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The Crucible

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The magazine of the Minor Metals Trade Association

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Draft Programme:

Keynote presentation by **John Emsley**, Chemist & Author;
"Current and emerging applications of Se and Te in optoelectronic devices", by **Dan Hewak**, **University of Southampton**, United Kingdom;

Session 1: Wonderful world of minor metals: future movers and shakers:

"The lithium supply chain in batteries and battery materials", by **Martin Steinbild**, Senior Manager, Strategic Marketing, **Albemarle**, Germany;
"The impact of rare earth elements on the performance and application of magnesium based alloys" by **Jim Hickey**, Procurement Manager, **Magnesium Elektron Ltd**., United Kingdom;
"Hafnium supply: Past, present & future", by **Alister MacDonald**, Consultant, **Alkane Resources Ltd**., Australia;
"Self-healing in metallo-ceramics and the use of minor metals", by **Professor Sybrand van der Zwatt**, Novel Aerospace Materials Group, Faculty Aerospace Engineering, **TU Delft**, The Netherlands;

Session 2: Interactive session on supply chain management and REACH implementation:

"Are you ready to comply with the REACH 2018 registration deadline?" by **Karine van de Velde, REACH Orphan Substances**

The MMTA is currently working on supply chain management issues, and is delighted to offer this interactive session for delegates:

- "Tungsten – conflict free from mine to consumer", by **Steffan Schmidt,** Board Member, **Tungsten Industry – Conflict Mineral Council (TI-CMC)**
- "Cobalt supply chain issues", by **David Weight,** President, **The Cobalt Development Institute,** United Kingdom;
- **Panel discussion**

Session 3: Overview for steel and alloys:

"Alloy steel markets outlook", by **Markus Moll**, Managing Director, **SMR**, Austria;
Tantalum and niobium myths", by **David Henderson**, President, **Rittenhouse International Resources LLC**, USA;

Session 4: The diagnosis for minor metals post Fanya:

"Expectations for bismuth in a post-Fanya world", by **Sebastian Voigt**, **Hunan Jinwang Bismuth Industrial Co Ltd**, China;
"Selenium in infrared technology", by **Funsho Ojobuoboh**, Consultant, **Vital Materials Co Ltd**, USA:
"Recycling and recovery of minor metals from residues", by **Koen t'Hoen**, Managing Director, **M&R Claushuis**, The Netherlands;
"Indium Market: after the Fanya years", by **Brian O'Neill**, Marketing Manager, **AIM – Minor Metals**, USA;

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(Updated 10th March 2016)

Will the new EU Union Customs Code finally bring centralized clearance?

The EU customs union is central to the EU dream of a common and efficient market. Ideally, whether your container enters through Felixstowe or Rotterdam or Riga, it should go through an entirely predictable customs process, and you should be able to handle it all electronically within one system from anywhere within the EU.

Unfortunately, the EU still has a long way to go to get there. The new Union Customs Code ("UCC"), launched with the aim of modernizing and simplifying customs clearance processes, moves in the right direction – slowly. The **UCC will take effect in May 2016**, but some elements will come much later, especially the long-awaited IT systems enabling centralized clearance of all customs information.

Meanwhile, companies have plenty to look out for in the new UCC, which runs to 100 pages, plus another 1,000+ pages of related legislation. Some special customs procedures will be modified; the "first sale" principle for determining customs value will end; and some customs authorizations will be reassessed – by national customs authorities.

Importantly, companies will need to be wary of varying practices by EU Member States. Despite the European Commission's best efforts at harmonization, the various **Member States are interpreting the UCC in varying ways**, so be sure to consult the customs authority of your relevant Member State. The Commission will be issuing Guidelines to help companies and national customs authorities make sense of the new rules.

Centralized clearance IT system will be in place by 2020… or later

Industry associations have been waiting for electronic centralized customs clearance since 2005. The new UCC sets out to develop and deploy electronic data-processing systems by the end of 2020. However, the Commission now says that it may take longer than anticipated to upgrade all Member States' IT systems, and that there may be amendments to the UCC to allow **some IT elements to start even *after* 2020**. There are delayed target dates for each element of the new systems. For example, the electronic "Proof of Union Status" to replace the paper form T2L was due to come online in 2017, but this will likely slip to 2019.

With the EU taking longer to deliver the new IT systems, companies may have to align their own IT systems with the EU's on very short notice. Industry associations are putting pressure on the EU to ensure that **companies get at least 18 months to align their systems** after their national customs authority notifies them of the technical specifications.

For a "Single Window" to enable one-stop filing of all customs (and non-customs) information, there is no concrete timeline. The veterinary sector has tested the Single Window as an isolated project, but there are no specific plans to roll this out more widely to other sectors.

So what will change in May 2016?

If your company is using any **special procedures, such as inward processing, outward processing, temporary admissions or customs warehousing**, there are likely to be changes in effect from May 2016. How this affects your business will depend on your specific case. One change to watch out for is whether you will need to provide a **guarantee** for using a special procedure. Currently, Member States have discretion to decide when a guarantee is, or is not, required. Under the UCC as applied from 1 May 2016, a guarantee will be mandatory in some circumstances.

Another key change under the UCC is the **end of the so-called "first sale" principle**. Currently, companies can use the value of an earlier sale in the supply chain as the customs value, provided certain conditions are met. Under the UCC, companies must use the value of the sale occurring "immediately before the goods are brought into the territory of the EU". Each company will need to consider how this impacts their business model and supply chain. This change applies as of 1 May 2016, although there is a transitional period until the end of 2017 for existing contracts that use the first sale principle.

What about current authorizations? Will they need to be renewed in May 2016?

Regarding the renewal of customs authorizations, companies will again need to watch out for differences in practices among Member States. For example, for temporary storage authorizations, some national customs authorities are giving longer transitional periods than others. In general, the UCC deals differently with three categories of authorizations:

- Authorizations with a **limited period of validity** that are still valid on 1 May 2016: These will continue to be valid until the final date of the limited period as stated on the authorization, or until 1 May 2019, whichever is earlier.
- Authorizations with **no particular period of validity** that are still valid on 1 May 2016: These will need to be re-assessed by the relevant national customs authority. The timing of that re-assessment is up to the customs authority.

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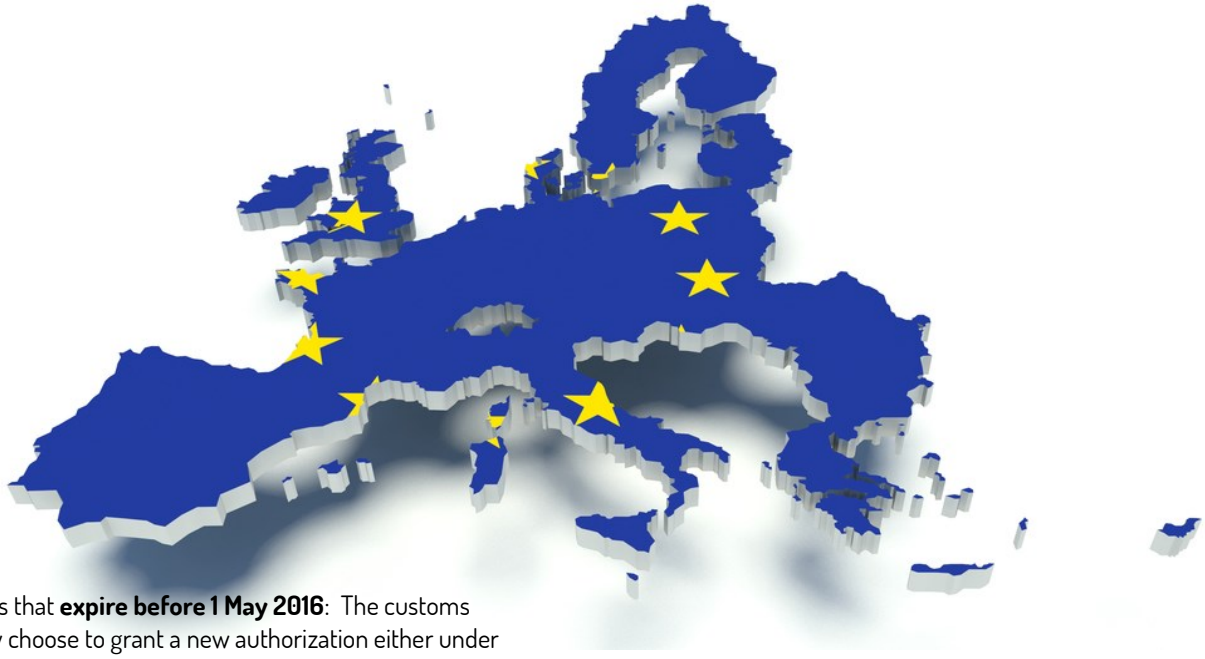

- Authorizations that **expire before 1 May 2016**: The customs authority may choose to grant a new authorization either under the current customs rules or under the new UCC rules. However, if the new UCC rules are used, the new authorization will only be valid from 1 May 2016.

Even if a company's authorizations continue to be valid, it will also need to take the new UCC rules into account. Although the procedure may be authorized, the new UCC rules will affect how the procedure is used and how the goods are treated after they have undergone the procedure.

What else is new in Brussels on the customs front?

The EU is negotiating a **free trade agreement with Japan**. The negotiations are still at an early stage, so this is a good time to contact the Commission with the industry's priorities. There will be a specific chapter on customs and trade facilitation, which will push for (i) transparent customs rules, (ii) simplification of procedures, (iii) consistency with international standards, and (iv) risk management while avoiding arbitrary discrimination. One point already on the agenda is the Temporary Admission procedure. The EU is negotiating for easier use of the ATA Carnet in Japan, with a common list of merchandise between the two economies.

Meanwhile, there is strife within the **EU-Turkey customs union**. Companies report that Turkey is increasing import duties on their products, especially for goods that are of EU origin but with non-EU aspects in the supply chain. The Commission is aware of these issues and is raising them with Turkey, but so far to little avail.

And a final word...

If your company is struggling to digest aspects of the 1,000+ pages of legislation before 1 May, you can reach out to the relevant national customs authority for guidance. The relevant implementation team in the customs authority can advise on any specific changes that may relate to your company's processes or existing authorizations. For issues that are particularly difficult or sensitive to resolve, we recommend that you speak to your customs lawyer before contacting the customs authority.

Jung-ui Sul, Sidley Austin LLP.

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- Incoterms,
- Customs Formalities,
- Methods of Shipment,
- Cargo Insurance,
- Documentation,
- Methods of Payment.

The event is being held at the MMTA Office in London

Jon Walden MBE (Crown Agents) will again be the course presenter.

The cost will be £395 + VAT

(including a copy of INCOTERMS 2010)

Book online on the 'Events' page of the MMTA's Website or contact executive@mmta.co.uk

Clean Energy Runs on Magnets

With all the talk about the battery boom, I thought it'd be worth a mention that it's not just lithium that's powering clean tech: it's also neodymium and dysprosium. These are the most important elements in the permanent magnet market.

Magnets? But how are those related to clean energy?

As a rule of thumb, any time you hear or read "electric motor" or "electric generator", you should be thinking "contains magnets". Permanent magnets are one of the best ways we have for converting back-and-forth between mechanical and electrical energy because once you've created an aligned magnet, you get to use its magnetic field in perpetuity: you don't have to "recharge" a permanent magnet like you do a battery, and it doesn't have ongoing energy costs like an electromagnet or combustion motor.

Because of this, magnets enable turbines to convert flowing wind and water to usable electricity, and use that clean energy to spin electric motors in cars, AC units and other applications. Since we also need hard disks made of magnetic materials to store the data and software that's critical to grid and energy management, it's no stretch to make the argument that magnets are at the core of clean energy.

So let's take a look at just how critical magnets are to the clean tech and renewable energy markets:

Energy Generation

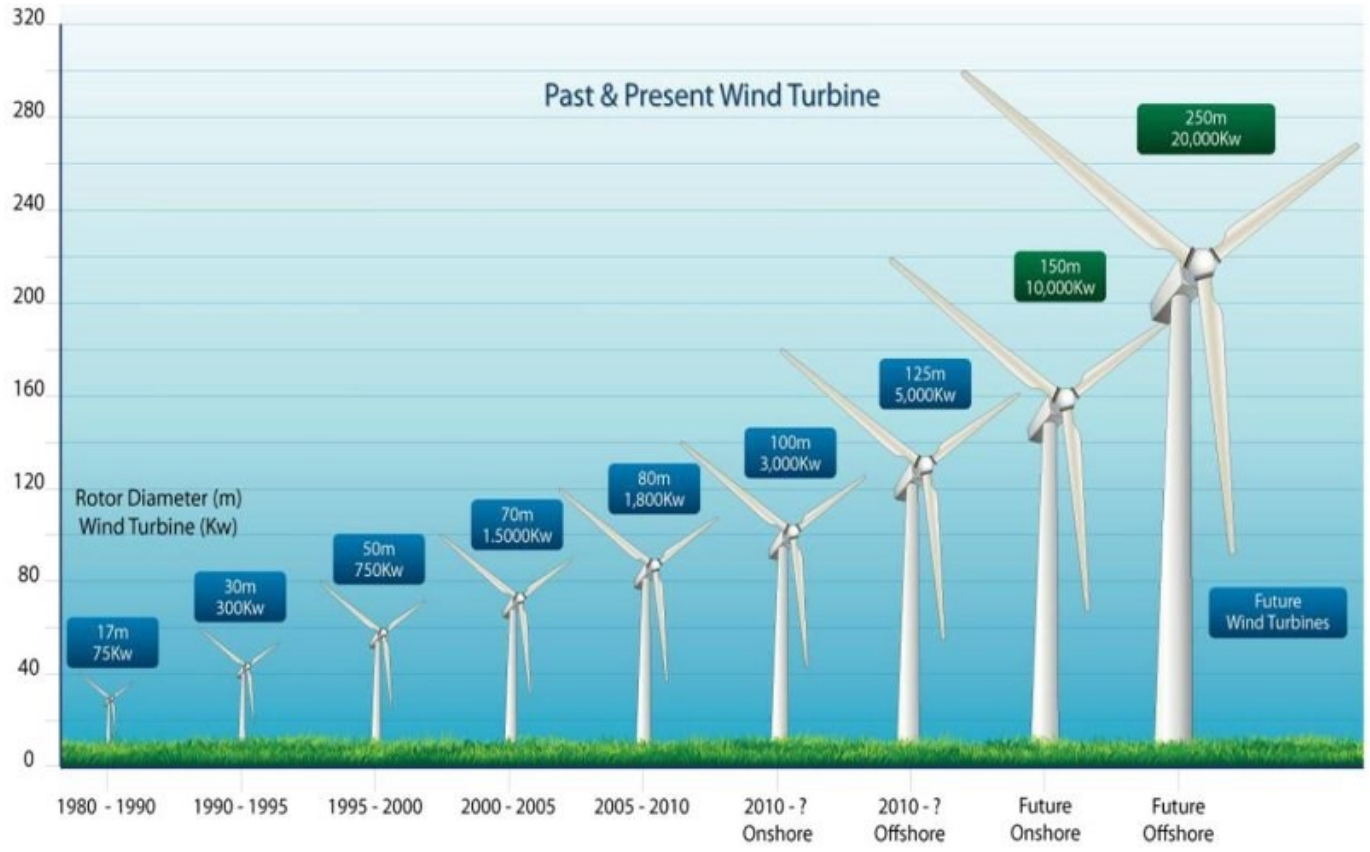

Image source: SBC Energy Institute.

Wind Power:

There are ~500 kg of permanent magnets for every MW produced by the newer, more efficient wind turbines. That's *2.75 tons* of magnets per 5 MW turbine being installed today. There are also plans to double and quadruple[5] the generation capacities for future onshore and offshore turbines, respectively, which would likewise increase magnetic material consumption.

Tidal Power:

There are a few different types of tidal power with varying degrees of real-world testing and market potential, but most still rely on spinning turbines (as with classic hydropower), which power magnet-containing electric generators. Since the technology and market is still relatively nascent (though there are several projects in various stages of completion[7]), there is limited per-unit and market data for magnetic material use. If you know of any, please let me know!

Transportation

Hybrid and Electric Cars/Trucks:

A typical electric car uses ~0.7 kg of permanent magnets in its motor (with the notable exception of Tesla's AC induction motors). While that doesn't sound like much, especially compared to wind turbines, the total market size is formidable: it is estimated that 7,000 tons of rare-earth magnets were used in 2015 for this industry, and that is expected to rise to 17,000 tons by 2020.[6]

Electric Bikes:

Here, I'm just going to quote Steve Constantinides' article[6] because this market was surprising even to me and he sums it up very well:

> *This is a stealth application – one that grew rapidly without much notice, at least in the west, until it was a large market. In 2009, the China market for EBs (electric bikes) was 20 million units. The major market is currently China and Southeast Asia, but India's market is growing and global production in 2018 is forecast to be 60 million units. Magnet consumption per bike is highly variable ranging from motor assisted pedaled bicycles to high-power sport bikes competing with conventional motorcycles. Magnet usage in 2015 was 6,000 tons and is expected to rise to more than 15,000 tons annually by 2018.*

Buildings/Efficiency

HVAC:

Traditional air conditioning units can have 3-4 electric motors within them. As I mentioned above, every time you see "electric motor" or "electric generator", you should be thinking "probably contains magnets". Based on Constantinides' and Arnold Magnetic's estimates,[6] the proportion of the permanent magnet market going toward HVAC units is only a little behind that of hybrid/electric vehicles. Furthermore, HVAC systems might get a whole lot more efficient if even more magnets are used as discussed below.

Refrigeration:

There is a big potential for magnetic refrigeration that takes advantage of the magnetocaloric effect. Franco *et al.*[9] summarize the advantages really well in a 2012 review paper:

> *Magnetic refrigeration is [...] more energetically efficient than the process based on the compression/expansion of gases (magnetic refrigerator prototypes can achieve 60% of ideal (Carnot) efficiency, whereas the best commercial conventional refrigerator units can reach only 40%). Moreover, as no refrigerant gases are required for magnetic refrigeration, there is no concern about ozone depletion or greenhouse effect, which contributes further to its environmental friendliness.*

Or put it another way: it's potentially a 50% improvement in efficiency over existing technology. GE, which has been pursuing this technology, reports that they have already achieved a ~20% improvement [see video: https://youtu.be/WIKKKMTA7XM]. That number is going to go up as the technology matures, and HVAC and refrigeration applications will get even more magnets!

I think this is a really exciting market with lots of potential.

Magnetic Couples/Drives:

There are many places in industry (mining, traditional power generation, water/wastewater) where big motors are used to turn fans, pumps and conveyors. These big motors use lots of energy, so running them at peak efficiency is hugely important to the bottom line.

These motors have optimal run speeds for their most efficient operation. Deviating from that optimal speed, which happens frequently if the fan/pump/conveyor needs to slow down or speed up, costs energy and harms equipment life. However, if it's possible to can keep that motor humming at its optimal speed while still slowing down the load to where it needs to be, operation costs stay low and equipment life is extended.

This is achievable with magnetic couples that put a physical air gap between the motor and drive (and if this air gap is adjustable, it is possible to gain speed control as well). These magnetic couples and drives are (as the name would imply) big magnet users, but can result in up to 70% in energy savings.

Energy Storage

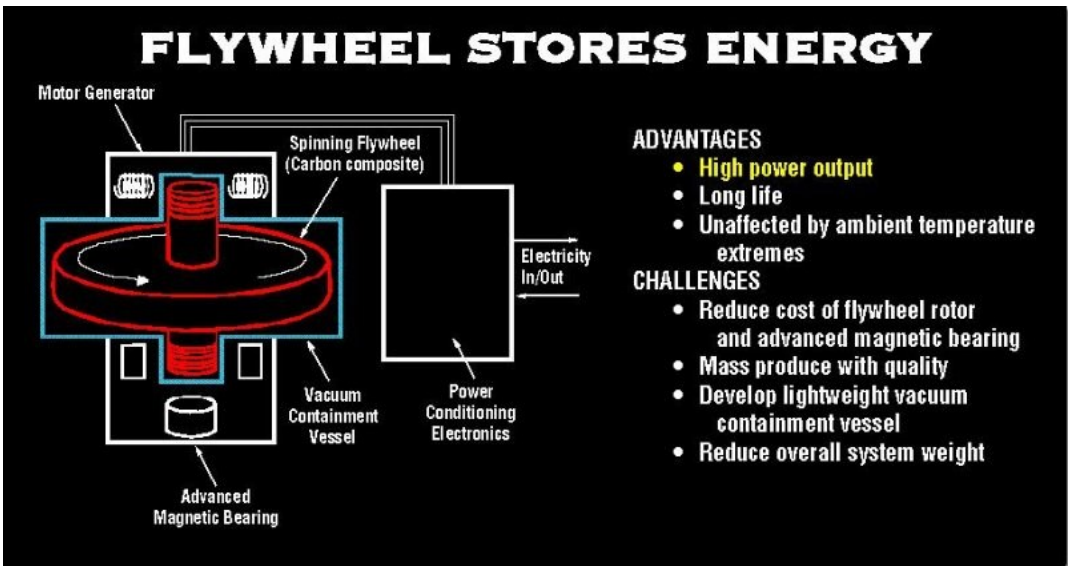

Image source:

University of Oregon.

Flywheels:

A flywheel is essentially a mechanical (rather than electrochemical) battery: you can spin a large heavy rotor that has a lot of inertia when you have extra energy, and then recover that energy by spinning the rotor down later. Magnets are used both in the electric motor/generator that spins the load up and down, and also as a way to reduce friction on the load through magnetic bearings.

However, flywheels have never quite taken hold as an energy storage option that is scalable and economical, so I'm mostly including them here for the sake of completion. If someone cracks the code for a feasible/scalable flywheel, you can be sure it'll be magnet intensive.

Magnets and Clean Tech go Hand in Hand

So while solar and batteries are (rightfully) getting a lot of attention in the clean tech world, don't forget what's at the heart of most of the rest of the technologies that are part of this sector. Magnets made the data revolution possible. They might just make the energy revolution possible, too.

Luke G. Marshall Ph.D. is a researcher at Northeastern University in Boston, MA, exploring synthesis and processed methods for the creation of novel and sustainable magnetic materials. A graduate of Whitman College and the University of Texas at Austin with a doctorate in Materials Science & Engineering, Luke's passions are energy and clean technology with a focus on business solutions for transitioning cutting-edge science from the lab bench to the real world. Follow him on LinkedIn (https://linkedin.com/in/lukegmarshall) and on Twitter @lukegmarshall.

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Growth of the Mexican Aerospace Industry

In recent years, Mexico has steadily been climbing the ranks to become a global player in the Aerospace and Defence (A&D) industry. Mexico has some unique attributes which have facilitated this growth, as well as strong support from the government. The future is also looking bright, with a long backlog of orders and clear plans mapping the industry's growth until 2020.

Current situation

The A&D industry is one of the most important industries in Mexico. In the 5 years to 2014, the Gross Domestic Product (GDP) of the A&D industry grew more than 20% each year and reached around 18,759.8 million MXN in 2014. From 1999 to 2014 the A&D industry has contributed 3,183.7 million USD to Mexico and contributed to its trade balance surplus. The country's Free Trade Agreement (FTA) also helped build this success.

Geographically well positioned and with access to the European and Asian markets, logistically Mexico is ideal. The country stands within a corridor of several large aerospace manufacturers: the US (Boeing) is to the North and Brazil (Embraer) to the South. In addition, an increasing Aerospace industry presence in the southern US states over the last few years (e.g. Airbus in Alabama) means that Mexico is ideally located to build on its supplier base.

Another facilitator of the A&D industry's strong recent growth was the established and experienced workforce. Trained in automotive and electric-electronic manufacturing, they were ready to transfer to the aerospace sector. A well-established infrastructure and supply chain was another benefit of having these other industries in place, which made the growth of the A&D industry much easier.

Mexico is more cost competitive than the United States with 2012 KPMG figure showing a 15.7% cost saving. This combined with a high proportion of engineering, manufacturing and construction graduates makes the workforce extremely attractive to international firms.

In order to fully develop its A&D industry, the Mexican government has paid attention to talent management, as well as establishing many research centres / institutions to serve the industry and enhance its current position in the industry. The value of the A&D industry is also expected to grow in the near future. The Mexican government has carried out a study called the 'Pro-Aeréo 2012 – 2020 (In Spanish)' to guide the industry, aiming to place Mexico among the top 10 suppliers in the A&D industry worldwide, as well as ambitious targets of $12bn in exports and over 110,000 employees, all by 2020.

On the technical side, Mexico is one of the few countries with a Bilateral Aviation Safety Agreement (BASA) with the Federal Aviation Administration (FAA). Companies in Mexico have certified their processes to comply with industry standards such as ISO-9001, AS9100 and NADCAP.

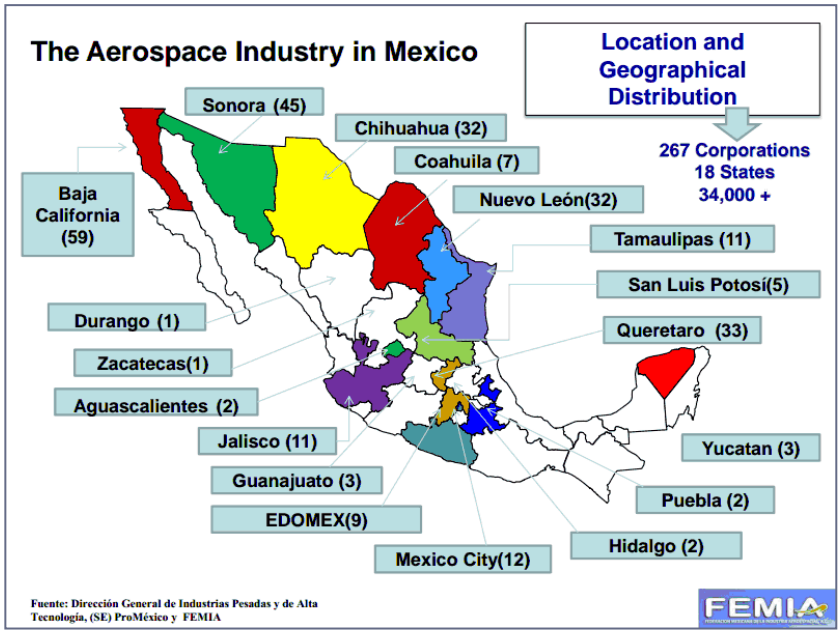
The economic potential of the country is underpinned by its ambitious President, Peña Nieto. Nieto has outlined a raft of social and political reforms during his time in office, including allowing FDI (Foreign direct investment) in Mexico's oil industry, clamping down on corruption, new educational and constitutional reforms and business-friendly tax code changes.

This being said, despite its advantages and the progress Mexico has already achieved, many challenges for the government and the people still lay ahead, with social and political change ongoing. President Nieto's reforms have faced resistance from all sides (he only won 39% of the presidential vote, so does not hold the legislative majority). Well-publicised corruption, and financial and business mismanagement in both government and industry remains, and Mexico's drug war, as well as its ongoing violence and security worries show no sign of being quickly resolved.

The view from abroad

In March 2015, ADS, the UK's Air Defence and Security Space sectors published their 'ADS Global Aerospace Outlook 2014' that identified Mexico as one of 9 priority countries that the UK aerospace industry and UK government should increase their efforts towards over the coming year. Indeed, many UK companies have already moved some production capabilities to Mexico's aerospace clusters over the last few years.

However, in 2013 the UK only exported £34m in Aerospace to Mexico, so there is a way to go before the UK at least takes full advantage of the Mexican A&D sector.



Mexico clusters

The A&D industry is spread throughout Mexico, with Baja California, Sonora & Nuevo Leon being the areas with the most aerospace corporations.

Other global trends have had a positive effect on Mexico. Rising labour costs in China have shifted focus towards countries like Mexico, which boasts relatively stable wages, greater IP protection for companies, as well as its skilled workforce.

In 2013, Mexico's GDP grew an estimated 1.2% and whilst this is relatively modest compared to some other emerging countries, it ranks higher than most western European countries, including Germany. In addition, Mexican government bonds earned an 'A rating' in 2013 for the 1st time, making investment in Mexico appear more attractive.

What the future holds

Here are some surprising facts about Mexico's industry which underpin its future growth capacity:

- 17% expansion in aerospace productivity since 2010
- Currently over 260 aerospace companies (see split by region in illustration), with around 34,000 employees.
- 10th largest supplier to the US market.
- Around 5% of Airbus A380 suppliers are located in Mexico's aerospace clusters.

[Figures from ADS]

Opportunities for the future

Large OEMs such as Boeing and Airbus are driving standards for the whole industry, and figures from 2012 show that the order backlog was 7 years for these large companies. For the medium OEMs such as Bombardier, Embraer and Mitsubishi, they have a 5-year order backlog. In addition to this, private plane and helicopter companies, such as Dassault, have a 3 year backlog.

It is also very important to remember that the average age of the world's aircraft fleet is 18 years plus, meaning that within the next 8 years 20,000 aircraft will need to be replaced, before taking into account any expansion or growth in the sector.

Although we have mentioned mostly commercial aircraft manufacturers, it is also worth pointing out that the defence market budget is significantly larger than the commercial sector, 4-5 times the size, with the 2012 total being 550-600 billion USD, and Mexico is well-prepared to claim its share.

[Figures from FEMIA- The Mexican Federation of the Aerospace Industry]

Challenges for the future

In order for Mexico to be prepared for the future, there should be some slight adjustments at the local and national government levels, to ensure that future demand can be met. Certification capacity should be increased to attract local companies to the sector. The supply of talent needs to continue strongly, as well as streamlining government R&D incentives. The competitive advantage of the different regions needs to be optimised, highlighting their favourable geographical positions, their infrastructure connectivity, and their high capacity to react to increased product requirements.

In conclusion, Mexico seems to be uniquely positioned to grow its successful A&D industry even further in the coming years.

China to curb illegal mining & export of rare earths

Mining.com recently reported that China is increasing its attempts to restrict illegal mining and export of rare earths. To do this, it is setting up a system to certify the origin of these important materials. It is reported that illegal mining and exports have been a factor in falling prices of the past year, as this material has been flooding the international market.

According to vice minister of industry and information technology Xin Guobin, the new "tracing system" will use special rare earth invoices and other information like export data to crack down on illegal miners, state-owned *China Radio International* reported.

Some estimates put illegal exports via Vietnam and Hong Kong as high as 40,000 tonnes. Amongst Beijing's concerns are not only the financial losses from smuggling, but also the environmental and health and safety impact of unregulated mining. Modernising China's industry is part of bringing pollution under control, but will also have the effect of consolidating and regulating the mining sector.

The Chinese government is set to introduce new environmental regulations, including green export certificates and new taxes that are based on the value of the minerals, rather than on volume as is the case at present, *Reuters* reports.

Recent figures disclosed by the Association of China Rare Earth Industry, show that about 90% of the nation's rare earth producers are currently operating at a loss, and many may not survive past this year.

It is interesting to note from the chart opposite that projected rare earth production from the rest of the world, excluding China, is estimated to increase as a proportion of the total worldwide annual production.

Adapted from MINING.com

Projected rare earth production for China and the rest of world from 2013 to 2018 (in metric tons REO)

This statistic shows projected rare earth production from China and also the rest of world from 2013 to 2018. For 2017, it is estimated that the rare earth production worldwide (excluding China) will be some 65 thousand metric tons.

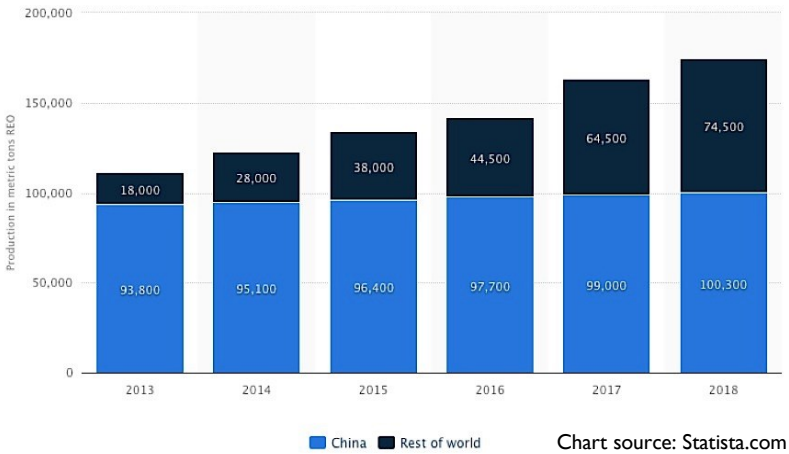


Chart source: Statista.com

Letter to the Editor

Following the Crucible's recent publication of responses to MMTA Members' questions to the metals press, the following Letter to the Editor has been received.

Sir,

Please allow me to look at the work of 'pricing agencies' through continental European glasses, with reference to Mo in the shape of Ferro Molybdenum and Mo oxide and FeV. The continental spot markets were next to dead in 2015 and are beginning to gain life again.

You may recall that steel products (such as escalators, steel rails, car parts etc.) were in recent years the subject of a number of anti-trust investigations, in many cases leading to expensive sanctions. In response, huge volumes of 'compliance rules' have been written, lawyers have taken over and now dictate how we do business.

This, one has to know when trying to understand the criticism (coming mainly from Western Europe) that pricing agencies might shape a market, rather than simply describe it. That the publication of price tables is not only a goodwill service to the market, but a business, can be concluded from the fact that one leading publisher changed to daily pricing of Mo oxide immediately after the LME's creation of the Mo-contract. The problem was and still is: there is not much to talk about in Europe in relation to Mo oxide powder, and the LME-contract is of no relevance.

The first point made by critics is that Mo oxide powder is hardly used in the steel industry, but industry uses Mo oxide compacted to briquettes, packed in both big bags and drums. Briquetting creates cost and different packing is linked with a difference in cost. The reporter, of course, can try to deduct Mo oxide powder from Mo oxide briquettes, but one should keep in mind that market premiums varied in recent years between more than USD1 and zero – and even those market players interviewed (trader, consumer), can only guess what the premium is – quite apart from the fact that in most cases packing does not even form part of the interview. The cost gap between big bags and drums is about USD 0.05 – 0.07/lb Mo; this is 1% of the prevailing market price of USD 5.30! A grey zone of 1% just for packing?

The critics' second point relates to the bad habit of showing prices by rolling forward even when the market is dead. If there is no business concluded or traceable, there is no turnover; it is a simple mathematical calculation with the result of zero. Some business in trade defines a specific day as the quotational period, and I can fully understand that a contract party develops mixed feelings when caught in a virtual price. 'A realistic assessment of the tradable value of the commodity in question' is no substitute for non-existent business.

The third point raised by critics is, let's call it smoothing of prices, by cutting off what in the eyes of the reporter is extreme in both directions and does not fit. Markets are extremely volatile and try to find their balance by working out high fluctuations. By cutting these off, a reader would years later get a completely distorted market picture, but also, real business is affected, and this might cost a fortune: concluding at a high or low quotation is risky, if the market is not properly reflected. I remember a buyer in a steel mill, who bought FeV spot at very favourable terms (and the market knew it), and he was subsequently confused to see a higher low than he had concluded.

Sincerely,

Michael Ihlenfeld

Consultant to F.W. Hempel Metallurgical GmbH

Fiji first to ratify COP21 deal

On Friday 12th February, Fiji became the first country in the world to formally approve the UN climate deal (COP21) agreed by 195 nations in Paris in December 2015.

The island nation's parliament unanimously agreed to ratify the Paris agreement, with a signing ceremony being held in New York in April, which the country's prime minister Voreqe Bainimarama will attend.

Tackling climate change is a major priority for the region, which could face wide-scale flooding, fiercer tropical storms, and depleting fish stocks as a result of the world's changing climate.

It is expected that many other countries will also sign within the next few weeks to also take part in the April ceremony.

The Paris agreement needs at least 55 countries, representing at least 55% of the world's climate emissions, to ratify the treaty. Observers are confident the milestone can be passed in time for the New York event, given all the world's major economies expressed full support for the Paris agreement at last year's summit in the French capital.

Iran: Mineral Resources and Opportunities

Tom Butcher, Consultant

A Bit of Background

Iran has lived with sanctions for many years now. And still does. The first hefty set of sanctions was unilaterally imposed upon the country by the US following the takeover of its embassy in Tehran in November 1979. These sanctions froze assets and affected, amongst other things, investment in gas, oil and petrochemicals, together with banking and insurance transactions, and shipping.

The next set of sanctions to hit the country followed the discovery by the International Atomic Energy Agency (IAEA) that, in September 2005, Iran was not in compliance with its international nuclear obligations. This time around, sanctions were imposed not only by the US, but also by both the EU and the UN. UN sanctions, under Security Council Resolutions 1737, 1747, 1803 and 1929, were imposed successively in 2006, 2007, 2008 and 2010. These hit the country particularly hard (especially those of 2010), affecting, not least, the development of the mining sector in Iran.

Today

To the surprise, perhaps, of many, in July last year the world powers and Iran struck a deal at the UN in Vienna over the country's nuclear programme which would, potentially, lead to the country's economy being reopened to both investment and global trade. Sanctions relief would become effective on verification by the IAEA of implementation by Iran of the nuclear measures agreed upon.

On January 16 this year, "Implementation Day", the IAEA certified that Iran had indeed fulfilled its initial obligations under the agreement. Subsequently, the UN (nuclear-related) sanctions were unwound, as were a number of others imposed upon the country.

Whilst some US-imposed (non-nuclear-related) sanctions still remain in place, as far as non-US companies are concerned, it should now be "business as normal" with Iran – as long as their dealings involve neither US persons nor banks. Such business can, now, include both the finance of mining projects and ownership of Iranian mines, together with exploration and extraction.

Mineral Resources and Opportunities

If the country's PressTV is to be believed, Iran's mining sector is one "*which boasts some of the world's most stupendous riches but remains vastly underdeveloped.*" Although not, perhaps, "stupendous", these riches are pretty impressive, including, depending upon whom you ask, some 68 different types of mineral worth US$700 billion.

"Major" Metals

In addition to significant deposits of iron ore in Kerman, Khorasan and Yazd, amongst the non-ferrous metals, the country produces and has significant major deposits of copper (in Sar-Cheshmeh, Sungun and Miduk), and zinc and lead (both in Mehdiabad). According to the United State Geological Survey (USGS), the country's zinc, copper and iron ore reserves are some of the largest in the world.

The country also produces aluminium, gold, manganese and uranium, of which last it reportedly has the world's tenth largest reserves.

Selected Iranian Metal/Mine Production – 2009-2013 ('000 Tonnes)

	2009	2010	2011	2012	2013
Primary Aluminium	281.3	282.0	321.9	338.0	*331.9
Copper (Refined)	210.3	219.8	227.2	226.8	190.3
Iron Ore	31,993.5	35,549.0	44,355.3	39,783.5	*40,000.0
Lead (Refined)	72.0	75.0	82.0	81.0	85.0
Manganese (Ore)	125.5	131.6	194.4	172.6	*170.0
Zinc (Metal Content)	115.0	128.0	138.0	140.0	134.0
Uranium	?	?	?	?	?
Gold (Kilograms)	*350	*350	*1,000	*1,000	*2,000

Source: British Geological Survey; Notes: * Estimated

Minor Metals

As well as base and other metals, the Iran mining industry has also produced, and still does produce, a number of minor metals.

Selected Iranian Minor Metal/Mine Production – 2009-2013 ('000 Tonnes)

	2009	2010	2011	2012	2013
Chromium (Ores and Concentrates)	274.5	350.0	417.6	411.6	*410.0
Molybdenum (Metal Content)	3.882	3.676	3.365	3.512	*3.500
Strontium Minerals	15.4	-	40.0	*20.0	*20.0

Source: British Geological Survey; Notes: * Estimated

Although this has not been possible to confirm, I did hear that some rather low-grade APR, sourced from Iran, was being sold out of Dubai. Whether this is true, I know not. Or, if it is, whether such APR is still being sold out of Dubai.

In addition to the metals above, in the recent past, the country has also produced white arsenic (in the form of orpiment and realgar concentrates), with the BGS listing estimated production in 2008 of some 100 tonnes, but none thereafter.

Whilst information is currently somewhat hard to come by, the country also appears keen to exploit several more of its minor metals' resources.

Future plans for minor metal production include one for a huge titanium mine in Fanuj, in Sistan-Baluchistan Province, in the south-east of the country (down near its border with eastern Pakistan), which will require an investment of US$4.2 billion over the next five years to bring into operation. Some 80 mines containing copper, iron ore and titanium have been "explored" in the Fanuj area in the last five years. With reserves estimated at some 3.6 billion tonnes, Fanuj is said to include "*a cluster of 30 deposits, each capable of yielding one million tons of titanium ore per year.*"

Other significant titanium reserves in the country are situated in Kahnuj in Kerman Province (400 million tonnes), in southeast Iran, and near Orumieh (200 million tonnes), in West Azarbaijan in the northwest of the country.

Over the past several years (since July 2014), REEs, and particularly heavy REEs, have been a focus of attention for the state-owned Iranian Mines and Mining Industries Development and Renovation Organization (IMIDRO). IMIDRO has actively been looking at sourcing these from iron and phosphate ore and tailings, not least as "*with their simultaneous extraction more value added can be created.*" And, indeed, "*IMIDRO calls for cooperation of all investors and owners of technology in the field of development of rare earth elements and strategic metals and will provide proper conditions for activities in this regard.*"

The country's ambitions are not, however, confined just to REEs and titanium. Other mining projects involving minor metals include a magnesium oxide production plant and a proposed antimony (considered by IMIDRO a "strategic" metal) mine at Sefidabeh in South Khorasan province in eastern Iran near Afghanistan.

Opportunities

Even before signature of the international deal in July last year, IMIDRO had organized a major mining conference in Tehran at the end of May/beginning of June entitled the Iran Mines and Mining Industries Summit (IMIS 2015). Over 200 mineral projects "ready for investment" were presented and the event drew in excess of 200 domestic companies. Foreign companies from over 20 countries registered to attend including ones from Canada, China, Finland, Germany, India, Japan and Sweden.

Since signature, at least a dozen European trade delegations have visited Iran, a figure that is bound, now, to increase following "Implementation Day". (The number of individual news items detailing such visits on the website of Ministry of Industry, Mine and Trade attests to their frequency.)

No one believes that the lifting of sanctions will have an immediate effect on Iran's mining sector. Indeed, a timeframe of three to five years, although possible, may even be optimistic. But, in the absence of sanctions, and as a purely practical matter, one immediate effect will be that mining equipment, together with mineral and mining technologies can, now, be exported to the country with considerably more ease.

According to Bloomberg, Mojtaba Khosrowtaj, First Deputy Minister in charge of trade at the Ministry of Industry, Mine and Trade, when he was interviewed back in November last year, said that, assuming an oil price of US$40 a barrel and daily exports of two million barrels, mining and metals such as copper and lead, and "higher priced rare earth elements" could be worth "much more" than the country's revenue of US$30 billion from the oil industry. Oil prices are now hovering around 25% less than this figure of US$40 a barrel

Whatever they may be worth precisely, the opportunities are by no measure insignificant, and probably range anywhere from US$20 billion to US$29 billion. Maybe even more. How many of these involve minor metals is not entirely clear. But what is clear is that some of world largest mining companies, for example Rio Tinto, have already started to scope out what these opportunities may mean for them. One can rest assured, however, that their numbers are only likely to get larger.

A Letter from Mufulira

Dear Reader,

It may not be easy to imagine living in a town where almost every person of working age has lost their job – but this is how it feels in present day Mufulira.

It seems that in this town we are just too dependent on Copper. It goes back to the time when copper was discovered here in the 1920s and the British then developed our mine and smelter. The whole reason for our existence was copper.

From relatively uninhabited bush, this place became a thriving hub for mining and all that goes with it. The problem is that for the approximately 300,000 people who live here, we do not seem to have developed alternative sources of livelihood.

So when copper prices fall on international markets, the consequences have real effects on people's lives.

I know, as an economist that, in our inter-connected world, a financial pebble thrown in a pond, thousands of miles away from Zambia can cause a ripple that will lead to a wave, that in turn could lead to a small Tsunami. In land-locked Mufulira, the financial Tsunami has come to town, and I want to try and describe what it feels like to be enveloped by the economic backwash.

My name is Mabvuto Chibende and I am 26 years old. That means I was born 26 years after Zambian Independence in 1964. My father, Mwansa Alick Chibende, was born in 1950 in Mufulira. Back then, education was quite rare but his father managed to have him educated. In 1977, he was among the few Zambians to graduate from the University of Zambia with a Bachelor's degree in Mechanical Engineering. The man could fluently speak four languages; Bemba, Lala, English and French. He gave me a good life so whenever he tried to explain how hard it was living in his time, I never could imagine it. I mean, besides his career, he was a golfer, played soccer and sometimes squash and above all, was a books collector. How hard could life have really been?

My mother, Ethel, on the other hand, was the only female in a set of triplets born in 1956. She grew up with 10 other siblings, of whom only four got educated, her inclusive. She was the only female in her family that got educated to tertiary level at David Livingstone Teachers college. I'm inspired by her dedication because she pushed herself to get a diploma in Religious Education via distance learning with West-Hill College of the UK. I was only 6 years old when my mother left for 3 weeks as she travelled to the UK in 1995 under a school exchange program.

I have grown up in Mufulira. It's not so different from most towns in Zambia except that we do not have large shopping malls; there is plenty of idle land and most households are either farmers or miners (or at least were). There are so many trees around most households with fresh fruits like mangoes, guavas, bananas etc. Mufulira is among the towns in Zambia that receive plenty of rain during the rainy season and so, the land is so fertile. In the morning, when you wake up, you can actually hear the sound of the birds singing, well that's of course after roosters around 5am. If you walk in the streets of Mufulira early in the morning, you will see children in school uniforms walking to school, miners waiting at a bus stop for the mine bus to pick them up and others going for work. You can get anywhere in Mufulira in time because there is literally no traffic. Not so many households can afford vehicles.

Today, it's really hard to live in Mufulira. The costs of living are high, the food prices are equally high, there have been cases of fuel shortages and above all, more than 60% of the population in the town are unemployed. I know the high costs of living is a case of the entire nation, it just feels like Mufulira is experiencing the worst of it.

Our country has many achievements we can be proud of. One of them is that we are one of the only countries in Africa to be generally at peace and to have recently held free and fair elections. Since independence, Zambia has been home not only to its citizens but also harboured a lot of refugees from neighbouring countries seeking asylum.

My economics tells me that Zambia is not the only country to suffer presently from low commodities prices. I understand excess world steel production has caused lay-offs in industrial towns in other parts of the world, and the consequences are similar to those we experience here with copper.

So the questions I am asking do not apply only to Mufulira, but also to you in your own countries. How can a town or community that depends on a single commodity protect itself from the swings of commodity prices beyond their control?

In Mufulira, there are two major influences on our livelihoods – the mine owners and the Government of Zambia. Could these two entities have prevented the present suffering and softened the blow? Could more have been done to keep employment levels going? Did the Government collect enough tax and wisely invest enough in social provision or diversification in the good times to underpin people's lives now in the downturn?

Let us look for a moment at what is it like here. On Monday 23rd November, 2015 Mopani Copper Mines (MCM) issued letters of redundancy to 4,300 miners in Mufulira and Kitwe and, quite simply, economic development came to a standstill.

Perhaps we can see the issue better through the story of one middle-ranking miner who I shall refer to as ST. ST is 34 years old and commenced work at the mines in 2011. He held a middle-ranking engineering job at the mine for two years, gaining promotion in 2013. In 2014, he took out a Kwacha loan of K133,000 ($12,000) from Stanbic Bank, which would have cost him K196,000 ($17,800) in repayments over five years, an approximate interest rate of 9.4% per year. At his redundancy he was paid K81,000 ($7,400) and K18,000 ($1600) tax free lump sums which were used towards loan repayments and subsistence. Today, he remains in debt for a further K36,000 ($3,300) and has no job, no income and no means to repay.

It seems that in the last few years, when Zambia became so credit-worthy based on the so-called super cycle and high copper prices, one group of companies expanded into Zambia at a phenomenal rate – the banks. Here in Mufulira we have five banks - Barclays Bank, Finance Bank, First National Bank (FNB), Stanbic Bank, and Zambia National Commercial Bank (ZANACO). We also have two micro-finance companies, Bayport and Unit Finance.

It is a brutal lesson to learn, but just as our Government has undoubtedly increased the country's indebtedness based on the expected returns of copper, so have the individuals whose personal incomes were derived from that industry.

As for ST, he is an industrious person and has a good chance of survival, but others have taken to alcohol or are suffering from depression and there are reports of suicides too.

Was this necessary?

I think what we fail to understand here in Mufulira is that we are part of a long chain of profit that starts with digging for copper. What starts with us, ends as cable in your car and your computer and brings light to your home. Our pebble dropped in the pond brings you sunshine and an easier life. Why does the pebble of lower prices on international markets bring us only redundancy and poverty?

I am an economist and I am part of a new generation of young Zambians who are trying to understand the position of our country within the inter-connected fabric of the world economy. For too long we have failed to benefit enough when times have been good and have not been supported enough when times are bad. It is something that I hope in my lifetime will be addressed through the spread of information and understanding of how international markets work so that Zambians may no longer be powerless before world events.

As for me, I am learning one hard lesson – never to borrow more than I am able to repay.

Mabvuto Chibende, Mufulira, Zambia

Asteroid Source: Erik Simonsen Getty Images

In an update on developments in asteroid mining, Luxembourg recently announced plans to support efforts to mine asteroids for their untapped mineral resources.

Europe's first government asteroid mining initiative will develop a legal and regulatory framework on the future ownership of minerals extracted from objects in space, such as asteroids, as well as investing in related research and development projects, and may even directly invest in companies active in the field.

"Our aim is to open access to a wealth of previously unexplored mineral resources on lifeless rocks hurling through space, without damaging natural habitats. We will support the long-term economic development of new, innovative activities in the space and satellite industries as a key high-tech sector for Luxembourg," said the country's deputy prime minister and minister of the economy, Étienne Schneider, in a recent statement.

Asteroids, being lumps of metal and rock left over from the formation of the solar system around 4.5 billion years ago, can contain base metals like iron, nickel and cobalt and trace amounts of precious metals including gold, platinum and rhodium.

The announcement followed the US passing of the SPACE Act in November 2015, which aims to support private sector exploitation of space resources.

According to Deep Space Industries (DSI), a California-based 'space prospector', supplier, and asteroid mining firm, the industry is already attracting $2 billion a year in private investment.
The company launched a Luxembourg subsidiary last year.

"There are moments when the world changes. By joining the U.S., private citizens and companies who are moving outwards into space, Luxembourg is making this time in history one of those moments," pronounced DSI Chairman, Rick Tumlinson, on the company's website.

DSI clearly sees tangible future opportunities in asteroid mining, so it will be interesting to observe developments.

Source: Katy Barnato, CNBC (www.cnbc.com) 3rd February, 2016

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