



**The Zircon Industry Association - moving forward**

**TZMI Congress, Shanghai, November 12<sup>th</sup> 2014**



Good afternoon ladies and gentlemen - and thanks to TZMI for the opportunity to talk about the Zircon Industry Association which I had the pleasure of rolling out at this congress in 2012. We are nearing the end of our second year of existence, the first full year with an elected Board and a several sub-committees. It is therefore timely to provide an update of what has been achieved so far and where we plan to go from here.

## Disclaimer

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Here is the usual disclaimer which in essence says do not take any decisions on the basis of anything you see or hear during this presentation.

## Presentation overview

- **What is the ZIA doing for its members?**
- **Market support and development**
- **Regulatory support**
- **Communications and key messages**

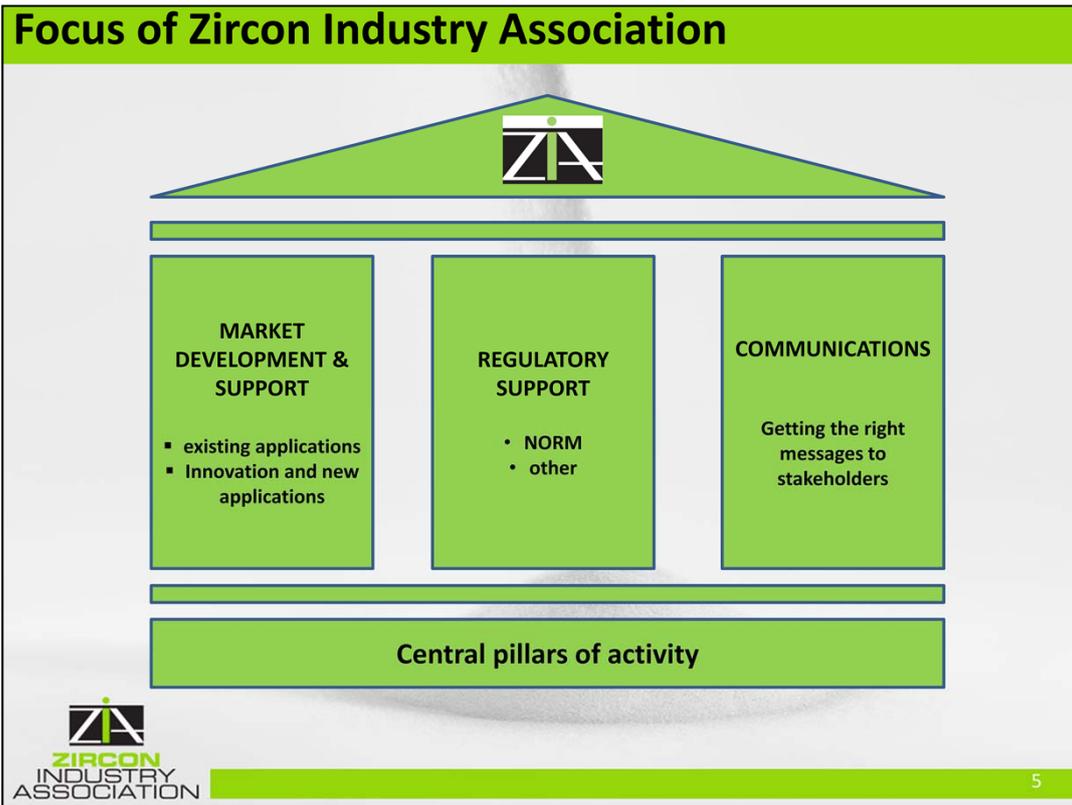


My presentation deals with our progress to date, outlines our key priorities and what further work we are planning based on these priorities for the benefit of our members in particular and the industry at large.

## Members - representing 80% of traded zircon supply



Currently we have 20 members, spanning a good part of the value chain, from mining to milling to zirconia to chemicals and we represent 80% or more of the global traded zircon supply. Geographically, our members are in the USA, Latin America, Europe, Africa and Asia.



As we have evolved, three main pillars of activity have emerged as priorities. They are as follows.

- The genesis of ZIA was to support and encourage the development of new applications and markets for zircon and its derivatives and this remains of key importance. However, new applications do not develop overnight and it's therefore essential that we look after our existing applications and markets.
- We asked members about their priorities and expectations of ZIA - it was certainly not a surprise to find that regulatory support was at the top of the list, especially in connection with radioactivity. Earlier this year we formed our NORM Committee, having first integrated the activities of the former Zircon Minerals Committee into our programme. The ZMC was a South Africa-based group of zircon sand producers and consumers with the purpose of tracking and addressing radioactivity issues. Our goal is that ZIA should be seen as the "go to place" for radiation information and support for the zirconium value chain.
- The third pillar is communications, close to the heart of any trade association. There is a great deal to do in spreading the gospel about zircon and its derivatives - the industry has seldom, if ever, spoken with a single voice, something we aim to put right.

## Technical handbook



**1. Introduction**  
**2. Material properties**  
**3. State of the art applications**  
**4. Emerging R & D**  
**5. References**

Available via the contact form at  
[www.zircon-association.org](http://www.zircon-association.org)

Technical handbook on  
zirconium and zirconium  
compounds

**ZIRCON** INDUSTRY ASSOCIATION

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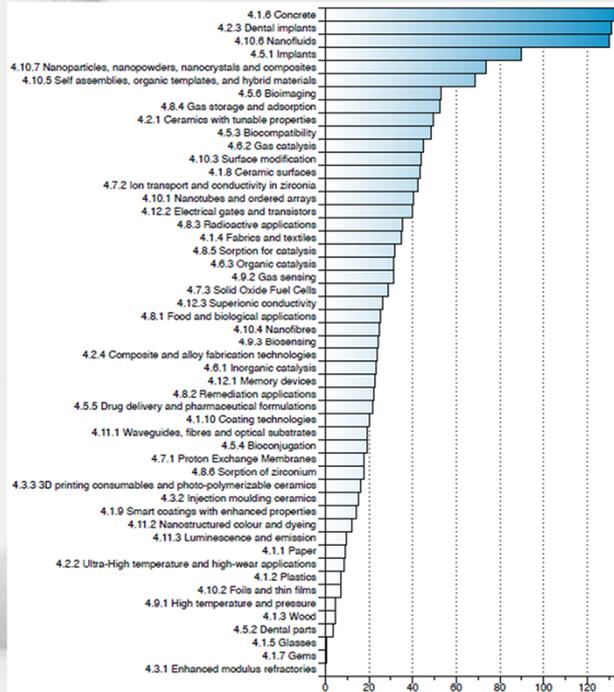
Turning now to market development and support, one of the first things that we did was to produce our Technical Handbook on zirconium and zirconium compounds, the cover of which is illustrated on this slide. We commissioned this from the Engineering Department of Cambridge University.

The handbook has four main chapters as shown as well as a list of references and is available to anyone who wants it, by application through the contact form on our website. We plan to issue the second edition in late 2015 or early 2016.

Note that chapter 4 deals with emerging research and development.

## Emerging R & D

- 347 references
- Zircon is present in numerous applications of distinct technological level and complexity.
- All research trends are strongly related to zirconium's fundamental properties:
  - Thermal resistance
  - Good refractory erial
  - Biocompatibility with human body and environment
  - Catalytic properties
  - Etc.



The chart on the right presents the results of a thorough literature survey designed to identify the current research and development trends along the zirconium value chain. This survey focused not only on identifying new material science developments, but also paid special attention to new application trends. It consisted of the review of abstracts retrieved from a scholar search engine after looking for the keywords 'zircon' (1,740 results), 'zirconia' (31,000 results), and 'zirconium' (35,700 results). The search was limited to the last five years and included both scholarly articles and patents.

Only the material deemed relevant to each category was considered, accounting for a total number of 347 references.

Two significant, although not really surprising conclusions were drawn, as written on this slide.

## Importance of supporting the existing applications

- The breadth of R&D activities is encouraging, the main focus being at the chemicals end of the value chain....
- Incremental volume growth from most of these new applications will probably be modest and not overnight....
- ZIA has some projects on its radar which could add quantum volume growth over the medium to longer term....
- We have a web page encouraging submission of R&D proposals....
- Meanwhile the industry must defend and support its existing markets....
- The game-changing high volume, new applications that we are waiting for have yet to come out of left field....



The point made on this slide is that it's essential that we defend and support our existing markets - as any salesman knows, the easiest business to win is repeat orders.

The breadth of R&D activities is very encouraging, but with it being concentrated at the chemicals end of the value chain, incremental volume growth from these activities will tend to be modest and will not happen overnight.

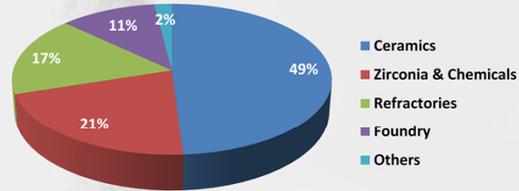
We do have a couple of projects on our radar with potential for significant volume growth over the medium to longer term - one is an old application which, metaphorically speaking, has been given an injection of steroids, but it will require considerable effort to convince the industry concerned - construction - to introduce new materials to traditional technologies. The other is more grass roots in nature and aims to develop composite ceramic materials.

→ → Of course one seldom knows when the next game changer will appear out of left field - with zircon's excellent suite of properties, it will surely do so sooner or later.

We have added a page to our website inviting submission of R&D projects.

## The ceramics market

- Still accounts for almost 50% of the market - 49% in 2013 per TZMI
- = about 0.5 mt in 2013



Data source: TZMI

When talking about supporting existing markets, ceramics is high on the list, at almost 50% by far the largest market for zircon, as shown in the chart on this slide, based on TZMI data for 2013.

## Defending the ceramics market



These charts tell the well-known story of zircon substitution and thrifting in the ceramics industry - the top left chart is a rather crude representation of the global average specific consumption of zircon per square metre of tile production over the last few years. Zircon intensity, the red line, has been derived from TZMI's estimates of zircon consumption in the ceramics sector and ACIMAC's tile manufacturing data.

The downward trend in intensity actually started more than 30 years ago, driven by the headwinds of technological development and cost pressures. However, despite these headwinds, zircon consumption in ceramics grew from just under 600,000 tonnes in 2003 to almost 800,000 tonnes in 2011, compound annual growth of 3.5% for that period.

Turning to the bottom right chart, the rapid increase in the zircon price, in combination with then forecasts that this would be the new paradigm, caused an immediate acceleration of substitution and thrifting.

On a more positive note, it seems reasonable to conclude that the decline in prices has slowed the pace of substitution – a conclusion that is supported by Iluka's most recent survey of the ceramic tile market. With the zircon price having fallen further in 2014 and with the apparent increase in zircon content in Chinese tiles, the corner may well have been turned.

## Defending the ceramics market....

| Ceramic application for zircon | Substitutes evaluated in this study  | Main conclusions  |
|--------------------------------|--------------------------------------|---|
| Engobes                        | 2 different aluminas                 | Alumina can be used to substitute zircon in engobes but the flux content of the engobe must be <u>increased</u> to compensate for the refractoriness of alumina     |
| Glazes                         | 2 different aluminas                 | Alumina is a suitable substitute for zircon only in glazes which have <u>low gloss</u>  |
| Porcelain tile bodies          | 2 different aluminas                 | Substitution of zircon with alumina is possible but alumina is <u>less effective</u> as a whitener on a weight basis, and causes the firing temperature to increase |
|                                | 1 whitening additive                 | The whitening additive gives a <u>poor result</u> – lower fired whiteness and significantly worse slurry behaviour, even with extra deflocculant                    |
| Frits                          | 1 TiO <sub>2</sub> -based white frit | There are <u>no viable substitutes</u> today for zircon-based white frits   |

### Next phase of work:

- **Indications are that if D<sub>50</sub> is reduced from 1.5 µm to say 0.7 µm, value-in-use increases by significantly more than the additional milling cost**
  - reduced zircon loading for tile producer
  - miller margin preserved
  - market share recovery for miners
- Zircon / alumina to be milled to various D<sub>50</sub> values
- Samples to be tested in porcelain body to identify the body compositions formulated with zircon and alumina opacifiers to give the same whiteness
- Samples to be tested in tile glaze with and without engobe to determine opacity and aesthetic characteristics



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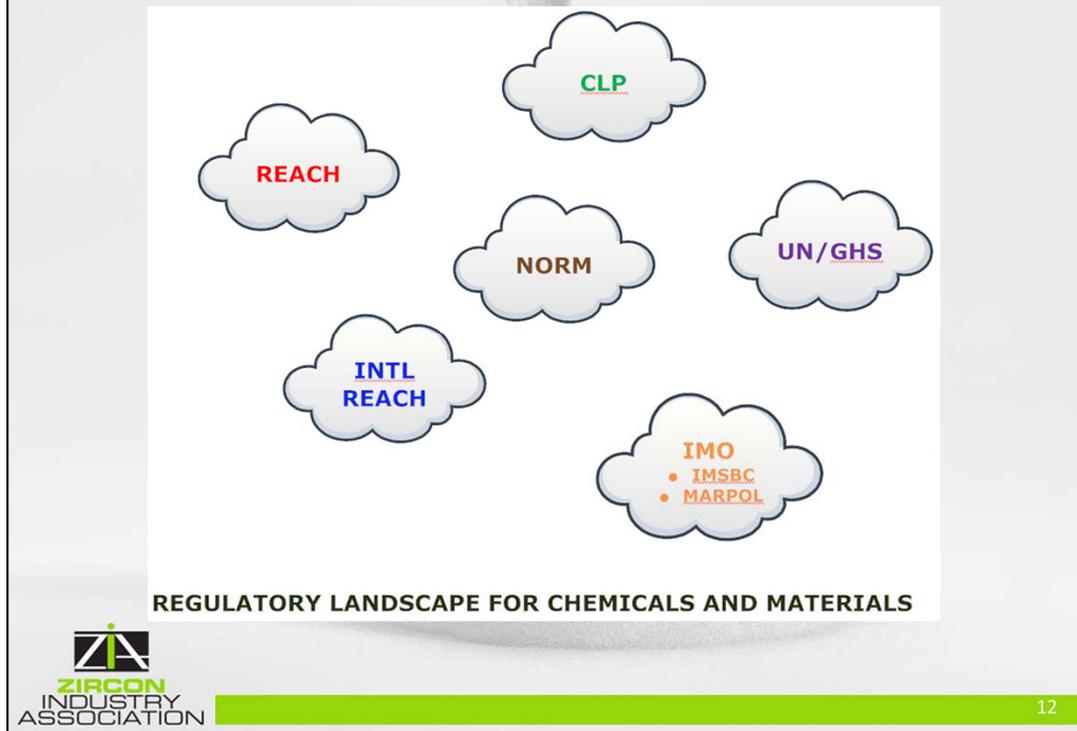
However, it would be naïve to think that just because prices have fallen back, normal service will be resumed. Of course price is an important driver of demand, but it does not always tell the full story. ZIA commissioned ITC, a well respected Spanish ceramics institute, to compare the performance of zircon opacifiers with substitute materials, principally alumina, in ceramic tile applications.

→ The results are shown in the table at the top of this slide - I will not dwell on this as we have presented it before - suffice it to say here that whilst zircon can of course be substituted in most applications, it is not without technical issues and cost.

→ In the world of performance minerals, fillers and pigments, there is a definite trend to smaller particle sizes, eventually to nano-particles. It has long been understood that zircon opacifiers generally perform better as particle size decreases to a certain point. Whereas the traditional 5 µm opacifier had D<sub>50</sub> of 1-2 µm, products with D<sub>50</sub> of less than 1 µm are now not uncommon. Of course, finer products are more expensive to produce, but indications are that the increased value-in-use of the finer product more than outweighs the additional milling cost - of course how the added value is shared is a matter of negotiation, but if the indications are borne out in practice, there should be something in it for everyone.

The next phase of ZIA's work with opacifiers will measure the effect of smaller particle size in two ceramic applications, bodies and glazes, for zircon and alumina, as mentioned on this slide. We hope to have this work completed by mid-2015.

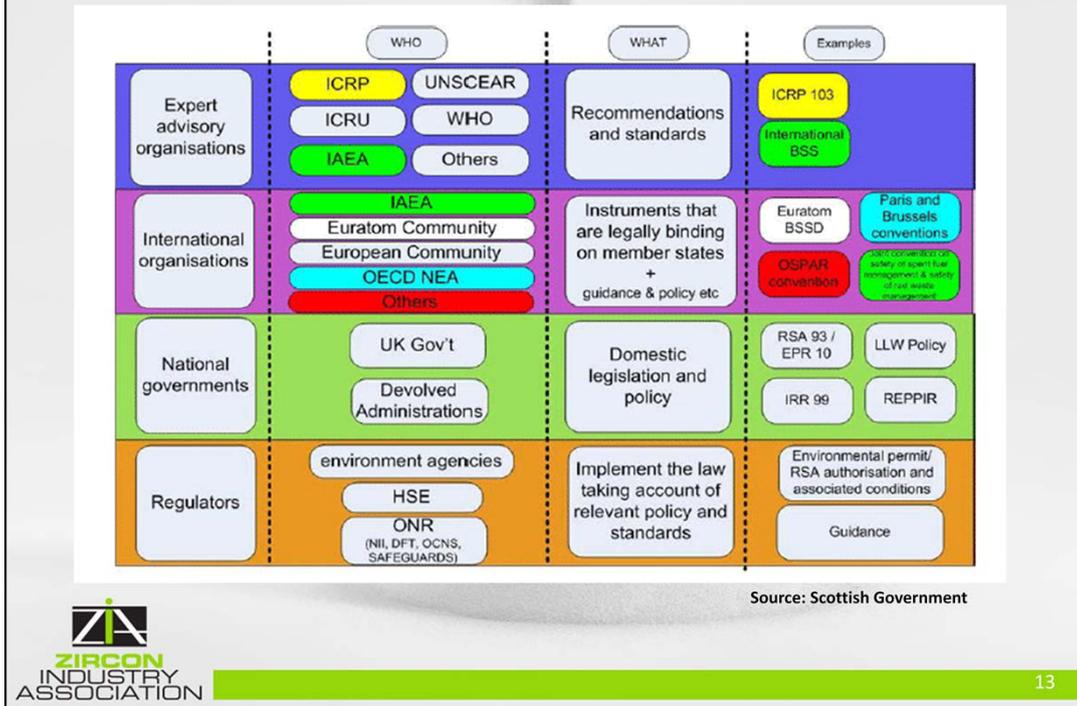
## Regulatory support



Now turning to regulation, as the graphic, there are many facets to the regulatory landscape for chemicals and materials - it's a minefield. A few weeks ago I gave a presentation to a workshop on the subject of REACH, the theme being that anticipation of regulatory developments is a key success factor for effective implementation and reduced economic impact. I included an image, the caption of which was "anticipation is staying one step ahead of punishment" - and punishment can certainly be painful and expensive.

The most important - but not the only - regulatory issue for zircon, a NORM material, is of course radioactivity. Development and application of NORM regulations is a continuous process, witness the latest EURATOM Basic Safety Standards regulation in the EU, adopted earlier this year, about which I'll talk briefly in a minute.

# NORM regulations



Earlier this year I attended a workshop on NORM waste, organised by the Scottish Government on behalf of all UK governments. This chart was shown and quite neatly illustrates the structure of NORM regulations, in this case with a UK emphasis.

At the top are the expert advisory organisations, the principal ones for our purposes being the ICRP, the International Commission on Radiological Protection, and the IAEA, the International Atomic Energy Agency.

The ICRP developed the International System of Radiological Protection used world-wide as the common basis for radiological protection standards, legislation, guidelines, programmes and practice. It is an independent, international organisation with more than two hundred volunteer members from approximately thirty countries across six continents. These members represent the leading scientists and policy makers in the field of radiological protection. The ICRP develops the thinking behind the radiation protection systems and its recommendations form the basis of the IAEA standards.

The IAEA is the world's centre of cooperation in the nuclear field. It was set up in 1957 as the world's "Atoms for Peace" organization within the United Nations. The Agency works with its Member States and multiple partners worldwide to promote safe, secure and peaceful nuclear technologies. It produces many standards, guidelines and reports on all fields of radiation safety. Although not mandatory on the member states of the UN, the IAEA standards are used as the basis for most international regulation on radiation protection. Some countries choose to apply stricter standards than recommended by the IAEA, but generally the standards are accepted internationally.

At the next levels down are international organisations and governments which develop their own regulations and finally the regulators themselves who implement and enforce the regulations.

## Cross-border movement of zircon and zirconia

| shipping & transport   | storage   | post delivery  |
|--|-----------|--|
| <b>IAEA TRANSPORT REGULATIONS</b><br>(zircon & zirconia exempt)  | grey area | <b>IAEA EXEMPTION REGULATIONS</b><br>(zircon & zirconia not exempt)                                  |
| <ul style="list-style-type: none"> <li>Transition between transport and exemption regulations is a grey area</li> <li>National regulators may apply the regulations differently to each other</li> <li>Prior to cross-border movements, regulators in destination country should be contacted and provided with activity data prior to dispatch</li> <li>Carriers should also be informed about the nature of the material and relevant regulations</li> <li>MSDS to include relevant information and be included in shipping documents</li> </ul> |           |  |
|  |           |                    |
|  |           | <b>ZIA intends to produce guidance to facilitate cross border movement over zircon and zirconia.</b> |


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Movement of NORM is governed by the Transport regulations, but on arrival at destination the regulatory regime switches to the Exemption regulations.

→ However, there are grey areas at the transition point, for example when the material is in storage. Under the transport regulations, zircon is in effect exempt, but this is not the case for the exemption regulations where the threshold is  $1 \text{ Bq.g}^{-1}$ . There are differences in application of these regulations from one jurisdiction to another and sometimes even within a single jurisdiction.

→ For a new cross-border movement especially, provision of activity data in advance to the regulators in the destination country, as well as to new carriers, should facilitate the process. Inclusion of a suitably worded MSDS in the shipping documents is also a good idea.

→ ZIA does intend to produce guidance to facilitate cross border movements.

## EURATOM Basic Safety Standards

Revised EURATOM BSS adopted by EU member states in 2014 - areas of possible concern for zircon and zirconia:

- the zircon and zirconia industries are now listed in the annex which lists industrial sectors where radiation is a risk
- only NORM material with  $<1 \text{ Bq.g}^{-1}$  are of no regulatory concern - those working with zircon and zirconia in EU jurisdictions will be subject to scrutiny and should prepare accordingly
- regulators must be notified of all permitted practices - in jurisdictions where this practice has not been applied, producers/users of zircon/zirconia should notify, first conducting radiation risk assessments and potential/actual exposure
- BSS provide minimum rules to be applied, but member states may apply more stringent measures
- BSS notes that ICRP 103 contains new methodology for calculating radiation doses
- Regulation 305/2011 requires relevant information to be made available when products are placed on the market - implication for MSDS, etc.
- BSS refers to default exemption level  $<1 \text{ Bq.g}^{-1}$  for "clearance" of materials [removal from regulatory control] - zircon/zirconia producers/users should establish U/Th activity levels of their wastes
- BSS applies to external exposures from building materials - could impact on use of zircon in ceramic tiles - this needs to be addressed with regulators
- Public dose limit is 1 mSv per annum, but regulators must make allowances for doses from other sources, so effective limit is 0.3 mSv



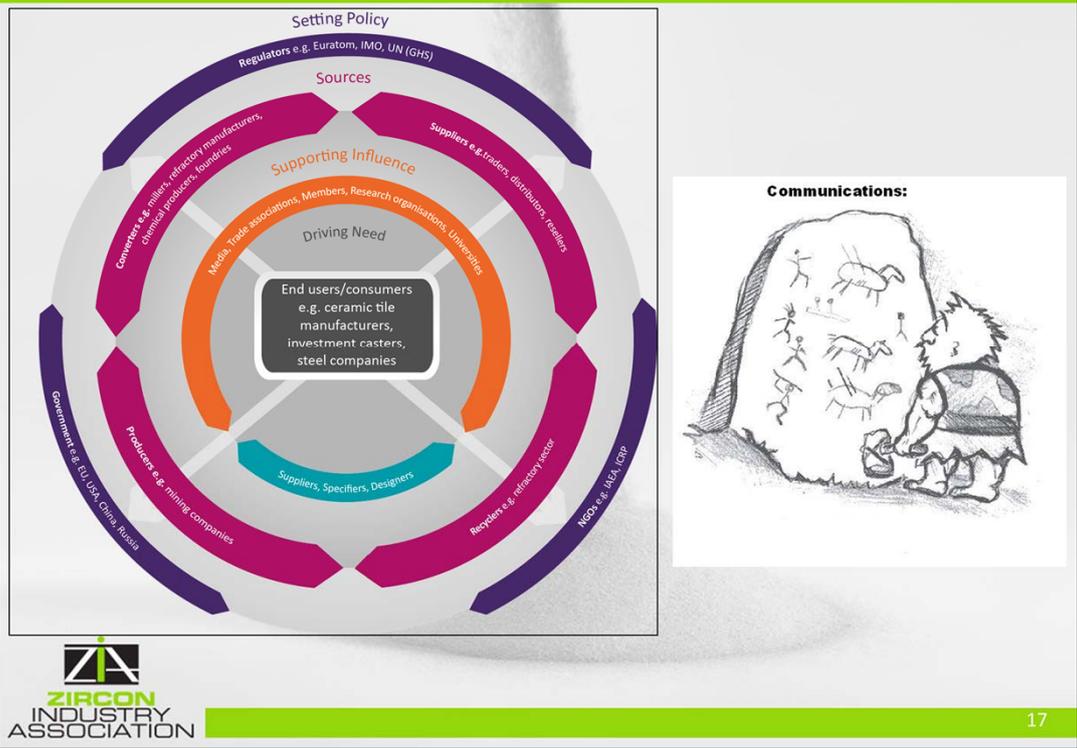
I referred earlier to the new EURATOM Basic Safety Standards. In comparison with the previous version, there are some areas of concern for zircon and zirconia which are now mentioned specifically by name and are therefore more likely to appear on regulators' radar screens. This slide lists some of the issues - in the interest of time I will not discuss them here - read them at your leisure and feel free to get in touch if you have questions.

## ZIA initiatives and plans in the NORM space

- ZIA now the international body dealing with zircon and zirconia NORM matters
- compilation of global NORM regulation inventory
- guidance for cross border movements of zircon/zirconia
- monitoring of global NORM regulatory developments
- interaction with regulators to clarify inconsistencies
- guidance and best practice on assessment and management of radiation hazard and dose risk (including waste)
- generic application-specific risk assessments for highest risk sectors and materials:
  - zircon milling, zirconia manufacture and ceramic tile manufacture
  - milled zircon, zircon/zirconia refractories and zircon/zirconia abrasives

To conclude on the subject of NORM and radioactivity, I'll list our principal initiatives and plans.....

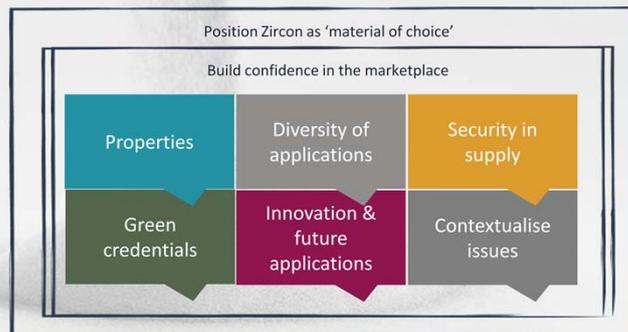
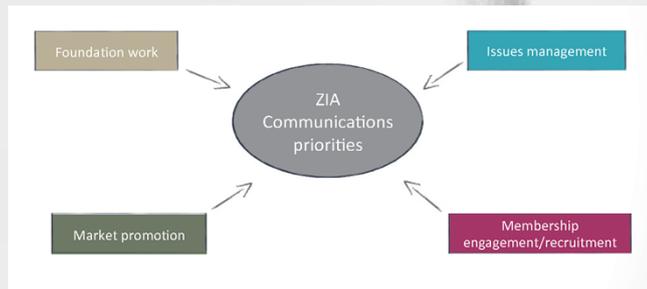
# Communications



Now we come to communications. This chart is known as the wheel of influence and was compiled by our communications consultant to identify our principal stakeholders. At the centre, driving need or demand, are end users such as ceramic tile manufacturers. Moving outwards we come to those who also have influence on demand, for example suppliers, specifiers and designers. At this level we also have supporting influence, for example from the media, trade associations, academia - and of course our own members. Moving further outwards we have sources of material, for example mining companies, converters, recyclers, traders and so on. Finally at the outer level we have policy setters such as governments, regulators and NGO's.

→ I used to think that communication was simple!

## ZIA communication priorities and focus



The first graphic on this slide depicts our communication priorities. The second one deals with positioning zircon as the material of choice.

All very straight forward I hear some of you saying! Actually not so! Communication needs to be integrated into almost every thing we do, to ensure that we get the right message to the right audience at the right time, both pro-actively and, where necessary, reactively.

The ZIA offers the industry the opportunity to improve its game with communications - which, let's face it, has not always been at the highest level.



In concluding, I would like to re-iterate that the ZIA now represents over 80% of global traded zircon. We have developed three main pillars of activity which are:

1. Market support and development
2. Regulatory support, especially in connection with the long standing and important issue of radioactivity
3. Communications – which is aimed at allowing the industry to speak to its stakeholders with a single voice.

→ We believe that the ZIA is increasingly providing valuable assistance to its members with respect to these three key areas. As such, we would encourage other companies within the zirconium value chain to join our association.

## The end



ZIA event to be held alongside Cersaie ceramic fair in Italy in September 2015 – open to members and non-members. Watch this space - details to be advised in due course.



## Thank you for your attention!

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I'd like to finish by letting you know that we are planning to hold a zirconium industry event in September next year, in Italy, in conjunction with the Cersaie ceramic fair. The meeting will be open to both members and non-members – details will be posted on our website as soon as possible.

Thank you for your attention.