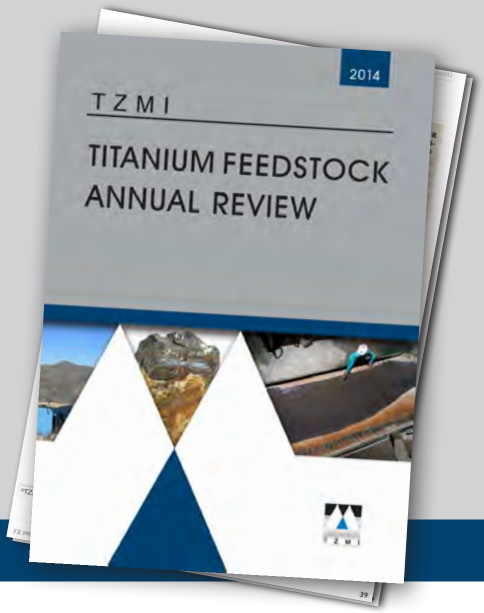


T Z M I

# TITANIUM FEEDSTOCK ANNUAL REVIEW *SAMPLE*

NEW EDITION TO BE RELEASED Q2 2014

## PROPOSED TABLE OF CONTENTS*



* minor changes may be made to this outline prior to publication

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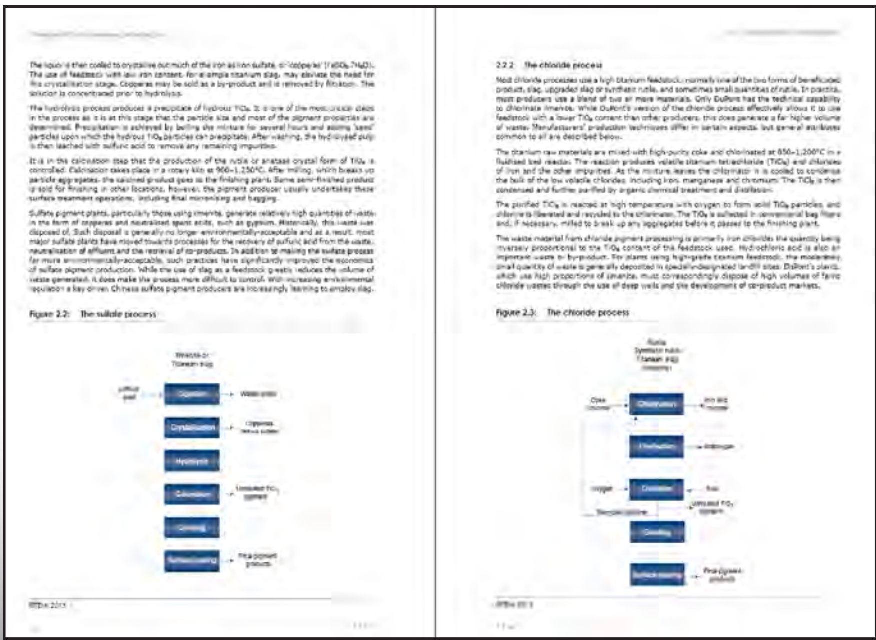
# SAMPLE OF 2013 EDITION

## FEEDSTOCK MARKETS

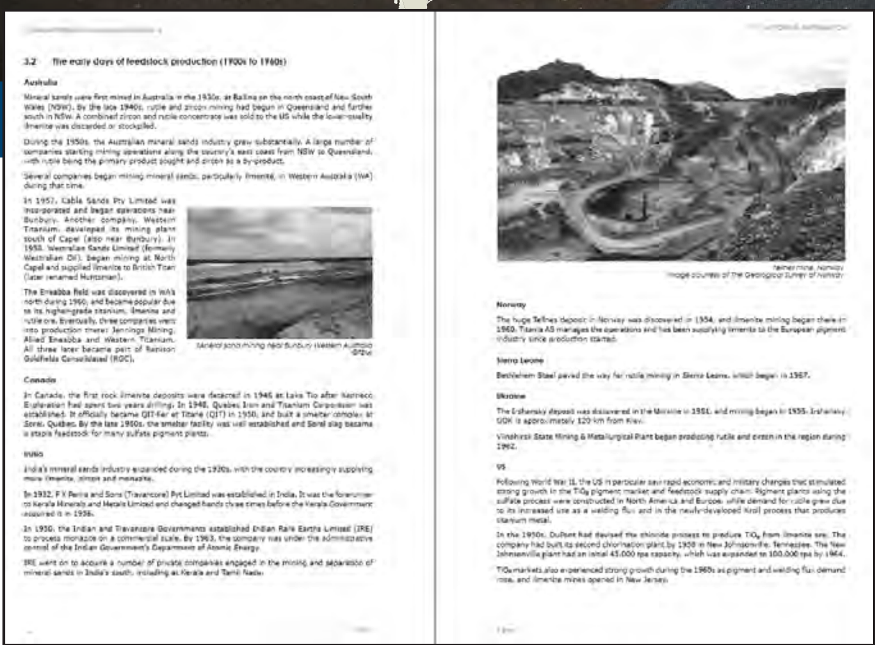
- World resources of titanium minerals, including charts and written summary for major producing countries.
- Processing technologies for pigment production are explained including flowcharts.
- Other end-uses for titanium raw materials outlined.



2.2 The chloride process

Figure 2.2: The sulfate process

Figure 2.3: The chloride process



3.2 The early days of feedstock production (1900s to 1960s)

Australia

Canada

India

Norway

Sierra Leone

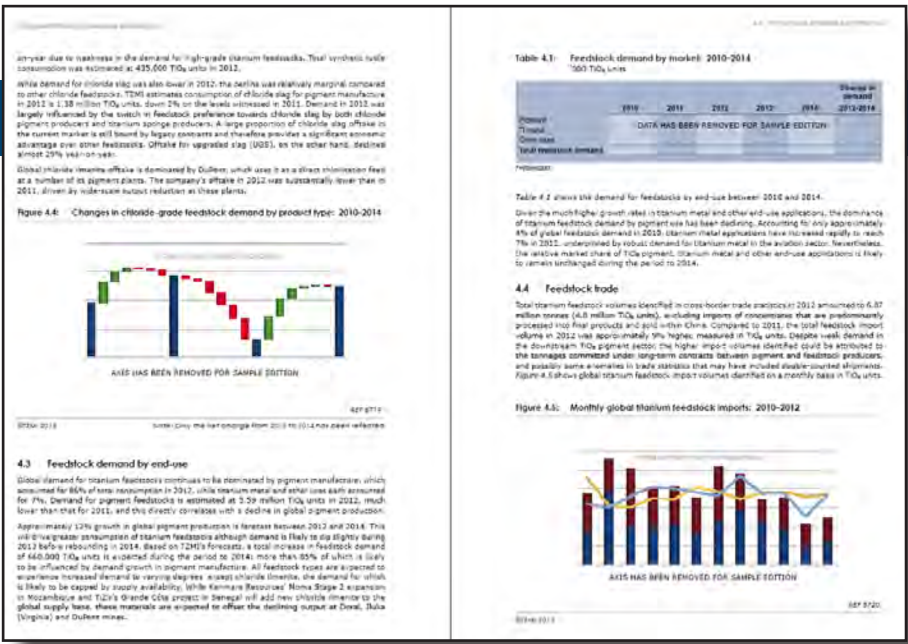
Ukraine

US

## HISTORICAL INFORMATION

This section provides historical perspective from 1789 until after the global financial crisis of 2008.

*Aerial view of KZN Sands plant*
*Image courtesy Exxaro Resources*




# DEMAND AND PRICING

- Pricing for titanium feedstock products and outlook for the following two years.
- Analysis of activity in the feedstock sector plus major producers supply and demand dynamics.

**World titanium feedstock import statistics by country and product: 2008–2012**

**Import statistics from more than 20 countries**

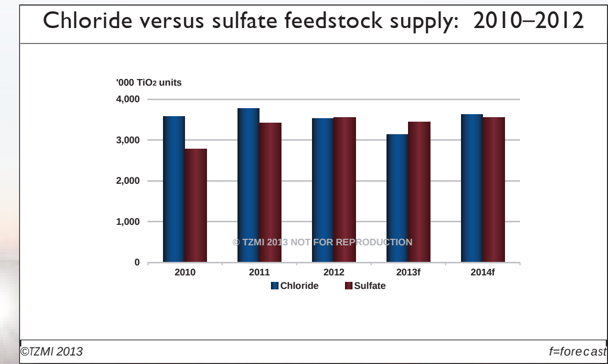
**Includes forecasting to 2014**

| Country | Product | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| Belgium | Rutile | | | | | |
| | Synthetic rutile | | | | | |
| | Titanium slag | | | | | |
| CIS | Ilmenite | | | | | |
| | Rutile | | | | | |
| | Titanium slag | | | | | |
| Canada | Ilmenite | | | | | |
| | Titanium slag | | | | | |
| China | Ilmenite | | | | | |
| | Rutile | | | | | |
| | Titanium slag | | | | | |
| Eastern Europe | Ilmenite | | | | | |
| | Rutile | | | | | |
| | Titanium slag | | | | | |
| Finland | Titanium slag | | | | | |
| France | Ilmenite | | | | | |
| | Rutile | | | | | |
| | Titanium slag | | | | | |
| Germany | Ilmenite | | | | | |
| | Rutile | | | | | |
| | Titanium slag | | | | | |
| Italy | Titanium slag | | | | | |
| Japan | Ilmenite | | | | | |
| | Rutile | | | | | |
| | Titanium slag | | | | | |
| | Synthetic rutile | | | | | |
| Malaysia | Ilmenite | | | | | |
| | Rutile | | | | | |
| Mexico | Ilmenite | | | | | |
| | Leucoxene | | | | | |
| | Rutile | | | | | |
| | Titanium slag | | | | | |
| | Synthetic Rutile | | | | | |
| Netherlands | Ilmenite | | | | | |
| | Rutile | | | | | |
| | Titanium slag | | | | | |
| | Synthetic Rutile | | | | | |
| Saudi Arabia | Rutile | | | | | |
| | Synthetic Rutile | | | | | |
| Singapore | Rutile | | | | | |
| | Titanium slag | | | | | |
| | Synthetic Rutile | | | | | |
| South Korea | Ilmenite | | | | | |
| | Rutile | | | | | |
| Spain | Ilmenite | | | | | |
| | Titanium slag | | | | | |
| Taiwan | Ilmenite | | | | | |
| | Rutile | | | | | |
| | Titanium slag | | | | | |
| | Synthetic Rutile | | | | | |
| UK | Ilmenite | | | | | |
| | Rutile | | | | | |
| | Titanium slag | | | | | |
| | Synthetic Rutile | | | | | |
| US | Ilmenite | | | | | |
| | Leucoxene | | | | | |
| | Rutile | | | | | |
| | Titanium slag | | | | | |
| | Synthetic Rutile | | | | | |
| Rest of World | Ilmenite | | | | | |
| | Rutile | | | | | |
| | Titanium slag | | | | | |
| **Total** | **Ilmenite** | | | | | |
| | **Rutile** | | | | | |
| | **Titanium slag** | | | | | |
| | **Synthetic rutile** | | | | | |
| | **Leucoxene** | | | | | |

# FEEDSTOCK SUPPLY

Included in this section is a breakdown of supply by country, by product type and by major suppliers. Production figures for the past 4 years are identified, plus forecasting for the following 2 years.

**Production statistics from the top 10 countries**




**2012 supply up 4% y-o-y 2011**

# TRENDS AND OUTLOOK

Trends observed in 2012 analysed and assessed for impact on the feedstock sector.

**Trade analysis**

**Supply and demand forecasts**

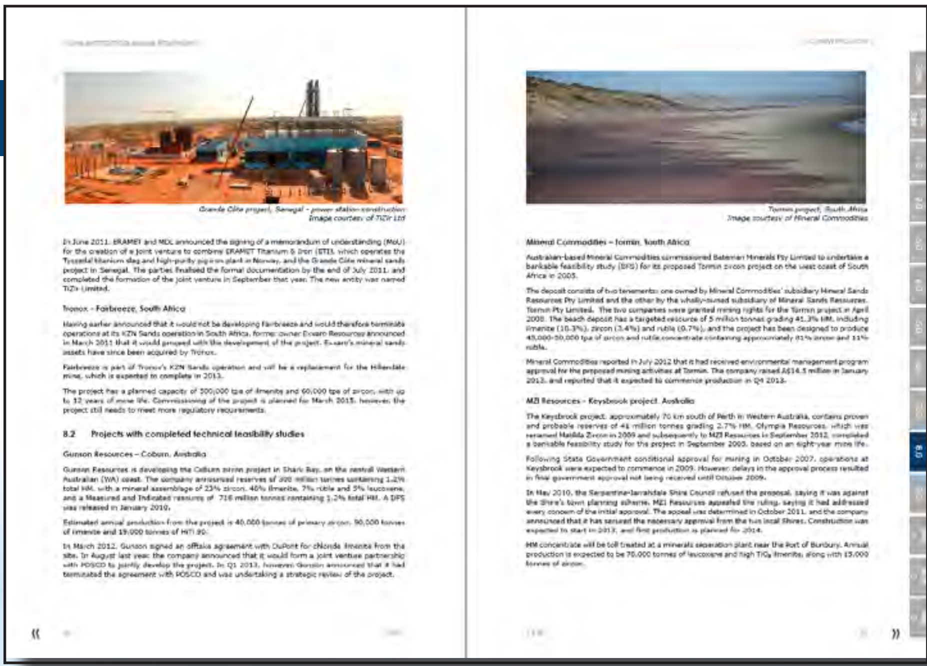
**Feedstock pricing**

2010 2011 2012 2013 2014

## NEW PROJECTS

The titanium feedstock sector has enjoyed renewed interest in the past couple of years due to increased investor activity, supply challenges and rising prices for minerals.

This section includes a synopsis of projects in the pipeline. It also includes an outline of each project and its development status.



*Grande Côte project, Senegal – power station construction*
*Image courtesy of TiZir Ltd*

In June 2011, ERAMET and MDL announced the signing of a memorandum of understanding (MoU) for the creation of a joint venture to combine ERAMET Titanium & Iron (ETI), which operates the Tyssedal titanium slag and high-purity pig iron plant in Norway, and the Grande Côte mineral sands project in Senegal. The parties finalised the formal documentation by the end of July 2011, and completed the formation of the joint venture in September that year. The new entity was named TiZir Limited.

**Tronox – Fairbreeze, South Africa**

Having earlier announced that it would not be developing Fairbreeze and would therefore terminate operations at its KZN Sands operation in South Africa, former owner Exxaro Resources announced in March 2011 that it would proceed with the development of the project. Exxaro's mineral sands assets have since been acquired by Tronox.

Fairbreeze is part of Tronox's KZN Sands operation and will be a replacement for the Hillendale mine, which is expected to complete in 2013.

The project has a planned capacity of 300,000 tpa of ilmenite and 60,000 tpa of zircon, with up to 12 years of mine life. Commissioning of the project is planned for March 2015, however, the project still needs to meet more regulatory requirements.

**8.2 Projects with completed technical feasibility studies**

**Gunson Resources – Coburn, Australia**

Gunson Resources is developing the Coburn zircon project in Shark Bay, on the central Western Australian (WA) coast. The company announced reserves of 300 million tonnes containing 1.2% total HM, with a mineral assemblage of 23% zircon, 48% ilmenite, 7% rutile and 5% leucoxene, and a Measured and Indicated resource of 716 million tonnes containing 1.2% total HM. A DFS was released in January 2010.

Estimated annual production from the project is 40,000 tonnes of primary zircon, 90,000 tonnes of ilmenite and 19,000 tonnes of HiTi 90.

In March 2012, Gunson signed an offtake agreement with DuPont for chloride ilmenite from the site. In August last year the company announced that it would form a joint venture partnership with POSCO to jointly develop the project. In Q1 2013, however, Gunson announced that it had terminated the agreement with POSCO and was undertaking a strategic review of the project.

*Tormin project, South Africa*
*Image courtesy of Mineral Commodities*

**Mineral Commodities – Tormin, South Africa**

Australian-based Mineral Commodities commissioned Bateman Minerals Pty Limited to undertake a bankable feasibility study (BFS) for its proposed Tormin zircon project on the west coast of South Africa in 2005.

The deposit consists of two tenements: one owned by Mineral Commodities' subsidiary Mineral Sands Resources Pty Limited and the other by the wholly-owned subsidiary of Mineral Sands Resources, Tormin Pty Limited. The two companies were granted mining rights for the Tormin project in April 2008. The beach deposit has a targeted resource of 5 million tonnes grading 41.3% HM, including ilmenite (10.3%), zircon (3.4%) and rutile (0.7%), and the project has been designed to produce 45,000-50,000 tpa of zircon and rutile concentrate containing approximately 81% zircon and 11% rutile.

Mineral Commodities reported in July 2012 that it had received environmental management program approval for the proposed mining activities at Tormin. The company raised A$14.5 million in January 2013, and reported that it expected to commence production in Q4 2013.

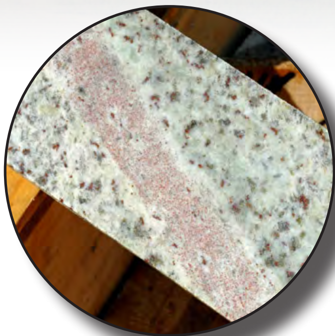
**MZI Resources – Keysbrook project, Australia**

The Keysbrook project, approximately 70 km south of Perth in Western Australia, contains proven and probable reserves of 41 million tonnes grading 2.7% HM. Olympia Resources, which was renamed Matilda Zircon in 2009 and subsequently to MZI Resources in September 2012, completed a bankable feasibility study for the project in September 2005, based on an eight-year mine life.

Following State Government conditional approval for mining in October 2007, operations at Keysbrook were expected to commence in 2009. However, delays in the approval process resulted in final government approval not being received until October 2009.

In May 2010, the Serpentine-Jarrahdale Shire Council refused the proposal, saying it was against the Shire's town planning scheme. MZI Resources appealed the ruling, saying it had addressed every concern of the initial approval. The appeal was determined in October 2011, and the company announced that it has secured the necessary approval from the two local Shires. Construction was expected to start in 2013, and first production is planned for 2014.

HM concentrate will be toll treated at a minerals separation plant near the Port of Bunbury. Annual production is expected to be 70,000 tonnes of leucoxene and high $TiO_2$ ilmenite, along with 15,000 tonnes of zircon.

## STRATEGIC ISSUES


The feedstock sector underwent a period of consolidation in 2012, following the prior two years which were marked by significant supply challenges and rapidly rising prices for all feedstocks.

This section discusses the challenges faced in 2012 and the outlook through to 2014.

# APPENDICES

## APPENDIX 1 *Introduction to the $TiO_2$ industry*

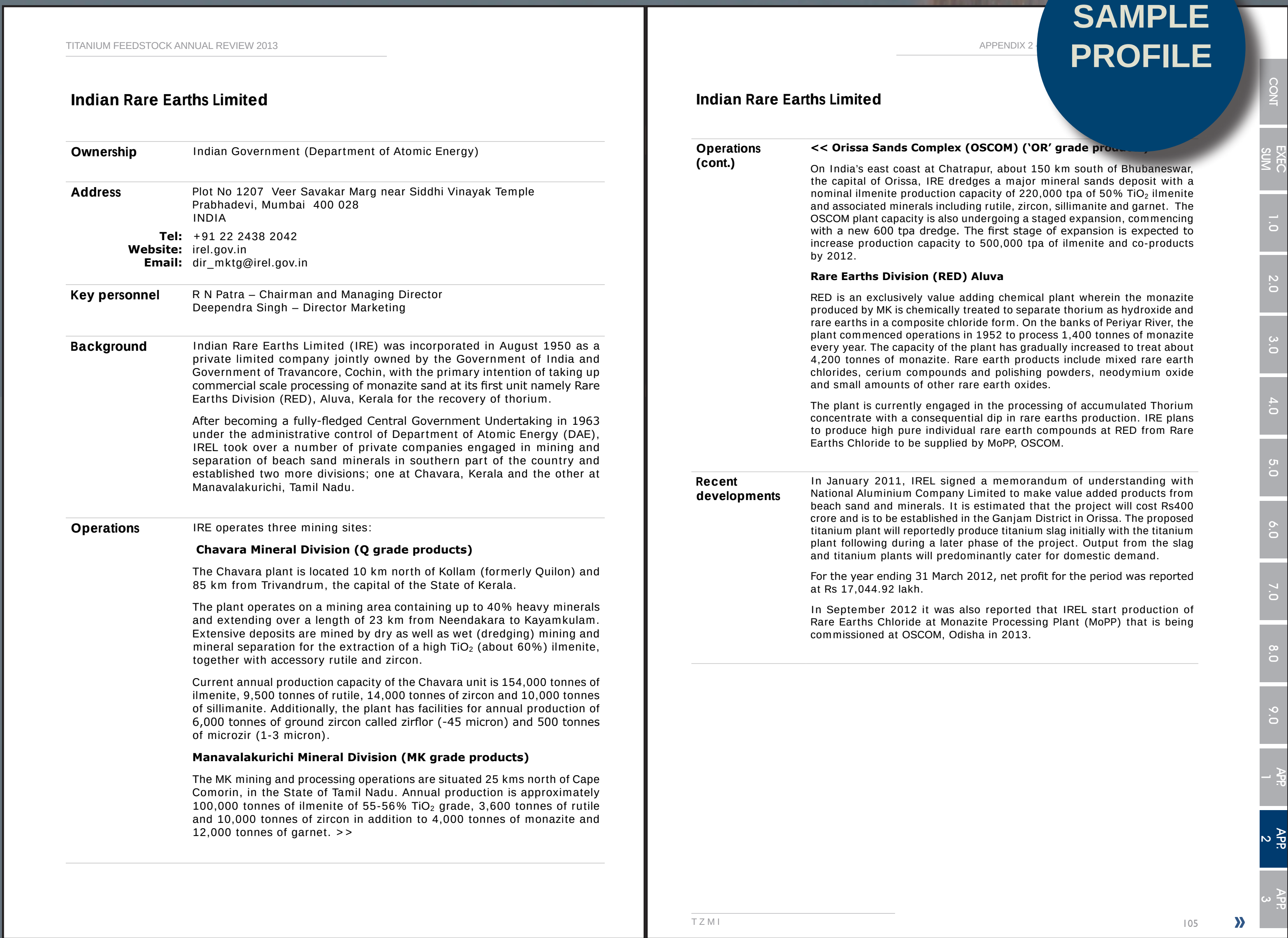
## APPENDIX 2 *Producer profiles*

Includes profiles for 29 major producers

## APPENDIX 3 *New projects profiles*

Includes profiles for 33 new projects

SAMPLE PROFILE



TITANIUM FEEDSTOCK ANNUAL REVIEW 2013

### Indian Rare Earths Limited

| | |
|---|---|
| **Ownership** | Indian Government (Department of Atomic Energy) |
| **Address** | Plot No 1207 Veer Savakar Marg near Siddhi Vinayak Temple<br>Prabhadevi, Mumbai 400 028<br>INDIA |
| **Tel:** | +91 22 2438 2042 |
| **Website:** | irel.gov.in |
| **Email:** | dir_mktg@irel.gov.in |
| **Key personnel** | R N Patra – Chairman and Managing Director<br>Deependra Singh – Director Marketing |
| **Background** | Indian Rare Earths Limited (IRE) was incorporated in August 1950 as a private limited company jointly owned by the Government of India and Government of Travancore, Cochin, with the primary intention of taking up commercial scale processing of monazite sand at its first unit namely Rare Earths Division (RED), Aluva, Kerala for the recovery of thorium.<br>After becoming a fully-fledged Central Government Undertaking in 1963 under the administrative control of Department of Atomic Energy (DAE), IREL took over a number of private companies engaged in mining and separation of beach sand minerals in southern part of the country and established two more divisions; one at Chavara, Kerala and the other at Manavalakurichi, Tamil Nadu. |
| **Operations** | IRE operates three mining sites:<br>**Chavara Mineral Division (Q grade products)**<br>The Chavara plant is located 10 km north of Kollam (formerly Quilon) and 85 km from Trivandrum, the capital of the State of Kerala.<br>The plant operates on a mining area containing up to 40% heavy minerals and extending over a length of 23 km from Neendakara to Kayamkulam. Extensive deposits are mined by dry as well as wet (dredging) mining and mineral separation for the extraction of a high $TiO_2$ (about 60%) ilmenite, together with accessory rutile and zircon.<br>Current annual production capacity of the Chavara unit is 154,000 tonnes of ilmenite, 9,500 tonnes of rutile, 14,000 tonnes of zircon and 10,000 tonnes of sillimanite. Additionally, the plant has facilities for annual production of 6,000 tonnes of ground zircon called zirflor (-45 micron) and 500 tonnes of microzir (1-3 micron).<br>**Manavalakurichi Mineral Division (MK grade products)**<br>The MK mining and processing operations are situated 25 kms north of Cape Comorin, in the State of Tamil Nadu. Annual production is approximately 100,000 tonnes of ilmenite of 55-56% $TiO_2$ grade, 3,600 tonnes of rutile and 10,000 tonnes of zircon in addition to 4,000 tonnes of monazite and 12,000 tonnes of garnet. >> |

APPENDIX 2

### Indian Rare Earths Limited

| | |
|---|---|
| **Operations (cont.)** | **<< Orissa Sands Complex (OSCOM) ('OR' grade pro**<br>On India's east coast at Chatrapur, about 150 km south of Bhubaneswar, the capital of Orissa, IRE dredges a major mineral sands deposit with a nominal ilmenite production capacity of 220,000 tpa of 50% $TiO_2$ ilmenite and associated minerals including rutile, zircon, sillimanite and garnet. The OSCOM plant capacity is also undergoing a staged expansion, commencing with a new 600 tpa dredge. The first stage of expansion is expected to increase production capacity to 500,000 tpa of ilmenite and co-products by 2012.<br>**Rare Earths Division (RED) Aluva**<br>RED is an exclusively value adding chemical plant wherein the monazite produced by MK is chemically treated to separate thorium as hydroxide and rare earths in a composite chloride form. On the banks of Periyar River, the plant commenced operations in 1952 to process 1,400 tonnes of monazite every year. The capacity of the plant has gradually increased to treat about 4,200 tonnes of monazite. Rare earth products include mixed rare earth chlorides, cerium compounds and polishing powders, neodymium oxide and small amounts of other rare earth oxides.<br>The plant is currently engaged in the processing of accumulated Thorium concentrate with a consequential dip in rare earths production. IRE plans to produce high pure individual rare earth compounds at RED from Rare Earths Chloride to be supplied by MoPP, OSCOM. |
| **Recent developments** | In January 2011, IREL signed a memorandum of understanding with National Aluminium Company Limited to make value added products from beach sand and minerals. It is estimated that the project will cost Rs400 crore and is to be established in the Ganjam District in Orissa. The proposed titanium plant will reportedly produce titanium slag initially with the titanium plant following during a later phase of the project. Output from the slag and titanium plants will predominantly cater for domestic demand.<br>For the year ending 31 March 2012, net profit for the period was reported at Rs 17,044.92 lakh.<br>In September 2012 it was also reported that IREL start production of Rare Earths Chloride at Monazite Processing Plant (MoPP) that is being commissioned at OSCOM, Odisha in 2013. |

CONT / EXEC SUM / 1.0 / 2.0 / 3.0 / 4.0 / 5.0 / 6.0 / 7.0 / 8.0 / 9.0 / APP. 1 / APP. 2 / APP. 3

TZMI 105

# SAMPLE PAGES

Includes
88
pages, plus
62
company
**profiles**

34
easy-to-read charts, images and detailed tables



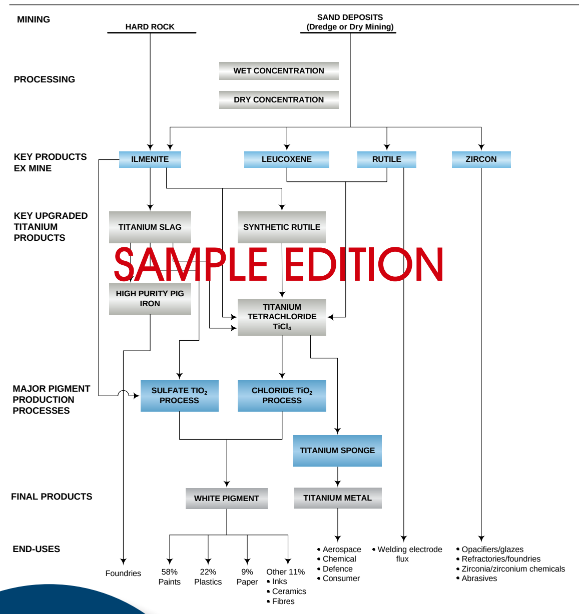
## Executive summary

### Introduction

The titanium industry involves key mineral sands commonly referred to as titanium feedstocks. These raw materials are used primarily in the production of titanium dioxide ($TiO_2$) pigment and, in smaller quantities, in the production of titanium metal and welding fluxes. The most common mineral sands products are ilmenite, rutile and, to a lesser extent, leucoxene and zircon.

The following figure shows the steps involved from mining through to major end-uses.

**Titanium feedstock flowsheet**








electronic version (PDF) with easy-to-navigate buttons



Titanium feedstocks are mainly used in the production of pigment, which accounts for more than xxx% of the world's consumption of titanium minerals. The remainder is used in the production of titanium metal and fluxes for welding rods, and as a metallurgical flux in iron and steel making. Demand for titanium feedstocks has, therefore, been historically linked with that of $TiO_2$ pigment, an industry discussed in detail in the *$TiO_2$ Pigment Annual Review 2013*.

Only a small number of large mining companies or groups are involved in the production of titanium feedstocks, and these are dominated by close relationships between producers (miners) and consumers (predominately pigment producers). In 2012, the industry experienced the impact of slowing demand throughout the value chain as well as a number of strategic moves within the industry to curtail costs and maintain security of supply.

The largest feedstock producers are based in Africa and Australia. Xxx is the biggest producer of titanium feedstock in the world. The second-biggest feedstock producer is xxx. Xxx is the world's third-largest feedstock producer as a result of xxx.

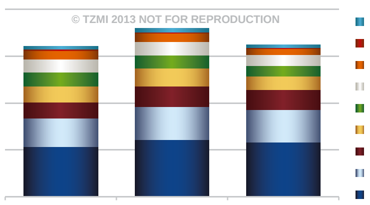
### Feedstock demand and pricing

The sector has been negatively impacted by the debt crisis surrounding the Euro Zone and the economic slowdown experienced in China. Following a year of considerable demand growth, the titanium feedstock market in 2012 was influenced by a significant de-stocking phase among pigment producers. Demand for titanium dioxide ($TiO_2$) pigment appeared to be strong at the beginning of 2012, as it rebounded slightly from the dramatic declines experienced in Q4 2011. However, as the year progressed, declining sales of $TiO_2$ pigment resulted in high inventory levels; reaching 120 day sales of inventory (DSI) for certain plants at one point in time.

In addition, the sector has been negatively impacted by the debt crisis surrounding the Euro Zone and the economic slowdown experienced in China.

During 2012, demand for titanium feedstocks declined significantly to xxx million $TiO_2$ units; down approximately xxx% year-on-year. Demand for feedstock by product type in shown in the following figure.

**Demand for feedstock by product type: 2010–2012**

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*REF 8716*





A decline in feedstock consumption was seen across all feedstock types and wide-scale production curtailment by pigment producers took place, particularly in chloride markets. Demand for chloride-grade feedstock fell substantially, down almost xxx% year-on-year, as major chloride pigment plants dramatically scaled back $TiO_2$ production, while demand for sulfate-grade feedstocks only declined by xxx% year-on-year.

Global demand for titanium feedstocks continues to be dominated by pigment manufacture, which accounted for xxx% of total consumption in 2012, while titanium metal and other uses each accounted for xxx%. Demand for pigment feedstocks is estimated at xxx million $TiO_2$ units in 2012, much lower than that for 2011, and this directly correlates with a decline in global pigment production.

Based on TZMI's forecasts, a total increase in feedstock demand of xxx $TiO_2$ units is expected during the period to 2014: more than xxx% of which is likely to be influenced by demand growth in pigment manufacture.

**Feedstock demand by market: 2010–2014**
'000 $TiO_2$ units

| | 2010 | 2011 | 2012 | 2013$^f$ | 2014$^f$ | Change in demand 2012-2014$^f$ |
|---|---|---|---|---|---|---|
| Pigment | | | | | | |
| Ti metal | DATA HAS BEEN REMOVED FOR SAMPLE EDITION | | | | | |
| Other uses | | | | | | |
| **Total feedstock demand** | | | | | | |

*f=forecast*

Following several consecutive price increases in 2011, feedstock pricing appeared strong at the beginning of 2012. However, signs of market softening in the downstream $TiO_2$ pigment sector began to emerge in late Q2 2012.

Many pigment producers cut back on production, which in turn, reduced their requirement for titanium feedstocks and prices for several feedstock types fell substantially as a consequence. Prices have also been influenced by the pricing mechanism moving away from an annual basis to quarterly, or even spot prices, for most feedstocks.

### Feedstock supply

At the start of 2012, supply for most feedstock products, in particular high-grade titanium dioxide ($TiO_2$), remained tight. However, as the year progressed, it became clear that the economic deterioration in Europe and slowdown in China, together with a looming 'fiscal cliff' in the US, had profoundly impacted global feedstock offtake. Some feedstock producers scaled back production at their mines in an effort to bring the feedstock supply/demand ratio closer to balance and reduce costs.

TZMI has estimated the global supply of titanium feedstock in 2012 at xxx million $TiO_2$ units: down xxx from 2011 levels.

The relative market share of the feedstock types for 2012 remains largely consistent with 2011. Sulfate ilmenite accounts for the largest share (xxx%) of global titanium feedstock supply in terms of $TiO_2$ units. Chloride slag comprises the second largest share of feedstock type supplied, accounting for around xxx% of global supply in 2012, and is the base load feedstock for chloride route pigment manufacture.