ISSN 2056-6735 (Online)

The Crucible

The New Blue

A History of Minor Metals in Nuclear

The Social Value of Metals

The magazine of the Minor Metals Trade Association

7th Edition 2016/July/August www.mmta.co.uk

ADVANCED ALLOY SERVICES LIMITED

We focus on quality

Established over 21 years with an unrivalled reputation for supplying pure metals and high temperature super alloys into the aerospace, oil, medical and associated industries

Accredited ISO 9001, ISO 14001, BS OHSAS 18001

We buy & sell

Specialists in the supply of

- Mo
- W
- Nb
- Ta
- Hf
- All Nickel / Cobalt based alloys

Full revert management/processing

- Shot blast
- Size reduction/plasma
- Bar cutting
- Turnings degreased

NEW VENUE

The MMTA's 43rd Anniversary Dinner

Tuesday, 1st November, 2016

Lord's Cricket Ground, London

The famous Long Room in the Grade II* listed Pavilion at Lord's Cricket Ground is the spectacular new venue for this year's Anniversary Dinner.

Join us for a networking drinks reception and dinner surrounded by the world's finest collection of cricketing art. (You don't need to be a cricket enthusiast to appreciate this stunning venue!)

Numbers strictly limited to 200 - tickets are selling fast!

£105 MMTA Members and their guests (+ VAT where applicable)

£150 Non Members (+ VAT where applicable)

Optional tour £12 (+ VAT where applicable)

An optional 45-minute tour of the Ground will be available before the start of the drinks reception - to book the tour, please add tour tickets to your booking when paying online:

http://www.mmta.co.uk/events/2016/11/01/274

Alternatively, email admin@mmta.co.uk if you prefer to receive an invoice or to enquire about sponsorship opportunities at this event.

INSIDE THIS ISSUE

The MMTA promotes essential elements that add quality, safety and enjoyment to our lives.

The MMTA is the world's leading minor metals industry organisation.

mmta Minor Metals trade association

Contact Us:

Address: MMTA, Suite 53, 3 Whitehall Court, London, SW1A 2EL, UK

Tel: +44 (0)207 833 0237

Email: executive@mmta.co.uk

Welcome to James Walsh...Goodbye to Tamara Alliot

As many of you will know, Tamara will be on maternity leave from the end of July. I am very pleased to say that we have recruited James Walsh to cover in her absence. James has a BEng degree in Materials Science & Engineering from Sheffield University and a MSc in Nuclear Science & Technology from the University of Manchester. After graduating, James worked for Firth Rixson and Neonickel. He is looking forward to meeting Members and learning more about minor metals and the industry.

I am sure you will join me in welcoming James to the MMTA and wishing Tamara all the very best with the birth of her first child.

James can be contacted at james@mmta.co.uk and on the general office number: +44 (0)207 833 0237.

Maria Cox, General Manager

ELG UTICA ALLOYS LTD

MMTA Welcomes New Member:

ELG Utica Alloys Ltd

ELG Utica Alloys Limited, part of the ELG Haniel Group, are global leaders in the sourcing, processing & supply of pure metals (Co, Hf, Mo, Ti, Ta, Nb, W, Zr) & super alloys (Nickel & Cobalt base). Working closely with all areas of the aerospace, medical & oil industries, we can provide comprehensive revert programmes & sourcing solutions.

Our business is based on experience, integrity & the highest quality standards.

Contact: Craig Wilkes – Commercial Director

Tel: +44 (0) 1709 765900

Website: www.elguticaalloys.com

E-mail: craig.wilkes@elguticaalloys.com

CALLING ALL MMTA PHOTOGRAPHERS

We will shortly be launching our new website and we would like to include some high quality images by Members illustrating the metals and processes that make up our exciting and vital industry.

Any pictures selected for the website will include a quote and a link to your company website. For more information or to send us your images, please email executive@mmta.co.uk

THE MMTA'S INTERNATIONAL MINOR METALS CONFERENCE 2017

TAKING PLACE AT THE CONRAD HOTEL, DUBLIN, IRELAND, 24-26 APRIL 2017

Organised by Metal Events Ltd

The 2016 conference was our biggest yet.

Make sure you are part of the industry's premier event for the minor metals sector

with new enhanced MMTA Member Conference Rates for 2017

Be sure to take advantage of the current excellent early-bird rates:

MMTA Members will pay the exceptional rate of **£600** (+ VAT where applicable) for all registrations received by 28th October 2016

The current fee for Non-Members is **£950** (+ VAT where applicable) for all registrations received by 11th January 2017

Non-Members have time to benefit from the excellent Member rate

by applying for MMTA membership now.

To find out more, contact admin@mmta.co.uk

To register for the conference or for more information please visit www.metalevents.com or www.mmta.co.uk alternatively email sales@metalevents.com

The Institute of Making

Tamara Alliot, MMTA

Its mission is to provide all makers with a creative home in which to innovate, contemplate and understand all aspects of materials and an inspiring place to explore their relationship to making.

The IOM3's Sustainable Development Group, of which I am a Member, was recently invited to visit the Institute of Making at University College London (UCL). Mark Miodownik, who many of you will remember as the keynote speaker at the MMTA's 2014 London Conference, welcomed us to the Institute with a look at the Materials Library, a growing repository of some of the most extraordinary materials on earth, gathered together for their ability to fire the imagination and advance conceptualisation. The walls are devoted to a myriad of materials, ranging from fish scales to tyres and ingots of metal. An added feature of the inspirational display is that visitors are encouraged to handle and closely examine the exhibits.

Image: Some of the exhibits in the Materials Library

From Pottery Wheels to 3D Printers

Alongside the Materials Library collection is the 'Makespace' – a workshop where both members of the Institute and guests can make, break, design and combine both advanced and traditional tools, techniques and materials. During the visit we saw traditional pottery wheels in action, quickly followed by 3D printing. The facility brings together equipment, expertise and perspectives of making from a wide range of disciplines, encouraging users to engage in craft, design, technology, history, philosophy, art and engineering.

The Institute of Making is a multi-disciplinary research club for those interested in the made world. Membership of and day-to-day access to the Institute is unfortunately only available to UCL staff and students. Luckily there is an active public programme of symposia, masterclasses, and open days exploring the links between academic research and hands-on experience, and celebrating the sheer joy of 'stuff', so we can all benefit from the Institute's activities.

Upcoming events can be found here: http://www.instituteofmaking.org.uk/events

Further Reading: **Stuff Matters**, *The Strange Stories of the Marvellous Materials That Shape Our Man-Made World*, Miodownik, Mark, Penguin Books, 2013

The New Blue

The latest product in a long tradition - the search for a perfect blue pigment - is about to reach the market. A new blue pigment, which was discovered in 2009 by chemists at Oregon State University, demonstrates that there are still new pigments to be discovered.

What is of particular interest is that the discovery was what department leader, OSU chemist Mas Subramanian, describes as "serendipity, actually; a happy, accidental discovery". Subramanian and his team were experimenting with potential materials for electronics applications when they mixed black manganese oxide with other chemicals and heated them to a high temperature. One of the samples turned a vivid blue.

The team reports that "the new pigment is formed by a unique crystal structure that allows the manganese ions to absorb red and green wavelengths of light, while only reflecting blue. The vibrant blue is so durable, and its compounds are so stable - even in oil and water - that the color does not fade".

The pigment, which is known as "YInMn" blue - from its elemental makeup, which includes yttrium, indium and manganese - will not only provide artists with another blue to add to their palette, it will be used in a wide range of coatings and plastics. There has also been interest from art restorers. Subramanian explains that "our pigment is useful for art restoration, because it is similar to ultramarine but really more durable."

The pigment's characteristics mean that it is completely non-toxic, and can be applied to a range of products, for example to keep buildings cool by reflecting infrared light when used in paint or even in green (or in this case, blue) roofing materials. Its infrared reflectivity (about 40 percent) is much higher than other blue pigments, so YInMn blue may play a role in energy efficiency.

Subramanian says that "ever since the early Egyptians developed some of the first blue pigments, the pigment industry has been struggling to address problems with safety, toxicity and durability."

The team at OSU will continue to test the new blue for other applications, but will also be attempting to discover more new pigments. "Who knows what we may find?," says Subramanian.

Maria Cox, MMTA

Sources:

Licensing agreement reached on brilliant new blue pigment discovered by happy accident by Mark Floyd, 27/05/15

http://oregonstate.edu/ua/ncs/archives/2015/may/licensing-agreement-reached-brilliant-new-blue-pigment-discovered-happy-accident

Mas Subramanian, Oregan State University

The Chemist Who Discovered the World's Newest Blue Explains Its Miraculous Properties, Artnet. Copyright 2016.

Sarah Cascone, Monday, June 20, 2016

http://www.techinsider.io/a-scientist-discovered-a-new-blue-2016-6?utm_content=buffer5e190&utm_medium=social&utm_source=facebook.com&utm_campaign=buffer-ti

LETTER FROM NORTH AMERICA

By **Tom Butcher**, Independent Consultant

Dear Members

Well, much has happened since I last wrote you back in May. Amongst other things, we've had: Brexit, Donald Trump prevailing, Cameron resigning, and Hillary Clinton not being indicted. And I've been busy speaking at the UN (as I now seem to do every June at the Conference of States Parties to the Convention on the Rights of Persons with Disabilities), and taking my holidays in the north of Cyprus.

You can, however, heave a sigh of relief, as I am not going to talk about any of these!

Instead, I am going to take a quick look at what's happening here with modernization of the Toxic Substances Control Act (TSCA). A more palatable alternative?

As many of you will remember, the original TSCA was enacted back in 1976. Roll forward 40 years, give or take, and on June 22 this year, after years of negotiation, President Obama signed into law The Frank R. Lautenberg Chemical Safety for the 21st Century Act (LCSA), bi-partisan comprehensive reform legislation to update the regulation of chemicals in the U.S.

As the American Chemistry Council describes it: "Thanks to TSCA reform, America's manufacturers will have the regulatory certainty they need to innovate, grow, create jobs and win in the global marketplace—at the same time that public health and the environment benefit from strong risk-based protections." Essentially, until now, the core provisions of TSCA had never been updated or amended since it was enacted all those years ago.

The new Act includes such changes as:

- Subjecting all new and existing chemicals to an EPA safety review
- Requiring EPA to focus on chemicals that are the highest priorities for full risk-based safety assessments
- Strengthening transparency and the quality of science used to make EPA decisions
- Expanding EPA's ability to require additional health and safety testing of chemicals
- Allowing industry to request that EPA conduct a safety assessment on a specific chemical
- Providing EPA with a full range of options to address the risks of substances including labeling requirements, use restrictions, phase-outs or other appropriate actions
- Setting aggressive and attainable timelines for EPA to complete its work
- Promoting cooperation between state and federal regulators while creating a strong national chemical regulatory system, ensuring interstate commerce is not disadvantaged
- Strengthening protections for the most vulnerable like infants, children and the elderly
- Protecting Confidential Business Information (CBI)

To put things in context, it is interesting to note that, as part of the whole process of updating TSCA, as far back as August 2007, the U.S. Government Accountability Office was asked to "review (by said Senator Lautenberg) the approaches used under TSCA and REACH for (1) requiring chemical companies to develop information on chemicals' effects, (2) controlling risks from chemicals, and (3) making information on chemicals available to the public."

As many of us are, perhaps, too well aware, and as described in the GAO findings, there were some significant contrasts between the two approaches, not least the fact that "TSCA places the burden of proof on EPA to demonstrate that a chemical poses a risk to human health or the environment before EPA can regulate its production or use, while REACH generally places a burden on chemical companies to ensure that chemicals do not pose such risks or that measures are identified for handling chemicals safely."

It will, therefore, now be the task of the EPA to make things "work". (There may be at least some comfort to be drawn from the fact that its leader, Gina McCarthy, has said that the agency is "*eager to get to work.*")

So, what has the EPA got to do? Amongst other things, within the first year alone, "it must complete formal rulemakings, including to establish processes of prioritization, risk evaluation and 'resetting' the inventory of chemicals in commerce." In addition, the agency must, within the next six months, start work on evaluating the risks of at least ten substances.

As June drew to a close, the EPA was as good as its word, publishing a "roadmap" of major activities and important deadlines for the coming year. On a metals front alone, two of its "Early Mandatory Actions" will be to address "Additions to Mercury Export Ban" and "Mercury Inventory".

It can only be described as refreshing that, when setting out its roadmap, the agency actually said that it "believes that it is important to engage partners and stakeholders early in the process, and to be transparent as possible." Now, how welcome is that?!

Or course it remains to be seen just how much engagement there actually will be going forward, but for the EPA to put itself on the line like that is, if nothing else, somewhat refreshing.

And, having passed on such refreshment, I shall now bid recipients of this missive farewell, while, at the same time, wishing them all the best from a rather warm New York.

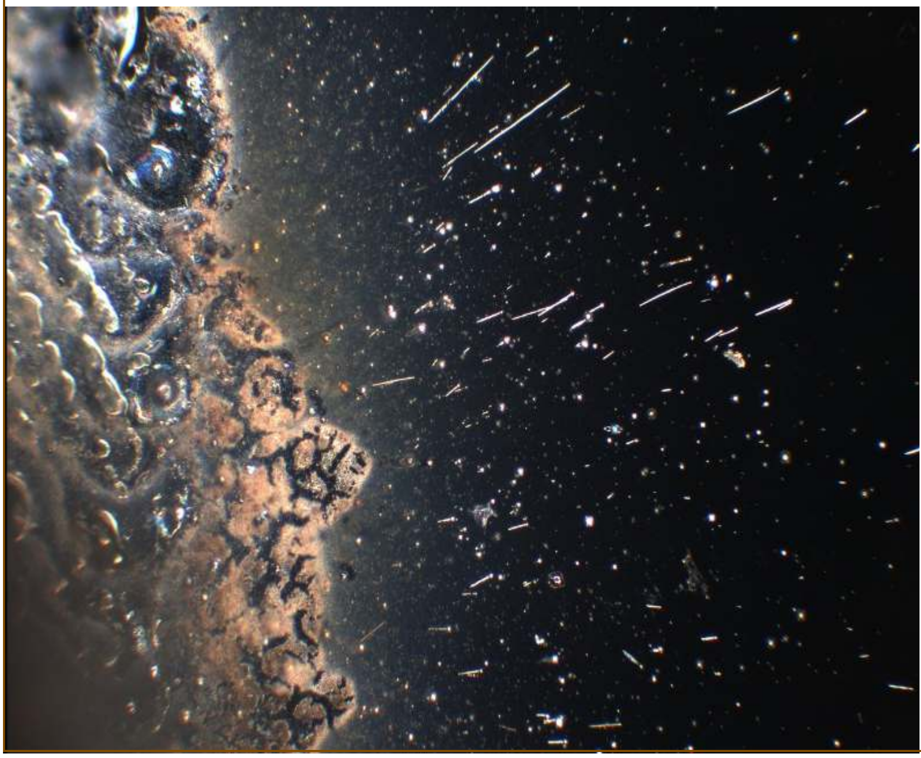
Yours

Tom Butcher, July 12th, 2016

Sources:

American Chemistry Council: Policy –TSCA, https://www.americanchemistry.com/Policy/Chemical-Safety/TSCA/
GAO: CHEMICAL REGULATION - Comparison of U.S. and Recently Enacted European Union Approaches to Protect against the Risks of Toxic Chemicals, http://www.gao.gov/new.items/d07825.pdf
Ibid.
ChemicalWatch: President's signature sets implementation in motion, https://chemicalwatch.com/48169/tsca-reform-signed-into-law
Ibid.
ChemicalWatch: EPA releases implementation roadmap for reformed TSCA, https://chemicalwatch.com/48353/epa-releases-implementation-roadmap-for-reformed-tsca
EPA: The Frank R. Lautenberg Chemical Safety for the 21st Century Act: First Year Implementation Plan, https://www.epa.gov/assessing-and-managing-chemicals-under-tsca/frank-r-lautenberg-chemical-safety-21st-century-act-2

Titanium Comet Diaspora



For many people, engineering conjures up images of bridges, tunnels and buildings. But the annual University of Cambridge engineering photo competition shows that not only is engineering an incredibly diverse field, it's a beautiful one too.

This experiment was an attempt to join sapphire to steel by using laser irradiation and titanium foil as a flux. This is a microscope image taken on the periphery of the experiment showing the underside of a sheet of sapphire with a titanium sheet to the left. The condition of the titanium, the brown condensation and all the ejecta on the right demonstrate the energy involved.

The image scale is approximately 1 mm x 0.7 mm.

Photo by Andrew Payne, University of Cambridge

Source: https://www.cam.ac.uk/research/news/bullet-holes-and-graphene-caves-picturing-engineering

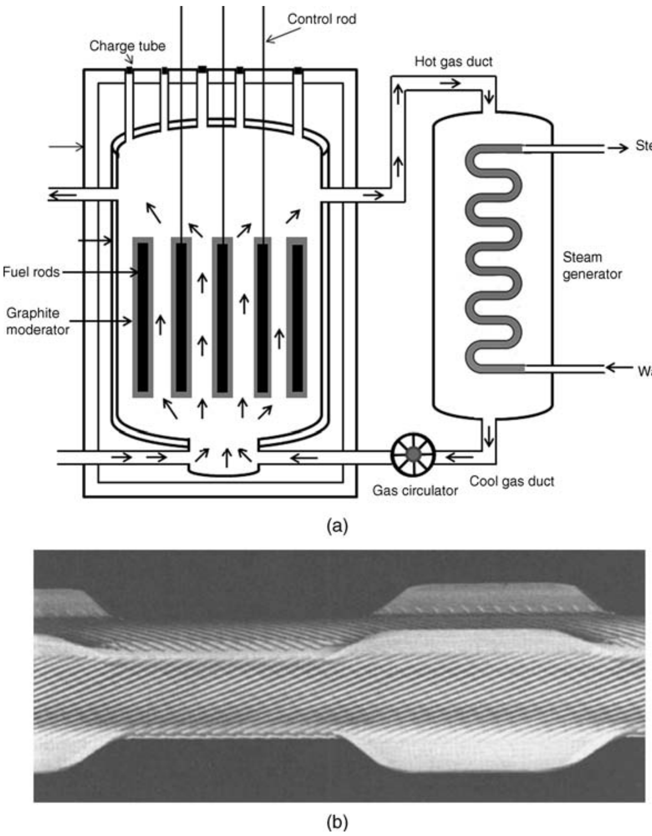
From the A Bomb to Hinkley Point and Beyond — Minor Metals in Nuclear

James Walsh, MMTA

Nuclear power has certainly had its up and downs over the last 70 years, tracing its origins back to the Second World War with the race to build the atomic bomb. The Manhattan Project was an R&D program led by Robert Oppenheimer, the father of the atomic bomb, and involved some famous names including Albert Einstein and Enrico Fermi.

Following the end of the war, attention was turned to utilising this new nuclear technology for more peaceful purposes and so began the commercialisation of nuclear fission power across the world.

The first commercial nuclear reactors began to pop up in the late 1950s at sites including Shippingport, USA and Calder Hall (Sellafield), UK. These early reactor designs, now classed as Generation I reactors, laid the foundations for the utilisation of nuclear power, including the necessary new materials' development required to withstand these new and challenging environments. The Calder Hall reactor was the test bed for the development of the Magnox reactor, the UK's own design deployed at ten other sites across the country.



(b)

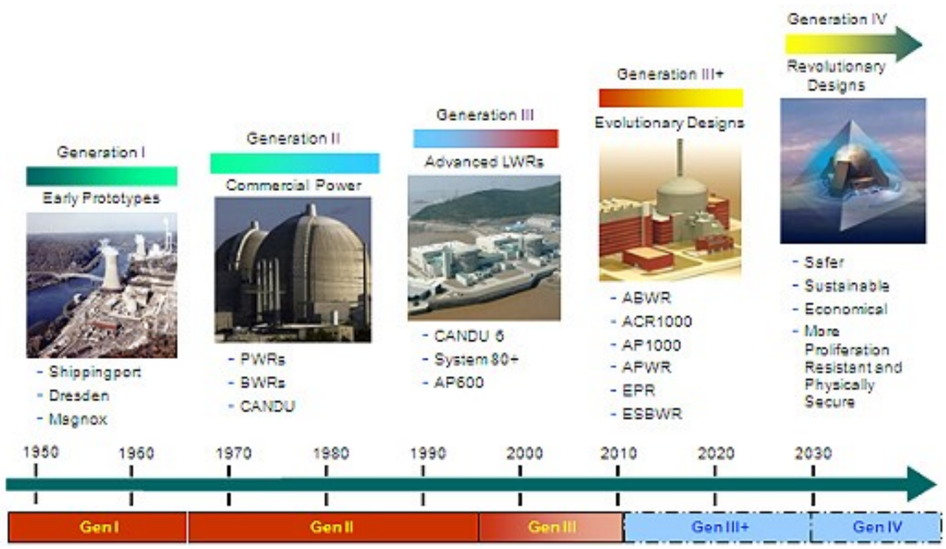
Magnox Reactor with Mg Alloy Fuel Rod   Source: Murty & Charit

The Magnox name, short for Magnesium non-oxidising, comes from the material used as a cladding, which separates the uranium fuel from the aqueous environment of the coolant. A magnesium alloy containing small amounts of aluminium and a fraction of beryllium was used since it has a very low thermal neutron capture cross section, which means the neutrons can pass through the material undisturbed and hence a chain reaction can be maintained. The addition of aluminium provided solid solution strengthening while the minor amount of beryllium helped improve the oxidation resistance.

Through the 1950s and 1960s technology progressed and a new version of the Magnox, the Advanced Gas-Cooled Reactor (AGR) was designed in the UK. The magnesium cladding was replaced by stainless steel, after originally planning to use a beryllium based cladding which eventually proved unsuitable for various reasons including its scarcity, cost and toxicity. The AGR, a Generation-II reactor, along with Light Water Reactors (LWR), both Pressurised Water Reactor (PWR) and Boiling Water Reactor (BWR) incorporated improved design and safety features over Generation-I reactors. LWRs make up the majority of reactors operated in the Western Hemisphere, with PWRs being implemented much sooner than BWRs due to the belief that pressurised water would be safer to handle than steam in the reactor core. The PWR employs Zircaloy -4, a zirconium alloy as the cladding, as it has excellent corrosion resistance in aqueous environments, low thermal neutron cross section and good heat resistance, and almost three times the melting temperature of magnesium. The alloy additions include tin (1.5wt %), chromium (0.1wt %) and iron (0.2wt %), which improve the mechanical properties and corrosion resistance.

Another major application of minor metals in nuclear is in control rods, which are used for rapid control of the reactor for start-up or shutdown, i.e. insertion of the rods into the core will shut down the reactor by slowing down or stopping neutrons. Suitable materials must have high neutron absorption cross section, typical examples include a silver-indium-cadmium alloy, boron carbide and hafnium.

The nature of a PWR is that the water that passes through the core is prevented from boiling, so this primary loop connects to a secondary loop via a heat exchanger, or steam generator, made up of thousands of thin pipes. A nickel-based alloy or superalloy is used, e.g. Alloy 800 (30%Ni, 19%Cr, 39.5%Fe) or Alloy 600 (72%Ni, 14%Cr, 6%Fe, 1%Mn) respectively. Intuitively, a Boiling Water Reactor allows the water to boil in the core, so there is no requirement for a steam generator. One similarity with PWRs is on the cladding material, also a zirconium alloy, Zircaloy-2, which has a small



Generations of nuclear reactors: Each time range corresponds to the design and deployment of each generation of reactors

addition of nickel (0.05%) and slightly lower iron content than Zircaloy-4. Zircaloy-2 is also used in the Canadian Heavy Water Reactors (CANDU).

Generation-III and III+ reactors again make evolutionary improvements on the Gen-II reactors in terms of fuel efficiency, longer operational life, passive safety and a more standardised design to help reduce capital costs. The first of these reactors that came online in 1996 is the Advanced BWR, but others that haven't been adopted or built yet, include the AP600 and AP1000 developed by Westinghouse and the European Pressurised Reactor (EPR) developed by Areva, EDF and Siemens. The EPR may be the first reactor to be built in the UK, at Hinckley Point C, in over 20 years. If the final go ahead is given by the UK Government, which is expected in Autumn 2016, it will become the most expensive structure on the planet, estimated at £18 billion, and is expected to deliver 7% of the UK's electricity.

Artist's impression of Hinkley Point C, Source: BBC website

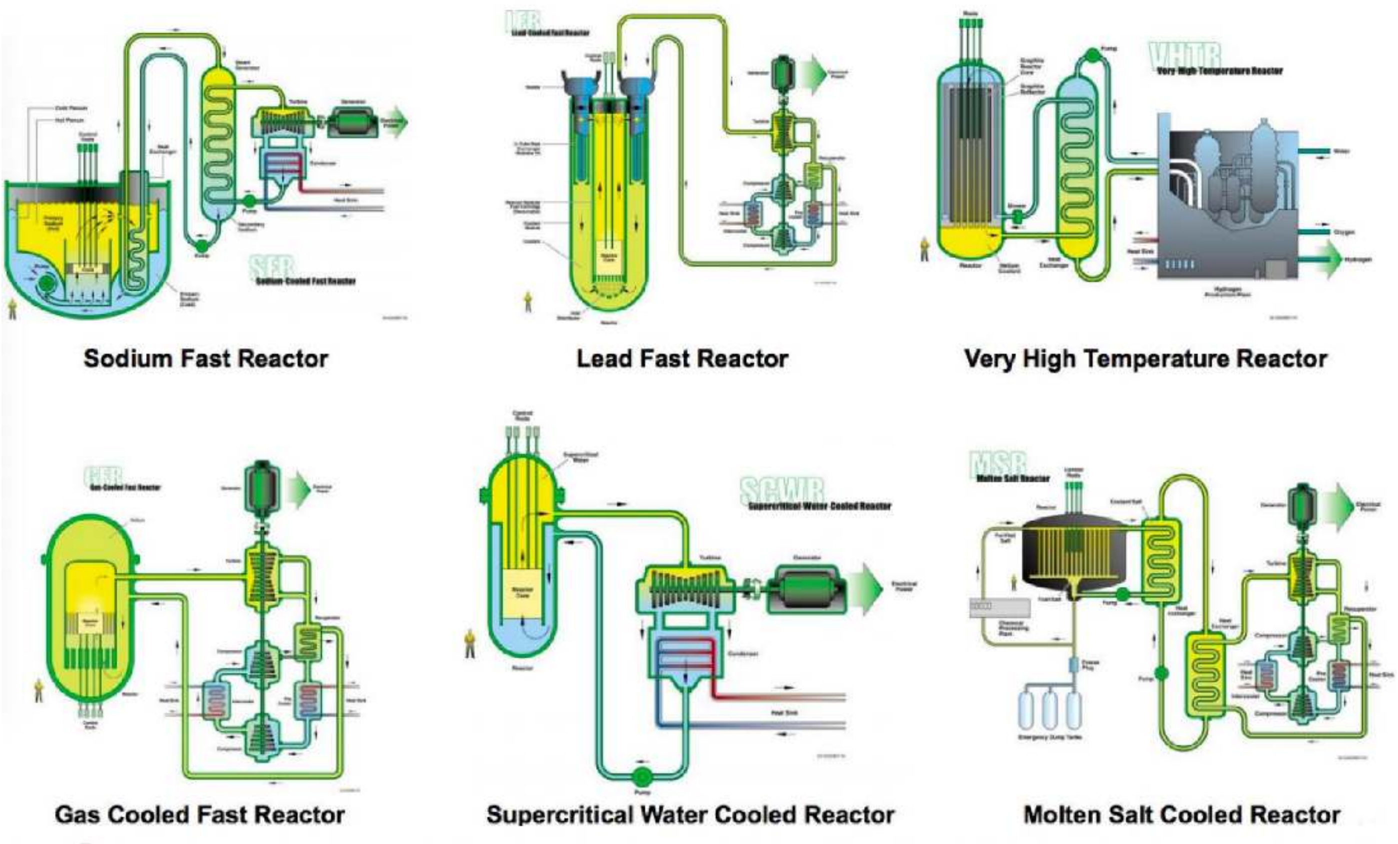
New advancements in materials technology have allowed for some of these developments, including an improved zirconium alloy, M5 (0.8-0.12%Nb, 0.09-0.13%O) developed by Areva. This fully re-crystallised, ternary Zr-Nb-O alloy gives further enhanced corrosion, hydrogen and creep behaviours. Its stable microstructure is responsible for these performance improvements and is the result of carefully controlled ingot chemistry. Ultimately, it makes high-burnup fuel cycles possible, which leads to significant fuel cost savings.

The future of commercial nuclear power has been encapsulated in the Generation-IV International Forum (GIF), a framework for cooperation in R&D for the next generation of nuclear reactors. Set up in 2000, it shortlisted six reactor types for several nations to work together and collaborate on. These reactors are being designed to be safer, have longer lives (over 60 years), be proliferation-resistant, and economically viable compared to the current fleet of nuclear reactors spanning the globe. The nature of these reactors will have demanding service conditions, in terms of higher neutron doses, exposure to higher temperatures and corrosive environments that the structural components will be expected to resist. This poses a significant challenge for the materials selection and qualification and because of these stringent requirements, the materials employed in today's commercial reactors are not suitable for use in Gen-IV reactors. Taking zirconium alloys as an example, these are used routinely as fuel cladding among other applications in reactors because of their low neutron capture cross section and good corrosion resistance in high temperature aqueous environments. In Gen-IV reactors, however, higher operating temperatures would limit the use of Zr alloys because of increased susceptibility to hydrogen embrittlement due to severe hydride formation, poor creep properties, and oxidation. Although, with that said, the Supercritical Water Reactor (SCWR) has a relatively low temperature reactor design (ranging from 280-620°C core outlet temperature) and so may be suitable for use of some high-performance Zr alloys.

At a recent Nuclear Energy Agency (NEA) international workshop, Structural Materials for Innovative Nuclear Systems, held at The University of Manchester in July 2016, there was significant focus on sustainability and longevity of the nuclear industry and reactor lifetime, and much of the current research covers both Gen-IV reactors and fusion technology. There are several ongoing programs supporting progress in materials' development for reactor technology, including The Joint Programme on Nuclear Materials (JPNM), which was created in 2010 as part of the European Energy Research Alliance (EERA) to coordinate European research on Gen-IV reactor materials. Another, the MatISSE project (Materials' Innovations for a Safe and Sustainable nuclear in Europe) supports the EERA/JPNM, aims at building a European integrated research program on materials innovation for safe and sustainable nuclear.

Some of the ongoing research has shown potential for minor metal-containing materials. Among several candidate structural materials for advanced fission and fusion nuclear reactors, oxide dispersion strengthened (ODS) steels are considered promising, as they have high strength at high temperatures and good resistance to corrosion and irradiation degradation. There are several types of ODS steels with different chromium content; 9-12wt%Cr martensitic steels and 14-16wt%Cr ferritic steels. It has been considered that the replacement of Zr alloy cladding with high-performance ferritic steels may help delay hydrogen generation in the case of a severe accident in a reactor core, resulting in a large time lag up to hydrogen explosion.

Molybdenum and its alloys have been shown to possess the necessary qualities to make them a desirable structural material for Gen-IV reactors, such as the Molten Salt Reactor (MSR) and Gas-Cooled Fast Reactor (GFR).



Comparison of Six Generation IV Systems, Source: IAEA

In fusion reactors, such as the International Thermonuclear Experimental Reactor (ITER) being constructed in the south of France, structural materials are required that can perform in temperatures as low as -269°C (4 Kelvin). One new material is a high manganese stainless steel (12Cr, 12Ni, 10Mn, 5Mo, 0.2N), which has been developed specifically for this purpose by the Japan Atomic Energy Agency (JAEA).

Tungsten is one of the most promising materials for plasma facing components in future fusion tokamaks, a technology invented in the Soviet Union in the 1960s, but soon adopted by researchers around the world. The Culham Centre for Fusion Energy (CCFE) is home to the Joint European Torus (JET), the largest and most powerful tokamak currently operating. The ongoing research on tungsten at CCFE requires further investigation on its performance under neutron irradiation.

It is clear that whichever Gen-IV systems are favoured, there is a bright future for minor metals in the nuclear sector; the big question marks are more in the area of political acceptability, as the new UK Government has only recently demonstrated by its last minute hesitation over Hinkley Point C.

Sources:
International Atomic Energy Agency (IAEA) https://www.iaea.org/
BBC http://www.bbc.co.uk/news/business-36897180
Murty, KL & Charit, I, An Introduction to Nuclear Materials: Fundamentals and Applications, Wiley, 2012 http://eu.wiley.com/WileyCDA/WileyTitle/productCd-3527407677,subjectCd-PH20.html
Gen-IV Forum, https://www.gen-4.org

THOR—the world's first 3D printed aircraft

Although only 4 metres (13 feet) long, Thor, Airbus' first 3D printed drone, was recently on display at the International Aerospace Exhibition in Berlin. THOR stands for 'Test of High-tech Objectives in Reality' and resembles a large, white model airplane.

Airbus sees the small pilotless propeller aircraft as "a test of what's possible with 3D printing technology," said Detlev Konigorski, who was in charge of developing Thor, speaking at the air show. "We want to see if we can speed up the development process by using 3D printing not just for individual parts but for an entire system."

In Thor, the only parts that are not printed from a substance called polyamide are the electrical elements.

Airbus and its US rival Boeing are already using 3D printing, notably to make parts for their huge passenger jets the A350 and B787 Dreamliner.

"Metal parts produced can also be 30-50 percent lighter than in the past, and there is almost zero manufacturing waste".

Engineers also plan to use the technology in space. The future Ariane 6 rocket of European Space Agency ESA, planned for a 2020 blast-off, is set to feature many printed pieces. Airbus cites big cost reductions on parts' manufacturing as a key factor. Partially as a result of this, the Ariane 6 may be half the price of its predecessor Ariane 5.

The new 3D printers can make pieces up to 40 centimetres (15 inches) long and are of most use in particularly complex designs. For example, Airbus is testing how to print an injection assembly for an engine that is currently assembled from 270 individual pieces.

Aside from the costs savings, 3D printing also promises ecological benefits, as lighter jets use less fuel and emit fewer pollutants.

To reducing carbon emissions in aviation—with air traffic expected to double in the next 20 years—"the decisive issue is radical technical innovation in a relatively short time," said Ralf Fuecks, head of the Heinrich Boell foundation think tank of the German Green Party. 3D printing is certain to play a major role in this, he said at a conference at the ILA event with Airbus president Tom Enders.

The air travel industry is already convinced of the benefits, according to a survey of some 102 aviation sector players by German high-tech federation Bitkom.

Some 70 percent of respondents believed that by 2030, aircraft spare parts will be printed directly at airports, and 51 percent expect that entire planes will by then be manufactured by 3D printing.

Original Article Source: http://m.phys.org/news/2016-06-airbus-3d-printed-mini-aircraft.html

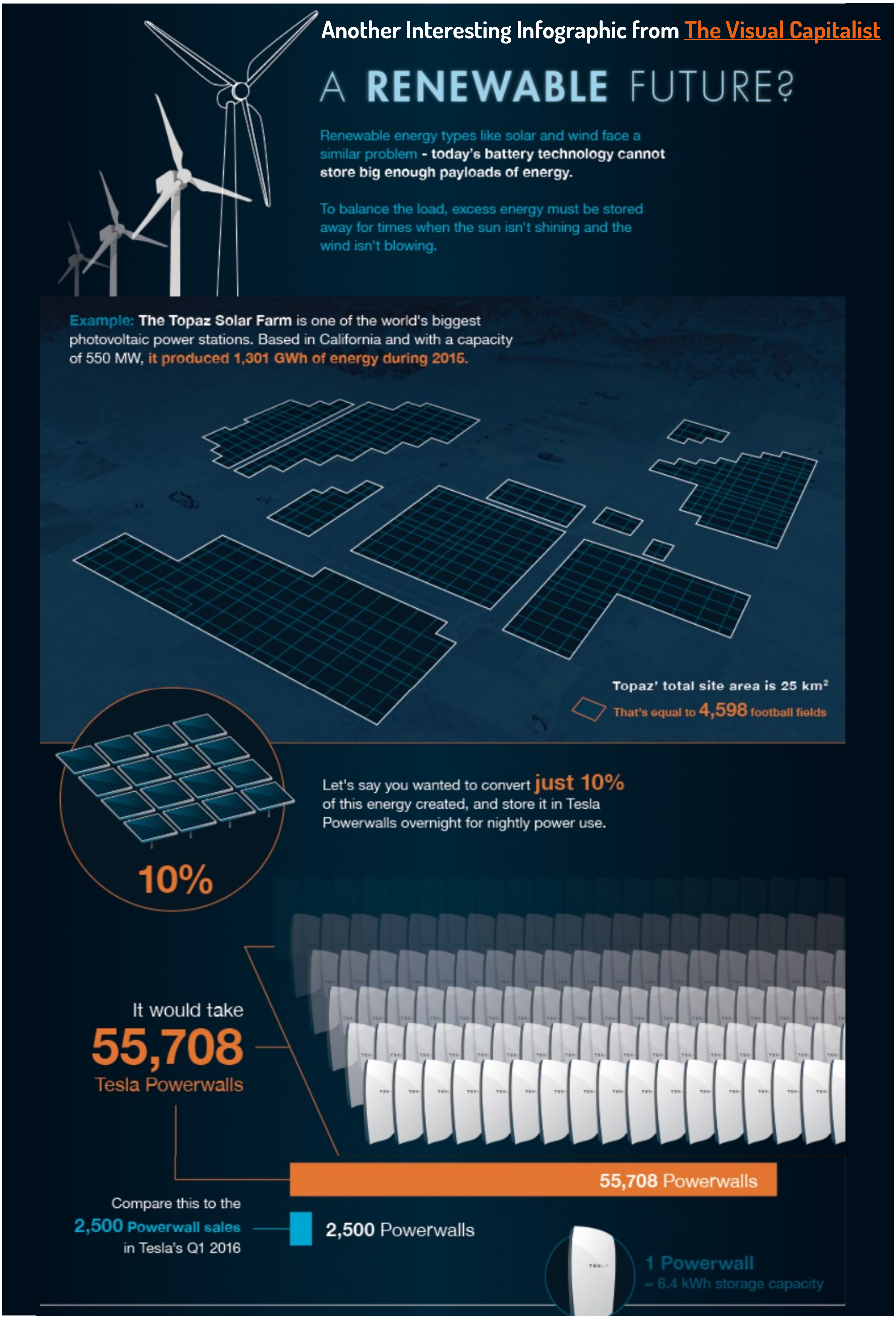
3D printed titanium parts from Alcoa

Alcoa will supply titanium fuselage and engine components for aircraft by using 3D printing technology expecting to deliver the first additive manufactured parts to Airbus from mid-2016.

The expertise required was gained through last year's acquisition of RTI International Metals (now known as Alcoa Titanium & Engineered Products (ATEP)) and expansion of existing operations. Alcoa also recently invested in 3D printing and metallic powder production capabilities at its technical centre outside of Pittsburgh, Pennsylvania. These new 3D printed parts utilise ATEP's titanium ingot melting and billetizing, machining, finishing and inspection technologies.

Alcoa will employ advanced CT scan and Hot Isostatic Pressing (HIP) capabilities at its advanced aerospace facility in Whitehall, Michigan. HIP is a technology that strengthens the metallic structures of traditional and additive manufactured parts made of titanium and nickel based superalloys.

Additionally, Alcoa is bolstering its additive manufacturing capabilities through a $60 million expansion in advanced 3D printing materials and processes, including metallic powders. The expansion is located at the Alcoa Technical Centre near Pittsburgh, Pennsylvania, the world's largest light metals research centre.


Another Interesting Infographic from The Visual Capitalist
A RENEWABLE FUTURE?
Renewable energy types like solar and wind face a similar problem - today's battery technology cannot store big enough payloads of energy.
To balance the load, excess energy must be stored away for times when the sun isn't shining and the wind isn't blowing.
Example: The Topaz Solar Farm is one of the world's biggest photovoltaic power stations. Based in California and with a capacity of 550 MW, it produced 1,301 GWh of energy during 2015.
Topaz' total site area is 25 km²
That's equal to 4,598 football fields
10%
Let's say you wanted to convert just 10% of this energy created, and store it in Tesla Powerwalls overnight for nightly power use.
It would take
55,708
Tesla Powerwalls
55,708 Powerwalls
Compare this to the
2,500 Powerwall sales
in Tesla's Q1 2016
2,500 Powerwalls
1 Powerwall
= 6.4 kWh storage capacity

Could electric vehicles be one solution to energy storage?

Maria Cox, MMTA

Image source: shutterstock

What if the electricity grid were to use the batteries in the growing numbers of electric vehicles to help ease the peaks and troughs in energy supply and demand and stabilise the grid? One of the big problems faced by the national grids of many countries is that even with a mix of electricity sources, there are wide variations in supply and demand, especially as we move towards higher use of renewables. The wind doesn't always blow and the sun doesn't always shine at the time of day when we all want to use our electricity (eg. early evening), and similarly it might be blowing a gale in the middle of the night when most of us are asleep. Electricity companies are faced with the problem of not having enough electricity for our use – and potentially having to buy it in at great cost – or absurdly, having to pay to get rid of excess power at certain times. Why? Because they aren't able to store sufficient amounts of power and release it back into the grid at times of shortage.

However, there could potentially be a solution: imagine a few years from today when significant numbers of us will be driving electric vehicles, if car manufacturers are correct. We charge our car batteries, we go about our business and when we return to the house in the evening, we plug our cars in to recharge their batteries.

It appears that it would be possible for the power grid to use these thousands of batteries to store excess power and then draw back on that power when the grid is under pressure. It would potentially provide a huge amount of extra capacity at no additional cost to us as electricity users.

Obviously, there are some questions that would need to be answered, for example what would happen if the grid has just emptied my car battery to meet the nation's power needs just at the time I have to rush out unexpectedly? I'm expecting my battery to be fully charged because I plugged it in when I got home, and suddenly it's flat! It's clear there would need to be some rules around when the grid could take our power, but that must be achievable. Similarly, car owners would need to be reassured that the additional charging and emptying cycles would not shorten the lifespan of the car's battery. However, there is potential in the idea to solve the energy storage issues associated with increased use of renewables.

Inspired by: *IOM3 Energy Materials Group Lecture – A Guide to the Surreal World of Energy Storage Materials: Understanding Materials Failure*

The periodic table:

fictional edition

In the event that you are bored of the periodic table – unlikely, I know – Bodycote have published a brilliantly fun fictional edition on their website. It showcases elements from mythology such as: Adamantine – used in the sword that killed Medusa; Dalekanium – Doctor Who fans unite!, and Valyrian steel, the mystical metal that the MMTA team has taken a special liking to.


Image Source: HBO

Valyrian steel is famously used in George R R Martin's *A Song of Ice and Fire* series – or, as most will know it, Game of Thrones. The author described Valyrian steel as a fantasy metal with magical characteristics. A Valyrian steel sword, said to be forged with dragon fire, is of unparalleled quality; it will never dull and can even defeat white walkers – the living dead!

There are clear parallels between Valyrian steel and Damascan steel: Damascan steel swords were extraordinary in their time, have not been successfully replicated in recent years and they, like Valyrian steel swords, have naturally occurring rippled patterns. Valyrian steel may be a fictional masterpiece, but it is a masterpiece inspired by a very real material.

Gina Evangelidis, MMTA

Source: http://www.bodycote.com/fictional-metals

REACH—no change in sight to 2018 deadline requirements

Maria Cox, MMTA

The UK's decision on 23 June to leave the EU has created some concern about the status of REACH, the EU's Chemicals Regulation. One particular area of uncertainty is the 2018 REACH registration deadline. The environment ministry (Defra) and the Health and Safety Executive (HSE), which is the UK REACH competent authority, are urging UK firms impacted by the 2018 deadline to continue as previously planned, in order to ensure that potential disruption to supply chains is kept to a minimum.

In addition to working towards the 2018 REACH deadline, both Defra and the HSE will additionally be undertaking work to build up their own capacity to manage chemicals regulation post-Brexit, as well as analysing the issues arising from the change. They will also be working to ensure companies are aware of and understand their obligations.

Defra says that UK-based companies affected have the legal obligation to register their substances by the 2018 deadline, and that the UK will remain bound by EU law until the agreement for the country's withdrawal comes into force, a period of 2 years (unless an extension is agreed by all parties) from the date Article 50 of the EU Treaty is invoked by the UK. However, even beyond that date, companies wanting to trade with the EU should expect to meet REACH standards.

The argument, put forward by some, that UK companies currently impacted by REACH need not register substances under the final 2018 REACH deadline would not be backed by the country's chemical manufacturers trade body, it has said.

Speaking to *Chemical Watch*, after last month's Brexit vote, Steve Elliott, Chief Executive of the Chemical Industries Association (CIA), said: "Some things won't change, like the UK Health and Safety at Work Act, because they are UK driven, and...as things stand, some existing rules and regulations will need to be complied with – the 2018 [REACH] deadline, for example, falls before the Brexit negotiations can be completed, and it would be pretty unfair to anybody who responded to the first two deadlines if there was a move to ignore the third one. And certainly, this isn't something we would support."

Echa, the agency to which REACH registrations must be submitted, has a dedicated REACH 2018 section on its website, with information designed to help first-time registrants, especially SMEs, understand what they need to do to register a substance, and providing step-by-step guidance.

Further Information:

CSF guidance document

Echa REACH 2018 webpages

Chemical Watch Brexit Coverage

Article adapted from:

UK firms should comply with 2018 deadline, says CIA head, Geraint Roberts, Chemical Watch, 14 July 2016 / REACH, United Kingdom, https://chemicalwatch.com/48607

UK government urges firms to press on with 2018 registrations, Geraint Roberts, Chemical Watch**,** 13 July 2016 / Chemical manufacturing, REACH, Substance registration, United Kingdom https://chemicalwatch.com/48577/uk-government-urges-firms-to-press-on-with-2018-registrations

Next generation sustainable magnesium primary production

Dr. Ing. Martin Tauber, Industry Consultant, President Critical Raw Materials (CRM) Alliance, Member of International Magnesium Association (IMA) EU Committee Contact martintauber3120@gmail.com

Although magnesium still has a strong position in the "lightweight material-mix", it has certainly lost ground to aluminium, carbon fibre and reinforced steel, with alternatives mostly chosen above magnesium because of supply-related issues. New magnesium primary producers and projects in the pipeline are forming a more sustainable supply base on a global level, and will provide different industries with a beneficial metal, building on strong environmental arguments. Toyota recently announced its intention to completely eliminate all CO_2 emissions, including materials, parts and manufacturing, from a vehicle's lifecycle.

There are arguably CO_2 footprint benefits in the Mg primary project pipeline which offer advantages over other lightweight material, and it is possible that magnesium industry benefits could influence future public and private procurement. This could mean that the next generation of global primary magnesium supply may provide the magnesium industry with beneficial sustainability arguments to support the case for high volume growth.

How is sustainability relevant to the magnesium supply value chain?

There are many tailored, often self-serving definitions of sustainability, with but all are fundamentally about:

- Living within the limits
- Understanding the interconnections between economy, society, and environment
- Equitable distribution of resources and opportunities

Sustainability is perhaps the most frequent green "buzz word", and is well used for "green washing" of information; it is neither a disruption of existing processes nor a direct call for savings. Furthermore, it is difficult to define whether a product or process is more or less sustainable without defining the right indicators. For the magnesium supply value chain, the concept of "Sustainability for Business and Production" can be used, and is described as follows:

- Product: Safe and ecologically sound throughout its life cycle
- Process: Wastes and ecologically incompatible by-products are reduced, eliminated or recycled on-site
- Workers: Their security and well-being is a priority

Sustainability for international and corporate reporting

Most companies and other organisations, as well as governments, have defined their sustainability standards and indicators based on international declarations and adopted non-binding standards. A frequently used term is also "Corporate Social Responsibility". Sustainability standards are often privately developed principles, providing guidance to businesses on implementation, and may or may not be derived from international norms.

Examples of such privately developed principles are:

- The Global Reporting Initiative (GRI) Sustainability Reporting Guidelines – globally the most widely used, including sector specific guidelines for "Mining & Metals".
- The ICMM Sustainable Development Principles
- The International Integrated Reporting Council (IIRC)
- The Sustainability Accounting Standards Board (SASB)
- The British Standards Institution (BSI) responsible sourcing sector certification scheme standard for construction products (BS 8902:2009)

An increasing number of stock exchanges (e.g. SGX Singapore) around the world are now mandating sustainability reporting from their listed companies, and as a result, sustainability reporting practices have grown rapidly, and are beginning to receive more attention in Asia as well.

From shareholders to stakeholders

A 2014 pwc CEO study reveals that most CEOs surveyed agree that business has social as well as financial responsibilities; 80% say it's important for their business to measure and reduce its environment footprint. 74% agree that measuring and reporting non-financial impacts contributes to their business' long-term success.

In 2014, the European Parliament set a duty in law to report on the non-financial impacts of business activities. After ratification, companies will have to report on their policies on diversity, social issues and on corruption, as well as the risks they pose to human rights and to the environment, including through their supply chains. To-date, 2500 companies have voluntarily produced sustainability reports and this number will rise to nearly 7000 by 2017, when the law comes into effect. As such, they will be making themselves accountable not just to their shareholders, but to all stakeholders.

From voluntary to mandatory – an opportunity for magnesium?

With mandatory sustainable reporting requirements, OEMs and also TIER companies, need to talk about their raw material procurement strategies and related sustainability indicators. Aluminium and automotive association member companies are already including sustainability content in their stakeholder communications.

Jaguar Land Rover (JLR), for example, was honoured with the 2015 Queens Award for Sustainable Development. The Governance structure of JLR expresses very clearly the high level responsibility for sustainability: **"**Our CEO and Board of Directors are ultimately responsible for sustainable business development at Jaguar Land Rover". JLR is part of the global Aluminium Stewardship Initiative (ASI), which has developed a performance standard for the whole supply chain by a multi-stakeholder approach.

Circular Economy

The concept of a circular economy has recently gained traction in European policy-making as a positive, solutions-based perspective for achieving economic development within increasing environmental constraints. The overall aim is to manage all natural resources efficiently and, above all, sustainably. Unlike the traditional linear take-make-consume-dispose approach, a circular economy seeks to increase the share of renewable or recyclable resources while reducing the consumption of raw materials and energy and, at the same time, cutting emissions and material losses.

The circular economy is not a single tool, but a package of measures aiming for a much more complete approach than sustainability alone, and it builds on other tools such as the Life Cycle Analysis (LCA), the Product Environmental Footprint (PEF) and the Organisation Environmental Footprint (OEF). The PEF is a measure of all quantifiable environmental impacts over the full life cycle of a product and covers emissions to water, air and soil, use and depletion of scarce resources, and impacts from land use.

Jaguar Land Rover also looks to the Circular Economy, by teaming up and building unique closed loops with its key suppliers. One of them is Novelis, pursuing their key goal of developing low cost alloys with higher recycled and End of Life (EoL) aluminium content. Similarly, JLR invested in a £6m closed loop system in their press shops to capture aluminium by segregating all metal waste to maximise what can be reused. Novelis also announced a new alloy designed for automotive to contain up to 75% recycled content, and strengthened its relationship with JLR: "As a leader in alloy innovation and aluminium recycling, Novelis is honoured to work with Jaguar Land Rover to help lead the automotive industry in sustainable vehicle manufacturing." This collaboration for a closed-loop value chain is also demonstrated in their earlier REALCAR project (REcycled ALuminium CAR).

However, neither the 2014 JLR nor the Novelis Sustainability Report mentions magnesium.

Life Cycle Analysis

Another tool of sustainability alongside the Circular Economy is the Life Cycle Analysis (LCA), and automotive companies, for example, need to examine every step in their supply and value chain.

Toyota has set itself the target to completely eliminate all CO_2 emissions, including materials, parts and manufacturing, from the vehicle lifecycle, and to achieve zero CO_2 emissions at all plants by 2050. This is the first OEM to include material and parts in a zero target. Toyota's Challenge 2 "Life Cycle Zero CO_2 Emissions Challenge" aims to develop and expand the use of materials with lower CO_2 emissions during production and will reduce the quantity of materials and number of parts used in a vehicle.

Volkswagen offers a different, but no less clearly expressed, perspective, stating that: "aluminium reduces the weight of the vehicle, which can significantly reduce CO_2 emissions during the use phase. However, production of aluminium is considerably more energy-intensive than production of steel, leading to higher CO_2 emissions at the manufacturing stage....This is why small and mid-range car bodies still tend to be made predominantly of steel. That said, it is perfectly possible to build a lightweight vehicle using steel."

Almost all aluminium alloys contain Mg as an alloying element, on a range from minor up to 6%, and although only one of many alloying elements for the aluminium industry, it represents the single biggest market for the magnesium industry itself. On the other hand, magnesium parts are in competition with aluminium parts when it comes to lightweight material mix strategies. With concepts like impact reporting, green procurement and sustainability reporting as a whole, primary raw materials, such as magnesium and other minor metals, also need to receive greater attention and transparency, both as a product in their own right, and as alloying elements. Sustainability reporting needs to cover different raw material intakes, not just capturing the fabricated product or part.

As with JLR and Novelis above, most sustainability reports from aluminium companies do not mention magnesium at all in relation to their sustainable sourcing or responsible procurement.

With increasing mandatory non-financial reporting, there will be an opportunity for more sustainable primary magnesium production to be profiled by means of life cycle assessments, in particular with regard to the raw material intake. But primary magnesium supply is not the only area which demonstrates the lack of current profiling of the magnesium industry. Pre-consumer and EoL recycling/treatment are also lacking transparency and knowledge among stakeholders. The fact that magnesium is used as an alloying element and *"lives on & on"* in secondary aluminium is missing from the message, and even dedicated aluminium recycling information fails to make reference to magnesium. This lack of profile is a significant disadvantage for magnesium, and as a result, it is very difficult to place magnesium within a circular economy approach, if the relevant stakeholders are not informing or being informed about what happens to the magnesium after collection of an aluminium beverage can, an automotive part or a construction profile.

The EU Emission Trading System

The EU Emissions Trading System (EU ETS) is a 'cap and trade' system. As the first and largest emissions trading system for reducing Green House Gas (GHG) emissions, the EU ETS covers more than 11,000 power stations and industrial plants in 31 countries. The current goal within the EU is to cut GHG emissions by 80-95% by 2050 compared to 1990 levels.

Within the sustainability context, it is crucial for new magnesium primary projects in the pipeline in Europe to not only put their focus on lower energy consumption across the different processes, but also to secure green contracts based on renewable energy.

Many stakeholders are urging a reform of the ETS Europe, for example Eurometaux's position is that: "More predictability means we can invest in our European facilities and innovate through research into low-carbon production methods."

However a carbon cap & trade system is of importance not only for pipeline primary magnesium projects in Europe, there is also the global dimension, determined as a result of Paris COP21: "An interconnected mechanism for sustainable development available to all who want to use it (both developed and developing countries) was agreed."


Image: Carbon Trust

The Carbon Impact Factor

The Carbon Impact Factor (CIF) stands for a family of financial instruments to differentiate and reward Carbon Efficiency in commodity production. CIF has global scope and is intended to allow market participants to incorporate the carbon efficiency of a commodity into purchasing decisions and communicate associated carbon migration to stakeholders. CIF also enables OEMs, for example, to demonstrate and communicate their efforts to reduce carbon intensity (risk) within their supply chain.

Despite that, the raw material producers are the major players and contributors to OEMs' efforts to reduce the carbon intensity within the supply chain, but often there is no traceability of raw material inputs beyond the primary processing point. As a result, different raw material data are aggregated or compounded.

OEM industry and the raw material supply chain

For OEMs in automotive or in other magnesium-using industries such as power tools, sustainability reporting is already a long used non-financial reporting tool, and year after year ambitious sustainability targets are set and measured against achievements in a transparent manner. With differing requirements for official non-financial and in particular sustainability reporting, companies will increasingly be forced to improve their transparency with a focus on raw material sourcing. In recent years, categories such as "Conflict Minerals" or "Critical Raw Materials" are finding their way into corporate sourcing policies and sustainability reporting structures, with raw material supply, and its contribution to GHG emissions becoming more important. However, there is seldom a traceability of raw material input beyond the primary processing point or even from an early part of assembly.

CO_2 emissions reduction targets

In Europe, CO_2 emissions from new cars have gone down by almost 34% in less than two decades. At the same time, manufacturers have significantly reduced the environmental impact of manufacturing. For instance, total CO_2 emissions from car production were cut by 27.4% over the last decade. In the EU, cars are responsible for around 12% of total CO_2 emissions. EU legislation sets mandatory emission reduction targets for new cars, which is the cornerstone of the strategy to improve the fuel economy of cars sold on the European market. If the average CO_2 emissions of a car manufacturer's fleet exceed its limit value in any year from 2012, the manufacturer has to pay an excess emissions premium for each car registered.

From 2019, the cost of this penalty will increase from a minimum of €5 for the first gram/km of exceedance to a flat rate of €95 from the first gram of exceedance onwards.

As a result of the UN Climate Change Conference (COP21), 13 North American and European governments have announced that they will strive to make all new passenger vehicles in their jurisdictions zero-emission vehicles (ZEVs) by no later than 2050. This guideline focusses on tail-pipe emissions, and applies to an entire OEM fleet. The applicability to raw materials and their CO_2 footprint will centre around weight reduction.

CO_2 heritage or footprint as a similar target as CO_2 reduction

A similar mandatory legislation would be possible for the overall CO_2 footprint of a complete vehicle. The previously mentioned Toyota Challenge 2 "Life Cycle Zero CO_2 Emissions Challenge" would build the base for such an approach: The aim is to completely eliminate all CO_2 emissions, including materials, parts and manufacturing, from the vehicle life-cycle, by means of:

- Cutting total vehicle lifecycle CO_2 emissions, including materials, parts and manufacturing
- Developing, designing and using low-CO_2 materials; reducing the amount of material and the number of parts used in order to cut overall CO_2 emissions involved in manufacturing materials
- Using recycled bio-materials more widely; designing vehicles for easy dis-assembly;
- Other initiatives focusing on environment-conscious vehicle designs

Every part used in a vehicle has its own CO_2 footprint or heritage, and OEM fleets would first have to reach a cap of X tons of CO_2 emissions from the sum of the parts of its vehicles and manufacturing processes. This cap would also decrease progressively with the ultimate goal of zero emissions vehicles in all its "life-stages", namely planning, production, use phase(s) and recycling.

Other industries are using this sort of information mainly to raise awareness, for example the Global Water App or the Global Water Footprint, where one can scan an EAN barcode and immediately see how many litres of water were needed to produce the product. However, if such a scheme included similar "emission" penalty structures, then greater attention on raw materials would be obvious, and zero or low CO_2 emission raw materials would already be given higher priority and preference from the planning phase.

Image: Shutterstock

The LCA CO_2eq materials fight

As sustainability reporting has become more popular, the LCA tool has also produced a high number of different studies for raw materials, components and complete industries. This has primarily been with the aim of beating the direct competition, sometimes without contributing to the bigger picture of building a base for forward-looking planning, to offer not only engineers but also project or procurement personnel a range of alternatives. LCA related standards and projects fall under the direct responsibility of the ISO/TC 207/SC 5 Secretariat. IMA published its "Life Cycle Assessment of Magnesium Components in Vehicle Construction" in full compliance with this standard; however most of the LCA studies looking at magnesium as an alternative or part of the lightweight material mix are still using a reference to the China Pidgeon process based on average GHG values up to 42 kg CO_2eq for 1 kg of magnesium. A couple of studies still refer to the already closed Hydro Becancour plant as a state-of-the-art process reference. The IMA study already indicates a lower level for modern Chinese Pidgeon plants down to 19,9 CO_2eq when using the waste gas credits. The Chinese Ministry of Industry and Information Technology (MIIT) released the Access Standard for Magnesium Industry and sets strict conditions for companies with the purpose of accelerating industry restructuring, enhancing environmental protection, regulating investment and preventing redundant construction. But as China is lacking a broadly available renewable energy base for powering the present diversified magnesium primary production, the CO_2eq level is not expected to decrease significantly. It will need new and different capacity to come on-stream with a much lower CO_2eq value base.

High volume growth will require a global diversified primary supply base

High volume growth in automotive, for example, is only possible with a globally spread raw material/semi-fabricated material supply base. Bigger aluminium players invest in primary technology, processing plants and recycling facilities around the globe to enable the increasing demand of aluminium in the transport industry. Hydro has just announced that its new pilot will produce primary aluminium with a 15% reduction in energy consumption, to achieve the lowest CO_2 footprint.

But to enable the resulting supply chain with a lower CO_2 footprint, not only magnesium pipeline primary projects are needed, but also much lower CAPEX Pidgeon plants able to provide a lower CO_2eq by using a raw material intake produced by renewable energy, and offering shorter delivery distances to their customers. For both aluminium and magnesium, pre-consumer and EoL recycling plays an important role when completing the picture from production to use-phase to recycling phase. With very stringent legislative recycling targets, both materials will need to use their synergies and their inter-dependencies.

The concept of sustainability is much bigger than LCA, and it should be noted that the selected current magnesium primary producer and pipeline projects are clearly above the current China average in HSE.

Outlook and conclusions

Today, a selected primary magnesium supply base already has valuable advantages for providing a much more sustainable base for their downstream value chain, and this will be significantly improved by new primary pipeline projects. Magnesium lacks stakeholder knowledge and transparency in many ways, such as an achievable CO_2 footprint of primary production, pre-consumer recycling, material flow analysis including EoL and the synergies to be gained from being the most important alloying element for the aluminium industry.

Magnesium has a great opportunity to position itself in a more prominent role, but also as an attractive sustainable alternative, when raw materials, too, become an integrated part in the ambitious emission targets of industry.

Sources:

Definitions of Sustainability; Sustainable Measures website: http://www.sustainablemeasures.com/node/35

Definitions of sustainable business and production; Sustainable Measures website: http://www.sustainablemeasures.com/node/38

G4 Sustainability Reporting Guidelines: https://www.globalreporting.org/standards/g4/Pages/default.aspx

SGX to make sustainability reporting mandatory: http://www.eco-business.com/news/sgx-make-sustainability-reporting-mandatory/

The why of sustainability reporting: http://www.eco-business.com/opinion/the-why-of-sustainability-reporting/

It's the law: Big EU companies must report on sustainability: https://www.greenbiz.com/blog/2014/04/17/eu-law-big-companies-report-sustainability

The Aluminium Association: http://www.aluminum.org/sustainability/sustainability-reports

JAGUAR LAND ROVER IS HONOURED WITH 2015 'SUSTAINABLE DEVELOPMENT' QUEEN'S AWARD: http://www.jaguarlandrover.com/gl/en/responsible-business/performance-and-reporting/sustainability-report/2015/11/13/jlr-is-honoured/

Aluminium Stewardship Initiative: http://aluminium-stewardship.org

Circular economy in Europe — Developing the knowledge base:

http://www.eea.europa.eu/publications/circular-economy-in-europe

Views on Environmental Footprint; YouTube: https://www.youtube.com/watch?v=FHPq0vPTu2M&index=1&list=PLIzqPSxpstTn0x2qLwXlNWbSS7Ka1w7Wl

Policy background; Sustainable Consumption and Production Action Plan: http://ec.europa.eu/environment/eussd/smgp/policy_footprint.htm

Aluminium International Today; Novelis/JLR alloy: http://www.aluminiumtoday.com/news/view/novelis-jlr-alloy

Novelis' Recycled Aluminum Builds Jaguar's Lightest, Most Aerodynamic Sedan; Sustainable Brands website: http://www.sustainablebrands.com/news_and_views/chemistry_materials/sustainable_brands/novelis_recycled_aluminum_builds_jaguars_light?utm_source=Twitter&utm_medium=schtweets&utm_campaign=social

Recycling Waste World website: http://www.recyclingwasteworld.co.uk/news/novelis-works-with-jaguar-land-rover-to-create-alloy-with-75-recycled-content/115251/

Toyota; Life Cycle Zero CO2 Emissions Challenge: http://www.toyota-global.com/sustainability/report/er/pdf/er15_01_en.pdf

Volkswagen Group; Sustainability Report 2014:

http://www.volkswagenag.com/content/vwcorp/info_center/en/publications/2015/04/group-sustainability-report-2014.bin.html/binarystorageitem/file/Volkswagen_Sustainability_Report_2014.pdf

Magnesium Lifecycle Analysis (LCA): http://www.intlmag.org/magnesiumsustainability/lifecycle.cfm

The EU Emissions Trading System (EU ETS):

http://ec.europa.eu/clima/publications/docs/factsheet_ets_en.pdf

http://ec.europa.eu/clima/publications/docs/ets_handbook_en.pdf

The International Carbon Action Partnership (ICAP): https://icapcarbonaction.com/en/partnership/about

Eurometaux: Our 5 priorities to strengthen the European ETS

http://ourmetalsfuture.eu/our-blog/five-practical-ways-to-strengthen-the-eu-ets/

Introducing the Carbon Impact Factor; A family of Financial Instruments to Differentiate and Reward Carbon Efficiency in Commodity Production; report:

http://www.thejei.com/introducing-the-carbon-impact-factor-3/

http://www.sustainablebrands.com/news_and_views/supply_chain/mike_hower/new_tool_measures_upstream_ghgs_global_supply_chains?utm_source=Twitter&utm_medium=schtweets&utm_campaign=social

Science based target; website: http://sciencebasedtargets.org/methods/

Science will help push companies towards a low-carbon future: http://www.theguardian.com/sustainable-business/2016/feb/23/ghg-emissions-paris-cop21-business-climate-change-low-carbon-targets-epa

What Are Conflict Minerals: http://www.sourceintelligence.com/what-are-conflict-minerals/

Critical Raw Materials: http://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical/index_en.htm

CRM Alliance: http://criticalrawmaterials.org/eu-and-us-need-uniform-list-of-critical-materials/

Auto industry sets record straight on emissions, as it reaffirms long-term environmental commitment: http://www.acea.be/press-releases/article/auto-industry-sets-record-straight-on-emissions-as-it-reaffirms-long-term-e

Penalty payments for excess emissions: http://ec.europa.eu/clima/policies/transport/vehicles/cars/index_en.htm

International Alliance Sets Ambitious Goal for Zero-Emission Vehicles:

http://ngtnews.com/international-alliance-sets-ambitious-goal-for-zero-emission-vehicles/

Toyota; https://www.toyota.ie/world-of-toyota/articles-news-events/2015/Toyota-Unveils-Bold-New-Environmental-Targets.json

Were is water; Youtube: https://www.youtube.com/watch?v=b1f-G6v3voA

Water Footprint Network; product gallery: http://waterfootprint.org/en/resources/interactive-tools/product-gallery/

Standards and projects under the direct responsibility of ISO/TC 207/SC 5 Secretariat: http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_tc_browse.htm?commid=54854

Hydro; Hydro to build the Karmøy technology pilot: http://www.hydro.com/en/Press-room/News/Archive/2016/Hydro-to-build-the-Karmoy-technology-pilot/

ESAN: Critical Raw Materials Seminar, Stuttgart 16.9.2015: https://www.linkedin.com/pulse/critical-raw-materials-seminar-stuttgart-1692015-take-martin-tauber?trk=mp-reader-card

The Social Value of Metals

Tamara Alliot, MMTA

How do you measure the contribution of metals to society? Do we ignore the negatives? How do you tell people about it?

The mining and metals industry has an image problem. Dirty, corrupt and exploitative are words that may spring to mind in certain parts of the world. Energy intensive and polluting are probably used even more widely. However, without the mining of ores and their subsequent processing into metals, we would have no buildings, infrastructure, consumer products (not to mention anything even vaguely high-tech), we would literally still be stuck in the Stone Age. It has been around for a while, but I heartily recommend this video to emphasise the point: https://www.youtube.com/watch?v=zZrfmPAvtV8

An important part of the work of the MMTA, and other metals associations, is to promote and inform industry participants, policy makers and interested parties on how (minor) metals are essential to modern technologies and how these resources can be better mined and managed, reducing any detrimental impact on the planet.

In a similar way to the disconnection between live animals and the meat on our tables, the mining and processing of metals have become completely disconnected from the high-tech (and low-tech) products used and relied upon by billions.

An example of this is the recent outrage over BP's sponsorship of the London art gallery, Tate Modern. There seemed to be no acknowledgement of the number of oil industry products used in the building and the artworks themselves or in just in everyday life. The protesters seemed happy to benefit from plastic products, but only as long as they were far removed from the oil industry itself.

Heavy production and manufacturing is now mostly done in developing countries, and far from the gaze of the public. So the link between a smartphone and a huge hole in the ground is not automatic. Dedicated supporters of the 'Sharing Economy' (Airbnb, UBER etc.) fail to acknowledge that computers, mobile devices and servers are still needed to enable this movement, and therefore, by default, raw materials!

Stating the obvious, calculating and communicating the 'social value' of a metal is a complex business. How many people were employed to move this material from mine to end-user? How much value does the end product add to someone's life? What energy/time/money saving does a particular product offer compared to an alternative... I think you will agree that there are no straightforward answers to be found...except that the 'quantity' is sure to be considerable.

The marvellous world of minor metals

As Members and associates of the MMTA, we are lucky to be exposed to an exceptionally diverse selection of information on metal innovations and applications: in the Crucible, at the MMTA's annual conference (other conferences are available...) and from those who have worked in the industry for many years and are passionate about what they do.

The ages of history are categorised by the discovery of different metals and the new tools that were made possible as a result: the Iron Age, the Bronze Age and even now the 'Minor Metal Age' according to chemist and author John Emsley. Metal has enabled the development and progress of humankind.

Metals are socio, economic and political power, with experts like David Abraham analysing in detail these aspects in his book, 'The Elements of Power'.

Even as we speak, a new age of technology, driven by Tesla and its vehicle and home batteries, is fully dependent on the reliable supply of a minor metal, in this case lithium. New electric vehicles and battery storage solutions to fix the problem of intermittent energy supply from renewable energy sources are again completely dependent on a mined product.

Mining has traditionally provided many jobs, but often under hazardous conditions and increasingly located in developing countries (due to the natural concentration of mineral deposits and perhaps due to the NIMBYism and stringent legislation in more developed regions).

This not to say that the mining and metals industry should be given free rein to conduct themselves as they please due to their important applications. Minerals and ores must be extracted ethically and to the highest environmental and social standards. Workers should be in a safe environment and appropriately compensated, and then, when the area is exhausted, habitats should be replenished and communities supported.

The industry should be subject to legislative pressure to keep improving its activities, but conversely, regulations should not be so onerous that businesses are tempted to re-locate to less stringent parts of the world, a trend that unfortunately is all too common.

In addition, transparency in the supply chain around conflict minerals and ethical sourcing with suitable scrutiny on end-users' activities can be a positive, by helping consumers see metals and mining as something that affects and benefits them.

The Circular Economy concept, as previously discussed in the Crucible, is a positive concept that is suited to the metal supply chain, but implementation cannot solve all the world's ills, especially in the short term. Waste needs to be minimised and recycling maximised, but there is still a gap between what can be retrieved through these efforts and what is required to meet the needs of a growing global population and an expanding middle class with increasing levels of disposable income. This disparity will still need to be met with primary production.

What should be done to better get the message across?

- Acknowledge that communicating the benefits of the mining and metal industry to society is tough; dirty, heavy, old fashioned industry does not tally well with clean, high tech innovations.
- Constant and consistent emphasis on exactly how metals enable the modern world.
- Ensure transparency and traceability in the supply chain and educating the public on where their beloved products are coming from, thereby building trust in the industry.
- Celebrate new technologies and academic research.
- Engage and motivate students in science and engineering from an early age.

In conclusion, better connections need to be made between the 'industrial' side and the finished products that they eventually become. Then not forgetting to reuse and recycle end-of-life products, and finally filling any demand gap with ethically mined raw materials.

Easy!

Further reading:

'Role of mining in national economies', ICMM, October 2012

'The Elements of Power', David Abraham, 2016

'Fifty minerals that changed the course of history', Eric Chaline, 2013, Apple Press