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30 January 2021



On Friday's Close

Weekly Commentary

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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°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.



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 nanotubes, 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

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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 electrolysisbased 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 μ m with this resulting from agglomeration of particles down to 20 μ m 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 58ϕ 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.

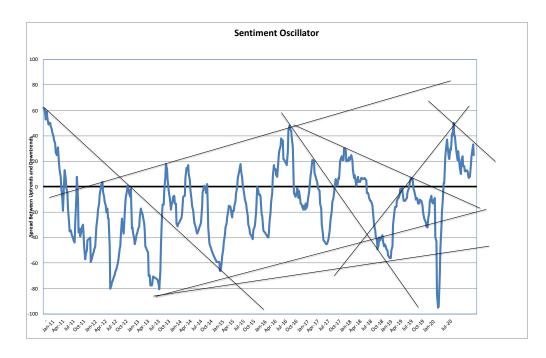
What is "green" hydrogen?

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	НРА
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	
Aurelia Metals	AMI	
Australian Potash	APC	
Auteco Minerals	AUT	
ВНР	BHP	
Base Resources	BSE	
Beach Energy	BPT	
Beacon Mining	BCN	
Bellevue Gold	BGL	
Blackstone Minerals	BSX	
Blue Star Helium	BNL	
Boab Metals	BML	
Breaker Resources	BRB	
Buru Energy	BRU	
Calidus Resources	CAI	
Capricorn Metals	СММ	
Caravel Minerals	CVV	
Celsius Resources	CLA	
Central Petroleum	СТР	
Chalice Gold	CHN	
Chase Mining	CML	
Chesser Resources	СНΖ	
Cobalt Blue	СОВ	
Cyprium Metals	СҮМ	
Dacian Gold	DCN	
Danakali	DNK	
Davenport Resources	DAV	
De Grey	DEG	
E2 Metals	E2M	
Ecograf (was Kibaran)	EGR	
Element 25	E25	
Emerald Resources	EMR	
Euro Manganese	EMN	
Evolution Mining	EVN	
Firefinch	FFX	
First Graphene	FGR	
Fortescue Metals	FMG	
Galaxy Resources	GXY	
Galena Mining	G1A	
Galilee Energy	GLL	
Genisis Minerals	GMD	
Gold Road	GOR	
Hazer Group	HZR	
Highfield Resources	HFR	

	Weekly Commentary
new high again	rare earths
down	gold + base metals
holding shallower uptrend	potash
new uptrend	gold exploration
breached trend line	diversified, iron ore
testing uptrend	mineral sands
slump	oil and gas
sideways	gold production
down	gold exploration
rising	nickel
spike through downtrend	gas, helium
named change from Pacifico Minerals	silver/lead
testing downtrend	gold exploration
uptrend	oil
down	gold
holding shallower uptrend	gold
steeply higher	copper
on support line	uptrend
rising gently	oil/gas
back to support line	nicklel, copper, PGMs, gold exploration
rising from lows	nickel/copper/PGE
down now	gold exploration
pullback	cobalt
pullback	copper
strongly higher	gold
steeply higher	potash
on support line	potash
shallower downtrend	gold
correcting lower, ST downtrend	gold exploration
pullback	graphite
new high	manganese
new high again	gold
pullback	manganese
down	gold
strongly higher	gold
on support line	graphene
pullback - uptrend breached	
new high	lithium
pullback	lead
down	oil and gas, CBM
down	gold
holding shallower uptrend	gold
pullback	hydrogen
rising	potash

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Pantoro PNR Panoramic Res PAN	Oz Minerals	OZL	
Panoramic Res PAN	Pacific American Holdings	PAK	
	Pantoro	PNR	
Peak Minerals PUA	Panoramic Res	PAN	
	Peak Minerals	PUA	

	Weekly Commentary
breached support line	copper
strong rise	mineral sands
testing support	mineral sands
pullback	gold
new high	lithium
new high	rare earths
rising again	nickel/cobalt
surge to new high	lithium
breached uptrend, down	gold
testing support	gold
back to support line	gold
turned down at resistance line	nickel exploration
pullback	lithium
trying to recapture uptrend	bauxite
pullback	lithium
surge higher on drill result	gold exploration
new high	uranium
breaking downtrend	diamonds
pullback	rare earths
down again	gold exploration
testing downtrend	gold exploration
testing downtrend	gold exploration
down	gold exploration
testing downtrend	gold
testing uptrend	gold exploration
new high	tin, nickel
breaching downtrend	bauxite
testing uptrend	gold/nickel
down	gold exploration
breaching downtrend	lead, zinc, silver
new high	gold exploration
pullback	lithium
pullback	REE
breached downtrend	gold
new high	gold exploration
testing steep uptrend	gold
down	gold expl.
rising again	gold development
pullback	lithium
at recent highs	copper
breaching ST downtrend	coal
commenced secondary uptrend	gold
holding shallower uptrend	nickel
forming a flag	copper exploration

Peak Resources	PEK	
Peel Mining	PEX	
Peninsula Energy	PEN	
Poseidon Nickel	POS	
Pensana Metals	PM8	
Perseus Mining	PRU	
Pilbara Minerals	PLS	
Polarex	PXX	
Queensland Pacific Metals	QPM	
Ramelius Resources	RMS	
Red5	RED	
Red River Resources	RVR	
Regis Resources	RRL	
Renergen	RLT	
Resolution Minerals	RML	
Resolute Mining	RSG	
RIO	RIO	
Rumble Resources	RTR	
Salt Lake Potash	SO4	
Saracen Minerals	SAR	
St Barbara	SBM	
Sandfire Resources	SFR	
Santos	STO	
Saturn Metals	STN	
Sheffield Resources	SFX	
Sky Metals	SKY	
St George Mining	SGQ	
Silex Systems	SLX	
Silver Mines	SVL	
Sipa Resources	SRI	
Stanmore Coal	SMR	
Strandline Resources	STA	
Sunstone Metals	STM	
Talga Resources	TLG	
Technology Metals	TMT	
Tesoro Resources	TSO	
Theta Gold Mines	TGM	
Thor Mining	THR	
Tietto Minerals	TIE	
Titan Minerals	ттм	
Vango Mining	VAN	
Venturex	VXR	
Vimy Resources	VMY	
West African Resources	WAF	

	Weekiy Commentary
new high	rare earths
breached new uptrend	copper
breaching uptrend	uranium
breached uptrend	nickel
pullback	rare earths
holding shallower uptrend	gold
pullback	lithium
testing downtrend	polymetallic exploration
pullback	nickel/cobalt/HPA
continuing down	gold production
down	gold
breached uptrend	zinc
down	gold
surge to new high	gas, helium
sideways at lows	gold exploration
down	gold
breached uptrend	diversified, iron ore
breached downtrend	gold exploration
risen to resistance line	potash
down	gold
secondary downtrend	gold
breached downtrend	copper
strongly higher	oil/gas
heavy fall	gold exploration
rising	mineral sands
back in downtrend	gold exploration
down	nickel
off its highs	uranium enrichment technology
on support line	silver
down	general exploration - Ni,Cu, Co, Au
breached steepest downtrend	coal
still in downtrend	mineral sands
turning up	
breached support line, down	graphite
back to highs	vanadium
down	gold exploration
new high	gold
testing downtrend	gold exploration
recovering uptrend	gold
sideways	gold
down	gold
weaker	zinc
steeply higher	uranium
holding shallower uptrend	gold

Far East Capital Ltd -	- 30 January 2021
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Far East Capital Ltd - 30 January	r East Capital Ltd - 30 January 2021 Weekly Commentary					
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 gravity of the rest can be added to give up some of the new uptrend. 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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