EMN		pullback	manganese
Evolution Mining	EVN		down	gold
Firefinch	FFX		strongly higher	gold
First Graphene	FGR		on support line	graphene
Fortescue Metals	FMG		pullback - uptrend breached	iron ore
Galaxy Resources	GXY		new high	lithium
Galena Mining	G1A		pullback	lead
Galilee Energy	GLL		down	oil and gas, CBM
Genisis Minerals	GMD		down	gold
Gold Road	GOR		holding shallower uptrend	gold
Hazer Group	HZR		pullback	hydrogen
Highfield Resources	HFR		rising	potash

Hillgrove Resources	HGO		breached support line	copper
Iluka Resources	ILU		strong rise	mineral sands
Image Resources	IMA		testing support	mineral sands
Independence Group	IGO		pullback	gold
ioneer (was Global Geoscience)	INR		new high	lithium
Ionic Rare Earths (Oro Verde)	IXR		new high	rare earths
Jervois Mining	JVR		rising again	nickel/cobalt
Jindalee Resources	JRL		surge to new high	lithium
Kin Mining	KIN		breached uptrend, down	gold
Kingston Resources	KSN		testing support	gold
Kingwest Resources	KWR		back to support line	gold
Legend Mining	LEG		turned down at resistance line	nickel exploration
Lepidico	LPD		pullback	lithium
Lindian Resources	LIN		trying to recapture uptrend	bauxite
Lithium Australia	LIT		pullback	lithium
Los Cerros	LCL		surge higher on drill result	gold exploration
Lotus Resources	LOT		new high	uranium
Lucapa Diamond	LOM		breaking downtrend	diamonds
Lynas Corp.	LYC		pullback	rare earths
Mako Gold	MKG		down again	gold exploration
Manhattan Corp	MHC		testing downtrend	gold exploration
Marmota	MEU		testing downtrend	gold exploration
Marvel Gold (was Graphex)	MVL		down	gold exploration
MetalTech	MTC		testing downtrend	gold
Meteoric Resources	MEI		testing uptrend	gold exploration
MetalsX	MLX		new high	tin, nickel
Metro Mining	MMI		breaching downtrend	bauxite
Mincor Resources	MCR		testing uptrend	gold/nickel
Musgrave Minerals	MGV		down	gold exploration
Myanmar Minerals	MYL		breaching downtrend	lead, zinc, silver
Nelson Resources	NES		new high	gold exploration
Neometals	NMT		pullback	lithium
Northern Minerals	NTU		pullback	REE
Northern Star Res.	NST		breached downtrend	gold
NTM Gold	NTM		new high	gold exploration
Oceana Gold	OGC		testing steep uptrend	gold
Oklo Resources	OKU		down	gold expl.
Orecorp	ORR		rising again	gold development
Orocobre	ORE		pullback	lithium
Oz Minerals	OZL		at recent highs	copper
Pacific American Holdings	PAK		breaching ST downtrend	coal
Pantoro	PNR		commenced secondary uptrend	gold
Panoramic Res	PAN		holding shallower uptrend	nickel
Peak Minerals	PUA		forming a flag	copper exploration

Peak Resources	PEK		new high	rare earths
Peel Mining	PEX		breached new uptrend	copper
Peninsula Energy	PEN		breaching uptrend	uranium
Poseidon Nickel	POS		breached uptrend	nickel
Pensana Metals	PM8		pullback	rare earths
Perseus Mining	PRU		holding shallower uptrend	gold
Pilbara Minerals	PLS		pullback	lithium
Polarex	PXX		testing downtrend	polymetallic exploration
Queensland Pacific Metals	QPM		pullback	nickel/cobalt/HPA
Ramelius Resources	RMS		continuing down	gold production
Red5	RED		down	gold
Red River Resources	RVR		breached uptrend	zinc
Regis Resources	RRL		down	gold
Renergen	RLT		surge to new high	gas, helium
Resolution Minerals	RML		sideways at lows	gold exploration
Resolute Mining	RSG		down	gold
RIO	RIO		breached uptrend	diversified, iron ore
Rumble Resources	RTR		breached downtrend	gold exploration
Salt Lake Potash	SO4		risen to resistance line	potash
Saracen Minerals	SAR		down	gold
St Barbara	SBM		secondary downtrend	gold
Sandfire Resources	SFR		breached downtrend	copper
Santos	STO		strongly higher	oil/gas
Saturn Metals	STN		heavy fall	gold exploration
Sheffield Resources	SFX		rising	mineral sands
Sky Metals	SKY		back in downtrend	gold exploration
St George Mining	SGQ		down	nickel
Silex Systems	SLX		off its highs	uranium enrichment technology
Silver Mines	SVL		on support line	silver
Sipa Resources	SRI		down	general exploration - Ni,Cu, Co, Au
Stanmore Coal	SMR		breached steepest downtrend	coal
Strandline Resources	STA		still in downtrend	mineral sands
Sunstone Metals	STM		turning up	
Talga Resources	TLG		breached support line, down	graphite
Technology Metals	TMT		back to highs	vanadium
Tesoro Resources	TSO		down	gold exploration
Theta Gold Mines	TGM		new high	gold
Thor Mining	THR		testing downtrend	gold exploration
Tietto Minerals	TIE		recovering uptrend	gold
Titan Minerals	TTM		sideways	gold
Vango Mining	VAN		down	gold
Venturex	VXR		weaker	zinc
Vimy Resources	VMY		steeply higher	uranium
West African Resources	WAF		holding shallower uptrend	gold

Westgold Resources	WGX		struggling beneath support line	gold
West Wits Mining	WWI		off its highs	gold
Western Areas	WSA		heavy fall	nickel
Whitehaven Coal	WHC		rising	coal
Wiluna Mining	WMX		down	gold
Yandal Resources	YRL		down	gold exploration
Zinc Mines of Ireland	ZMI		secondary downtrend	zinc
Totals	50%	75	Uptrend	
	25%	37	Downtrend	
		149	Total	

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	**37**	**24.8%**	
Gold Exploration	**25**	**16.8%**	
Nickel	**12**	**8.1%**	
Copper	**10**	**6.7%**	
Oil/Gas	**7**	**4.7%**	
Lithium	**8**	**5.4%**	
Zinc/Lead	**7**	**4.7%**	
Rare Earths	**7**	**4.7%**	
Mineral Sands	**5**	**3.4%**	
Iron Ore/Manganese	**5**	**3.4%**	
Potash/Phosphate	**5**	**3.4%**	

Coal	**4**	**2.7%**	
Uranium	**4**	**2.7%**	
Graphite	**2**	**1.3%**	
Bauxite	**2**	**1.3%**	
Silver	**2**	**1.3%**	
Cobalt	**1**	**0.7%**	
Tin	**1**	**0.7%**	
Diamonds	**1**	**0.7%**	
Other	**4**		
Total	**149**		

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