SOVEREIGN METALS LIMITED

20 April 2021

STUDIES CONFIRM SOVEREIGN'S NATURAL RUTILE COULD SIGNIFICANTLY REDUCE GLOBAL TITANIUM INDUSTRY CO_2 EMISSIONS

Sovereign Metals Limited ("Sovereign" or the "Company") is pleased to announce the results of Life Cycle Assessment Studies ("LCAs" or "Studies") by UK based consultancy, Minviro Ltd ("Minviro"). The Studies show substantial environmental benefits are possible by utilising natural rutile (TiO_2) versus beneficiated high-grade titanium feedstocks made from lower quality mineral ilmenite (~$FeTiO_3$) such as synthetic rutile and titania slag.

The titanium pigment industry is targeting reduced carbon footprints, reduced energy consumption, a move towards renewable energy and waste minimisation. A shift towards natural rutile feedstock offers a simple and short lead-time opportunity to significantly reduce overall carbon footprint and total environmental impact.

HIGHLIGHTS

- The Studies show that **Sovereign's natural rutile (TiO_2) could potentially eliminate significant global titanium industry CO_2 emissions** by displacing and substantially reducing the use of carbon-intensive upgraded alternatives.

- Up to **2.8 tonnes CO_2 eq.** for each tonne of natural rutile utilised could be saved compared to the upgrading/beneficiation of ilmenite, via smelting and chemical processes, to high-grade titanium feedstocks like titania slag and synthetic rutile (Figure 1).

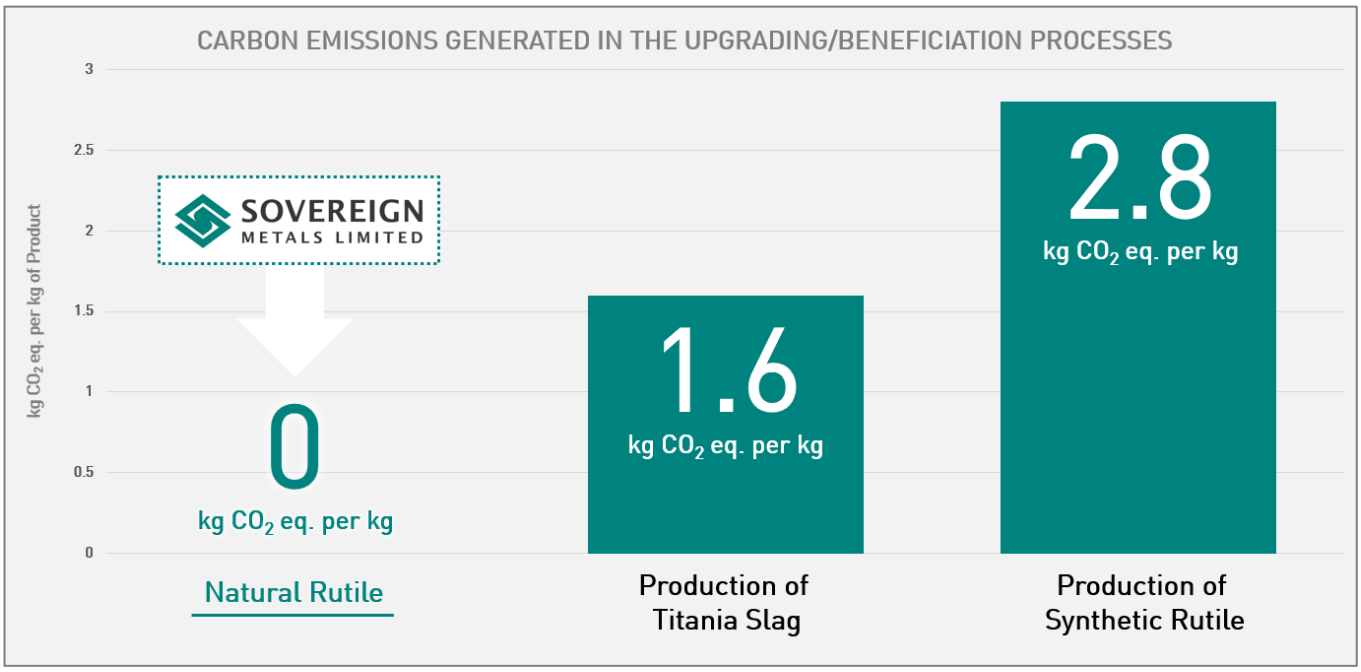

Figure 1: Summary of the LCA outcomes with overall Global Warming Potential of upgrading ilmenite to titania slag and synthetic rutile *(Source: Minviro)*

- The global high-grade titanium feedstocks market is approximately 2.5mtpa, with **natural rutile making up only 26%** of the market, due to its current scarcity compared to lower quality ilmenite.

- Sovereign's discovery of the **very large Kasiya and Nsaru deposits** represents a potentially **major new source of global supply of high-grade primary natural rutile** and an opportunity to remove significant CO_2 emissions created by upgraded alternatives.

- Sovereign has established an Environmental, Social and Governance ("ESG") Advisory Committee to ensure and integrate sustainability best practices and support the Board in unlocking a major new source of natural rutile.

Sovereign's new ESG Advisory Committee Chair Ben Stoikovich commented: *"The Minviro Studies confirm the positive CO_2 impact of unlocking a new, globally significant source of direct feed natural rutile. We now have validation of the potential importance of Sovereign's natural rutile to responsible investors and titanium industry companies needing to lower their carbon footprint. Our natural rutile deposits could help meet the growing demand for low carbon titanium feedstock throughout the titanium industry supply-chain."*

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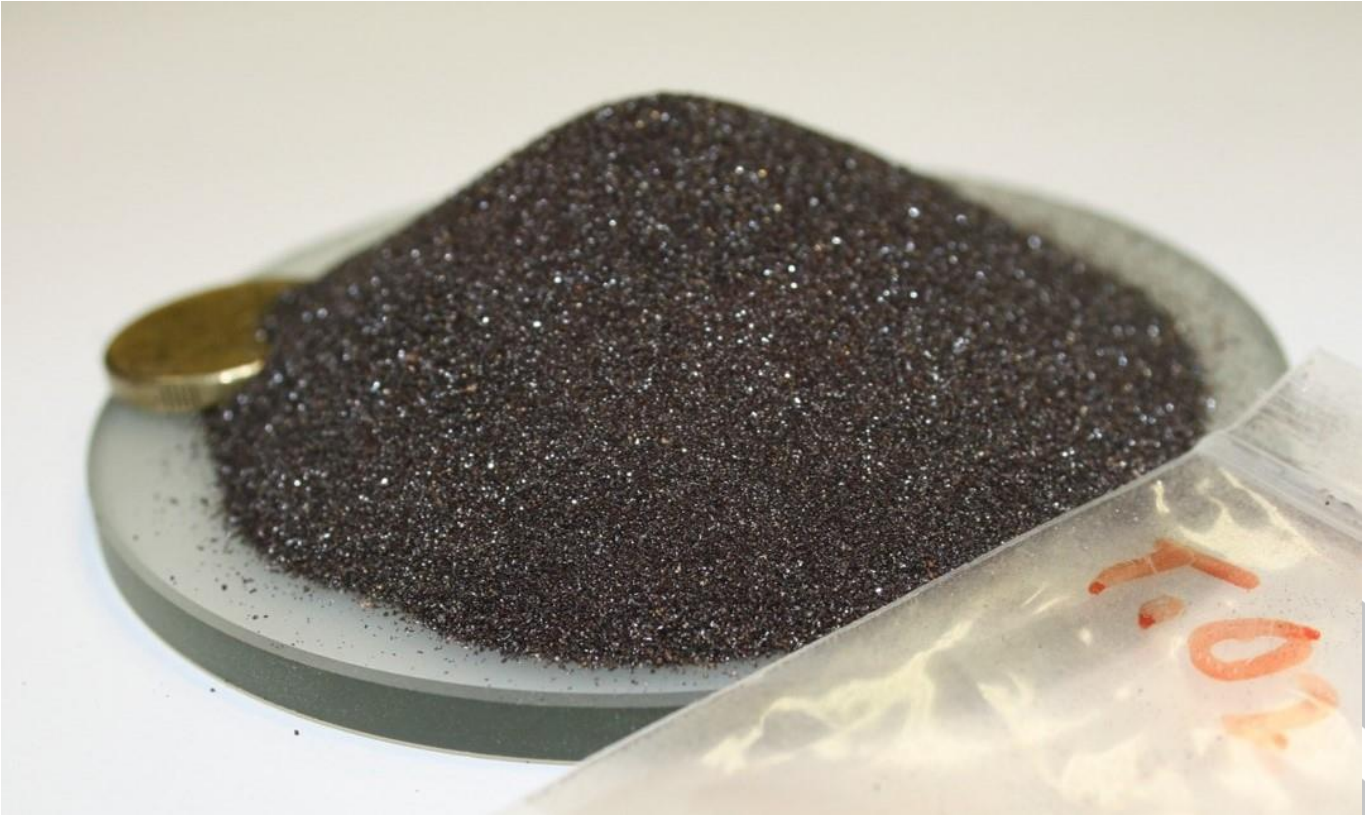

Figure 2. Sovereign's natural rutile product

BACKGROUND - TITANIUM FEEDSTOCKS

Natural rutile (~95% TiO_2) is the cleanest, purest natural mineral form of titanium dioxide with the other major source being ilmenite (~50% TiO_2). The genuine scarcity of natural rutile prompted the titanium industry to develop upgraded titanium feedstock products from ilmenite that can be used as substitutes for natural rutile (i.e. synthetic rutile and titania slag).

Two energy and carbon intensive processes have been developed to produce the upgraded synthetic rutile and titania slag. Both methods use ilmenite (~$FeTiO_3$) as the raw source material and are essentially processes for the removal of iron oxide. From a technical perspective, natural rutile is generally considered a superior titanium feedstock over synthetic rutile and titania slag due to its high purity and high TiO_2 content.

The downstream processes (i.e. pigment production) rely heavily on the use of upgraded titanium feedstocks such as synthetic rutile and titania slag, each having an associated substantial environmental impact.

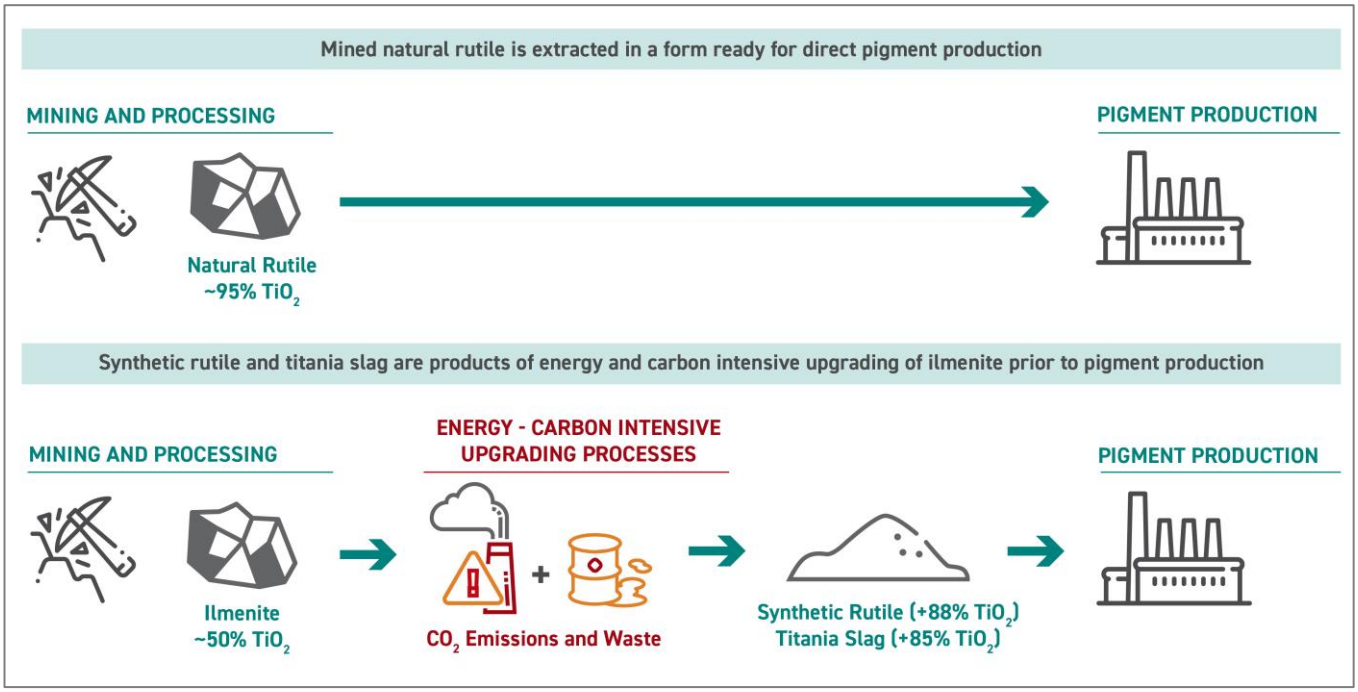

Figure 3. Natural rutile versus synthetic rutile and titania slag

SUMMARY OF MINVIRO'S STUDIES OF LCA FOR UPGRADED TITANIUM FEEDSTOCKS

Naturally occurring rutile (~95 TiO_2), as found at the Company's flagship Kasiya deposit and recently discovered Nsaru deposit, is the lowest carbon and lowest waste-producing natural form of titanium dioxide – the other major titanium source mineral being ilmenite (~50 TiO_2).

For downstream manufacturers of titanium products (including titanium pigment producers) focused on lowering their carbon footprint, natural rutile presents a preferred feedstock over higher energy and carbon-intensive upgraded titanium feedstocks synthetic rutile and titania slag.

In line with its Environmental, Social and Governance (**ESG**) Strategy, Sovereign appointed UK-based consultancy, Minviro Ltd. to carry out gate-to-gate Life Cycle Assessments (**LCAs**) for the production of upgraded titanium feedstocks, namely:

- **Synthetic rutile** (+88% TiO_2) – produced from ilmenite via the Becher Process in Australia; and
- **Titania slag** (+85% TiO_2) – produced from ilmenite via smelting in electric furnaces in South Africa.

The purpose of the LCAs is to quantify the Global Warming Potential (**GWP**) for the production of one kilogram of each upgraded feedstock. The Studies were conducted by Minviro according to the requirements of the ISO-104040:2006 and ISO-14044:2006 standards.

NATURAL RUTILE COULD DISPLACE CARBON INTENSIVE FEEDSTOCKS

Direct use natural rutile currently makes up just ~26% of the total high-grade titanium pigment feedstock market, with ~74% of the market made up of upgraded alternatives (Figure 4).

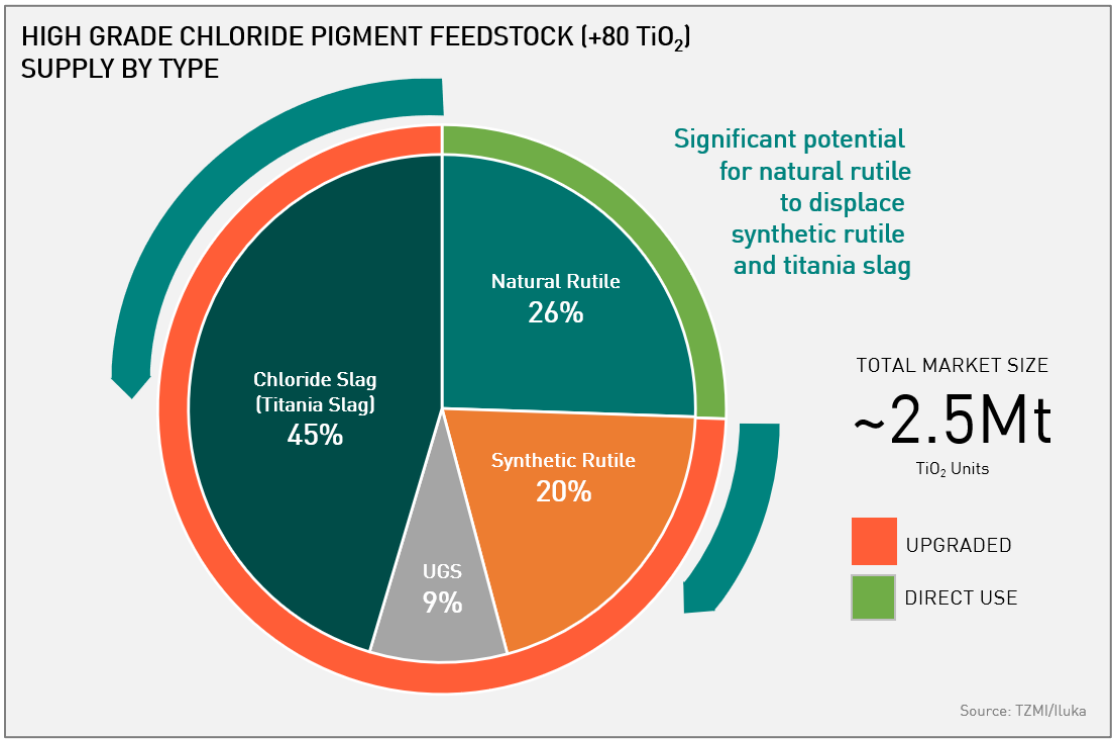

Figure 4. High-grade titanium feedstocks (+80% TiO_2) by supply type *(Source: TZMI/Iluka, based on 2018 data)*

The majority of high-grade titanium pigment feedstock is produced by five major producers that control about 84% of the total market.

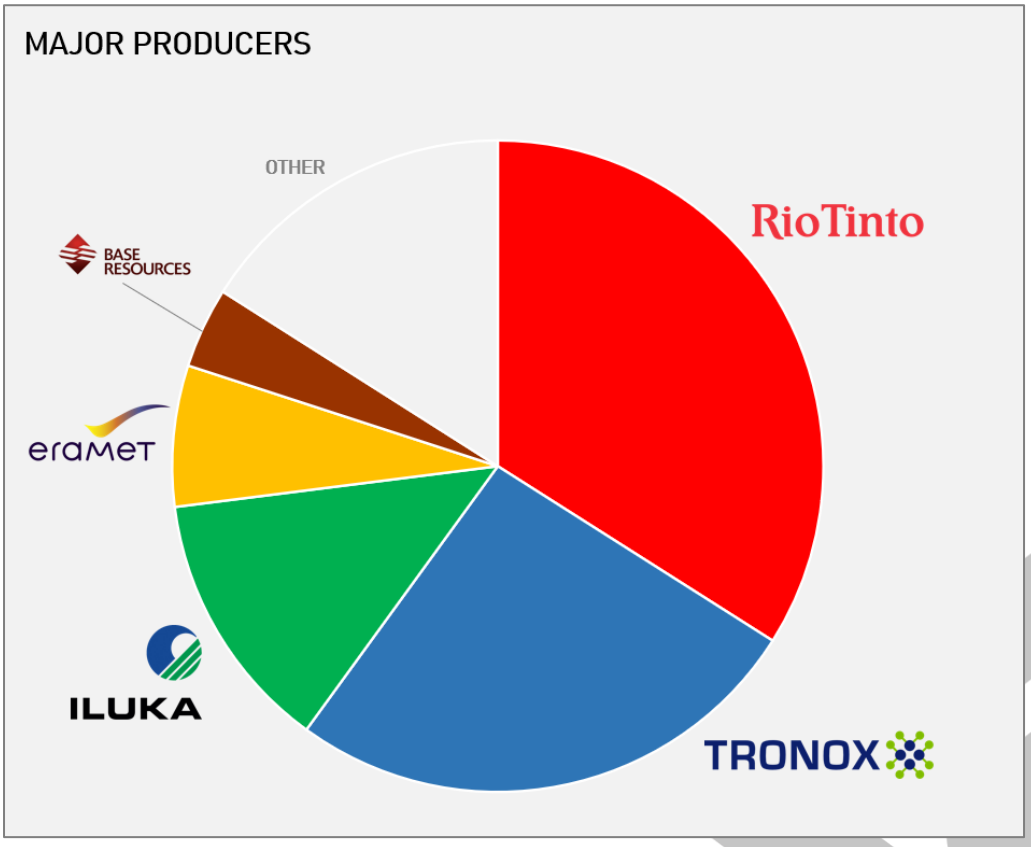

Figure 5. Major producers of high-grade titanium feedstock (+80% TiO_2) & percentage of sales as upgraded and direct use (i.e. natural rutile) *(Source: TZMI/Iluka, based on 2018 data)*

Due to growing environmental pressures, and with the significant carbon footprints of numerous industry players related to pyrometallurgical ilmenite upgrading operations, Sovereign's natural rutile product is well positioned to impact the titanium supply chain with the ability to displace and reduce the use of carbon and waste-intensive upgraded alternative titanium feedstocks.

SOVEREIGN METALS – A WORLD CLASS DISCOVERY OF A GENUINELY SCARCE COMMODITY

In September 2020, Sovereign announced stand-out metallurgical test-work results from bulk sample (1,000kg) taken from its very large, high grade rutile deposit Kasiya. Using a simple, conventional process flow sheet similar to that used to produce ilmenite feedstock, Sovereign's bulk sample material was able to produce a premium quality 96.3% TiO_2 natural rutile product with low impurities and a 98% recovery. Sovereign has since established that the Kasiya and recently discovered Nsaru deposits represent significant potential to become a major new source of global supply of high-grade primary natural rutile.

Natural rutile is traditionally a by-product from mineral sands mining where ilmenite is the dominant mineral in the assemblage, alongside lesser natural rutile and zircon. Rutile is therefore considered to be a genuinely scarce commodity, with no other known primary rutile deposits being discovered in the last half century. Since typically natural rutile is produced as a by-product, mining companies cannot selectively mine additional natural rutile in response to market demand, and hence have developed energy intensive downstream processes to upgrade ilmenite into substitute products for natural rutile.

Current sources of natural rutile are in decline as several operations' reserves are depleting concurrently with declining ore grades, for example Iluka Resources Limited's Lanti and Gangema operations in Sierra Leone and Base Resources Limited's Kwale operations in Kenya. Further to this, limited new deposits are forecast to come online in the short to medium term, and supplies of natural rutile are likely remain in structural deficit.

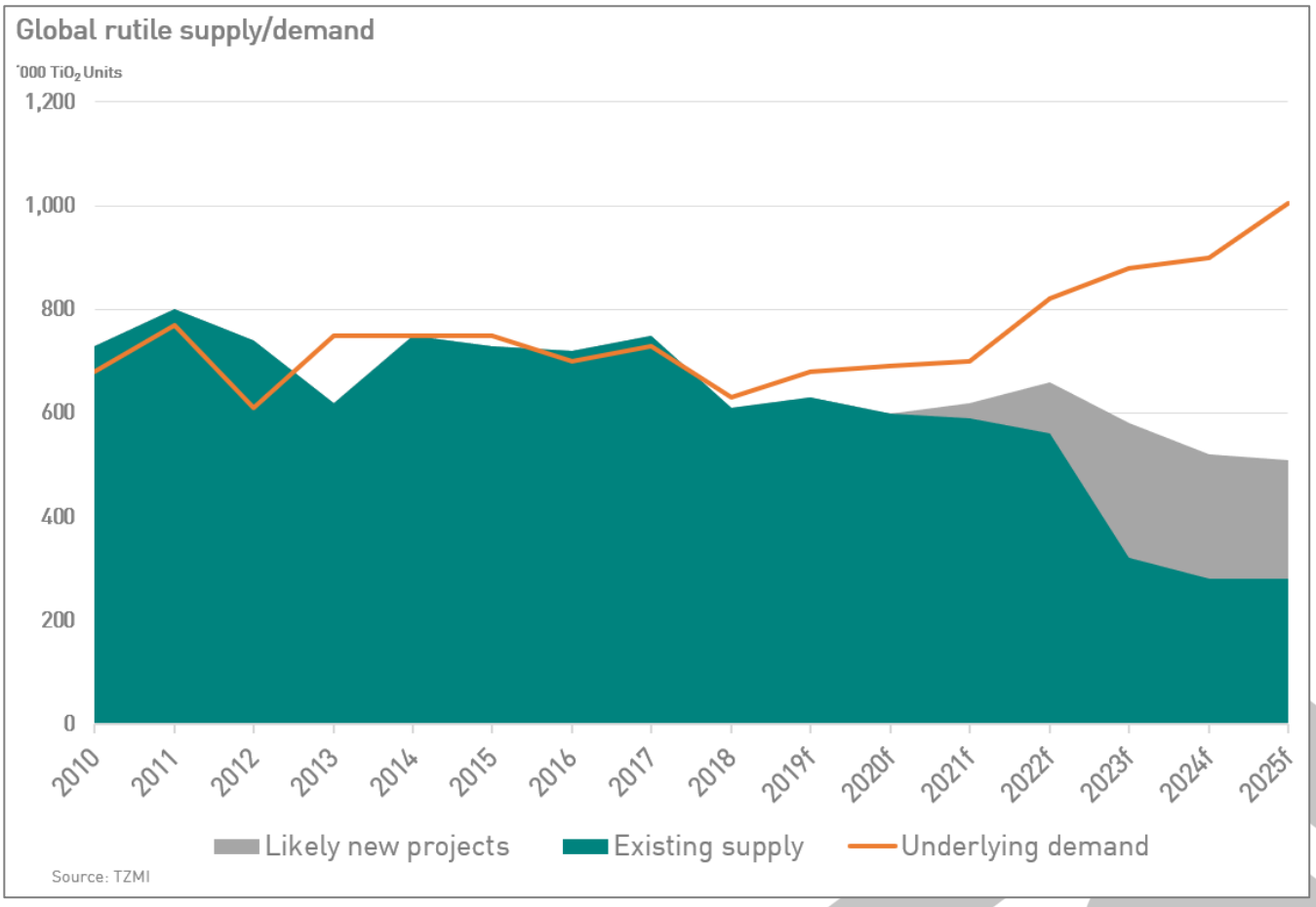

Figure 6. Global supply and demand for natural rutile (actual and forecasted) *(Source: TZMI)*

NATURAL RUTILE COULD HELP LOWER CO_2 EMISSIONS TO MEET GLOBAL CLIMATE TARGETS

Natural rutile requires no upgrading for direct use as titanium pigment feedstock, eliminating the upgrading step required for ilmenite, resulting in zero additional CO_2 emissions. The discovery of Sovereign's high-grade rutile province in Malawi is well-positioned not only to fill the supply gap but also displace the CO_2 and waste-intensive upgraded alternatives.

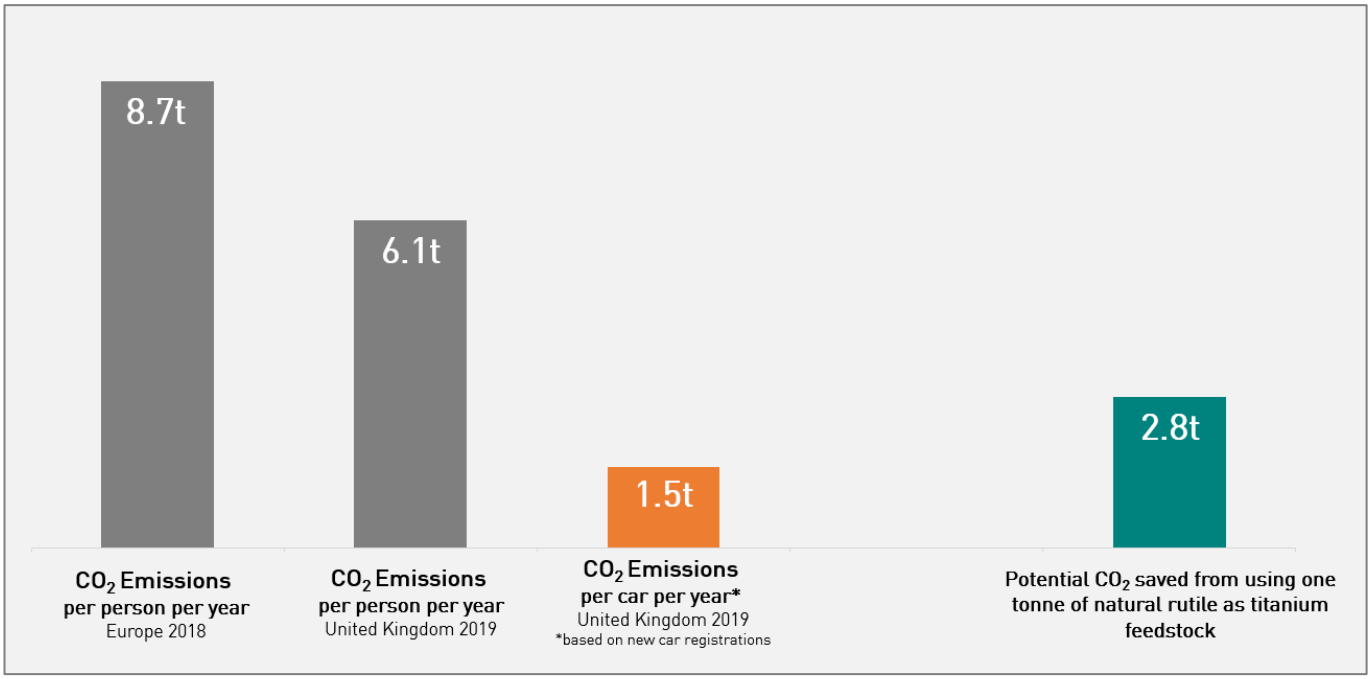

Figure 7. Indicative CO_2 emission data
(Source: European Commission (Eurostat), UK Committee for Climate Change, UK Department of Transport, UK SMMT)

SOVEREIGN METALS ESTABLISHES ESG ADVISORY COMMITTEE

As part of Sovereign's ESG Strategy, the Company has established an Environmental, Social and Governance Advisory Committee ("ESG Committee") whose purpose is to support the Company's ongoing commitment to environmental, health and safety, corporate social responsibility, corporate governance, sustainability and other public policy matters relevant to the Company.

The ESG Advisory Committee's overriding objective is to ensure and integrate sustainability best practices and support the Board in unlocking a major new source of natural rutile.

In order to navigate the transition to a low-carbon global economy, the ESG Advisory Committee plans to ensure Sovereign strives to:

- promote achievement of the UN Sustainable Development Goals through its business;
- recognise how the Company may responsibly continue its activities within the framework of the EU Taxonomy;
- continue to explore the Company's strategic considerations in light of the UK Government's Ten Point Plan for a Green Industrial Revolution; and
- operate under the Principles of the International Council on Mining and Metals.

The ESG Advisory Committee will be chaired by recent Board appointee Benjamin Stoikovich, a UK Chartered Environmentalist and Environmental Engineer. Further details of the ESG Advisory Committee will be announced shortly.

DETAILS OF MINVIRO'S STUDIES FOR UPGRADED TITANIUM FEEDSTOCKS

Synthetic Rutile

Synthetic rutile is produced by upgrading ilmenite in a rotary kiln via the Becher Process. The LCA for synthetic rutile considered all energy and material inputs and associated emissions for the processes involved from ilmenite feedstock entering the upgrading process to the end-gate of the synthetic rutile processing facility.

Becher Process

Ilmenite feedstock undergoes complete reduction of iron oxide using a coal-fired rotary kiln. Two energy sources were assumed for the heat requirements - light fuel oil and hard coal, with coal also being required as the reductant. The char product produced from the rotary kiln is removed from the reduced ilmenite through screening and magnetic separation.

The reduced ilmenite concentrate is then leached with ammonium chloride to precipitate iron oxides and synthetic rutile. The iron oxides are subsequently separated by cyclones.

Synthetic rutile undergoes additional leaching using sulphuric acid to further purify the product. The final synthetic rutile product contains 88% - 95% TiO_2.

The Becher Process is most commonly used in Australia, therefore the electricity requirements for the LCA were modelled for the Australian grid.

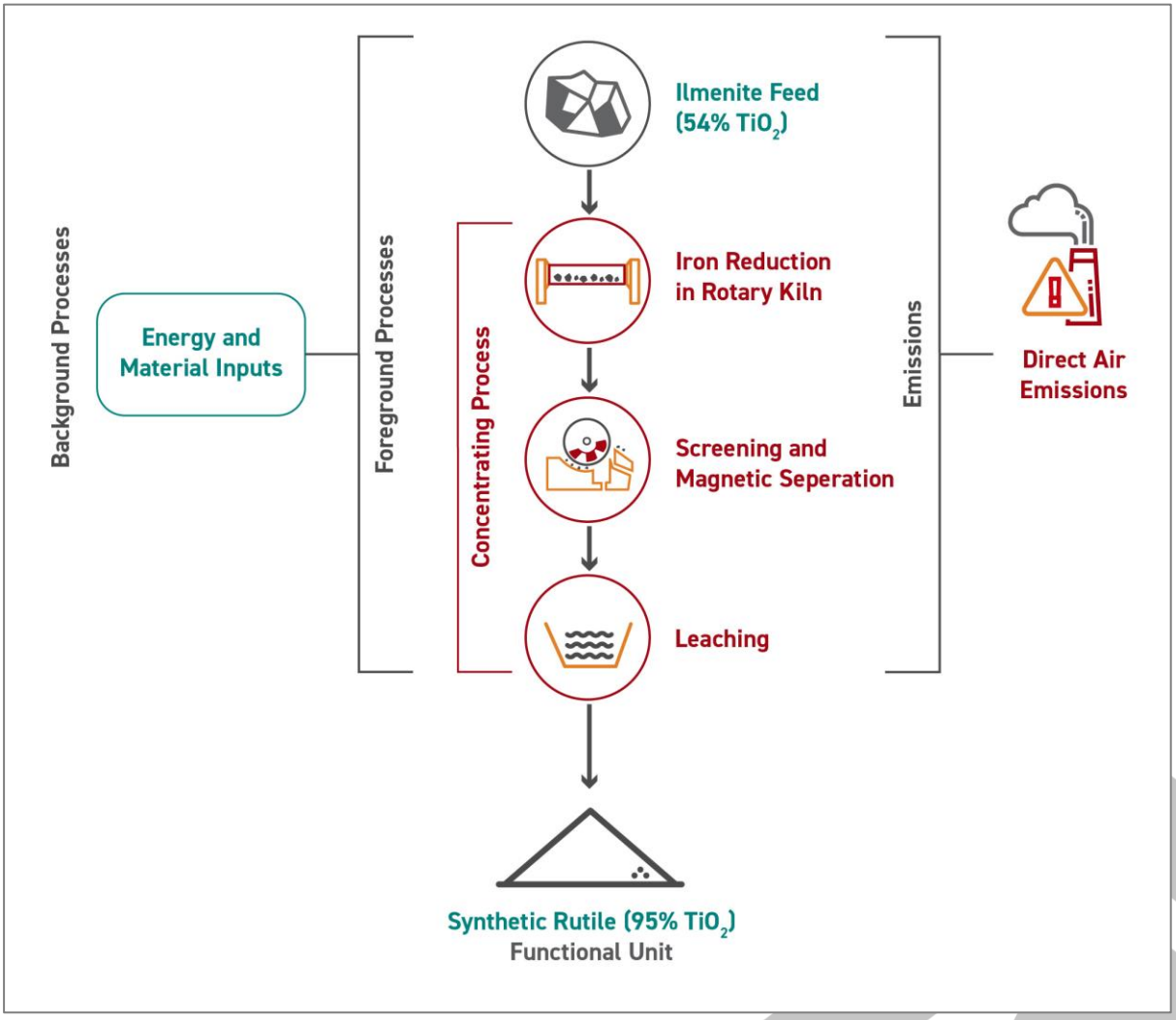

Figure 8. System boundary applied to the LCA for production of synthetic rutile (95% TiO_2) from ilmenite (54% TiO_2) via the Becher Process *(Source: Minviro)*

Synthetic Rutile – Global Warming Potential

The total GWP to produce a kg of synthetic rutile from ilmenite feedstock through the Becher process is estimated to be 2.8kg CO_2 eq. per kg synthetic rutile. The largest contributor to this is the use of coal as both a heat source and a reductant in the rotary kiln, which contributes 2.3kg CO_2 eq. per kg synthetic rutile.

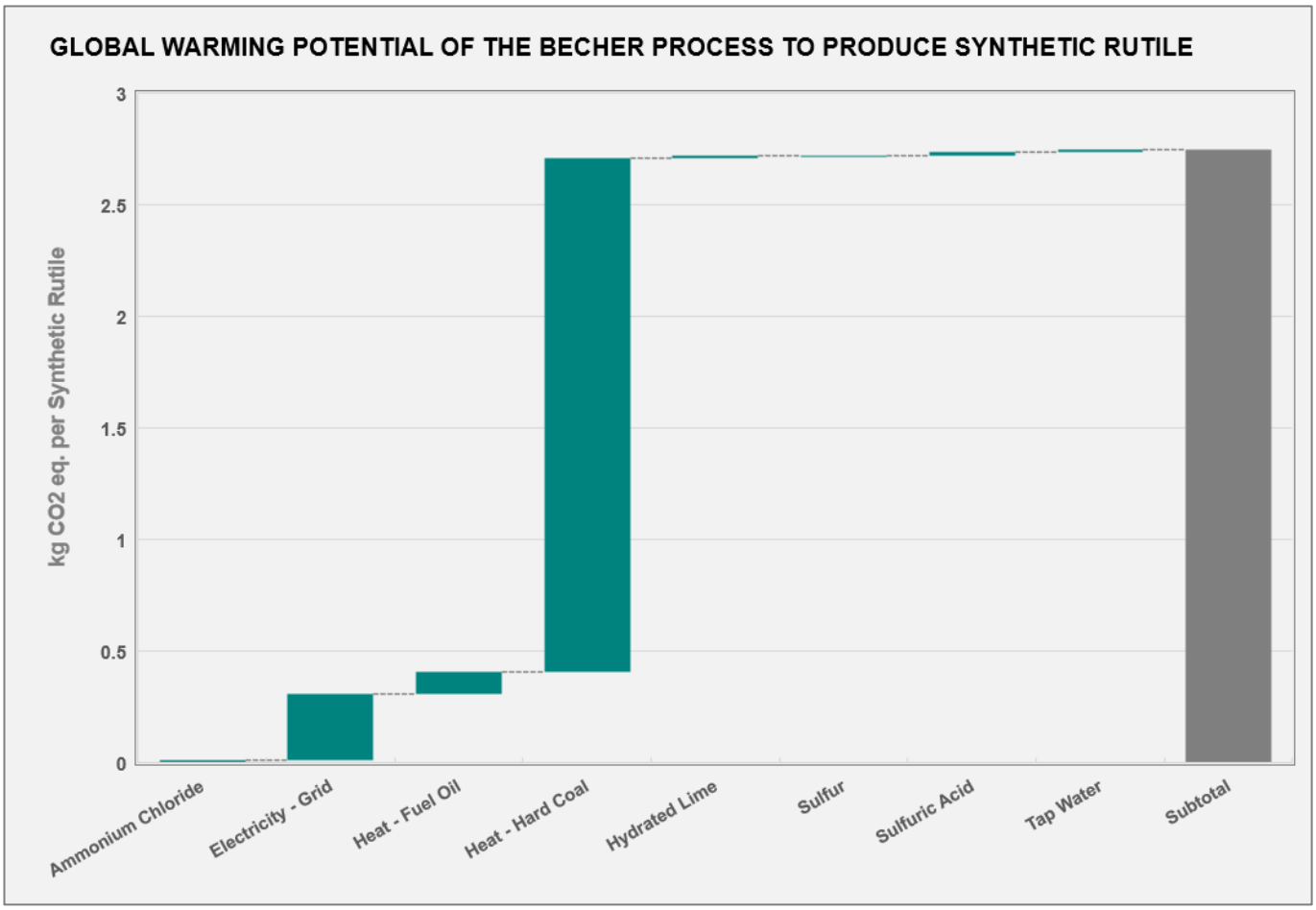

Figure 9. Contribution analysis for the production of synthetic rutile to the overall Global Warming Potential *(Source: Minviro)*

Titania Slag

Titania slag is produced by upgrading ilmenite through a pyrometallurgical process involving smelting. It is a high-grade titanium dioxide feedstock with typical TiO_2 content of 85% TiO_2.

The LCA for titania slag considered all energy and material inputs and associated emissions for the processes involved from ilmenite feedstock entering the pyrometallurgical process to the end-gate of the titania slag processing facility.

Titania Slag Production

Ilmenite feedstock initially undergoes an oxidizing roast followed by magnetic separation where chromium oxide is removed from the ilmenite. The ilmenite is then partially reduced to 85% TiO_2 slag in electric arc furnaces. High quality pig iron is also produced as a by-product in this stage.

Electrical power requirements have been modelled for the South African grid which is highly coal dependent.

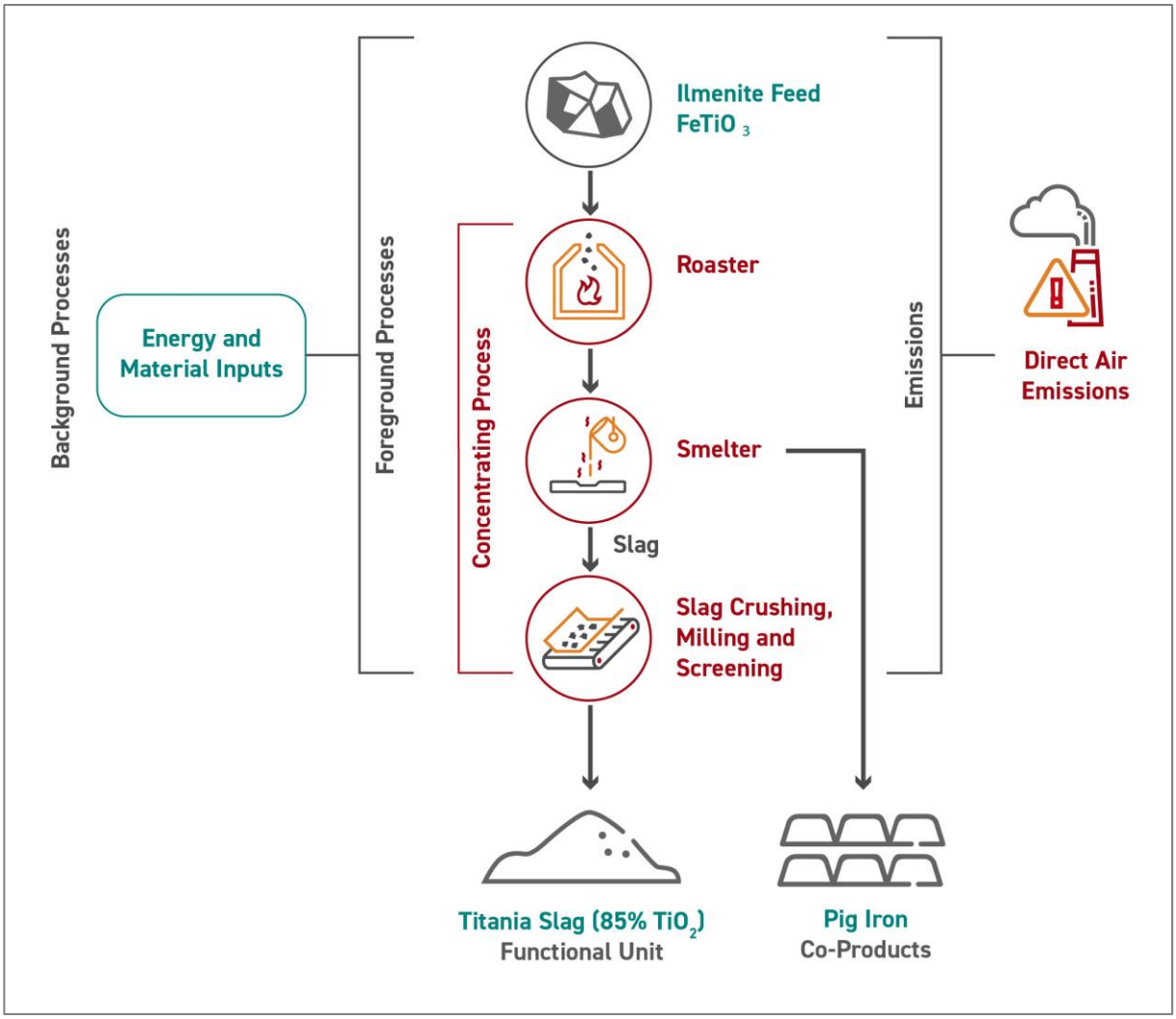

Figure 10. System boundary applied to the LCA for the production of titania slag (85% TiO_2) from ilmenite *(Source: Minviro)*

Titania Slag – Global Warming Potential

The total GWP to produce a kg of titania slag from ilmenite feedstock is estimated to be 1.6kg CO_2 eq. per kg titania slag. The largest contributor to this is the electricity required for the smelter, which contributes 1.3kg CO_2 eq. per kg titania slag. Direct CO_2 emissions from the coal reductant contribute a further 0.3kg CO_2 eq. per kg titania slag.

Additionally, the total GWP to produce a kg of titania slag plus its by-product of 0.5kg of pig iron is 2.4kg CO_2 eq. per kg titania slag.

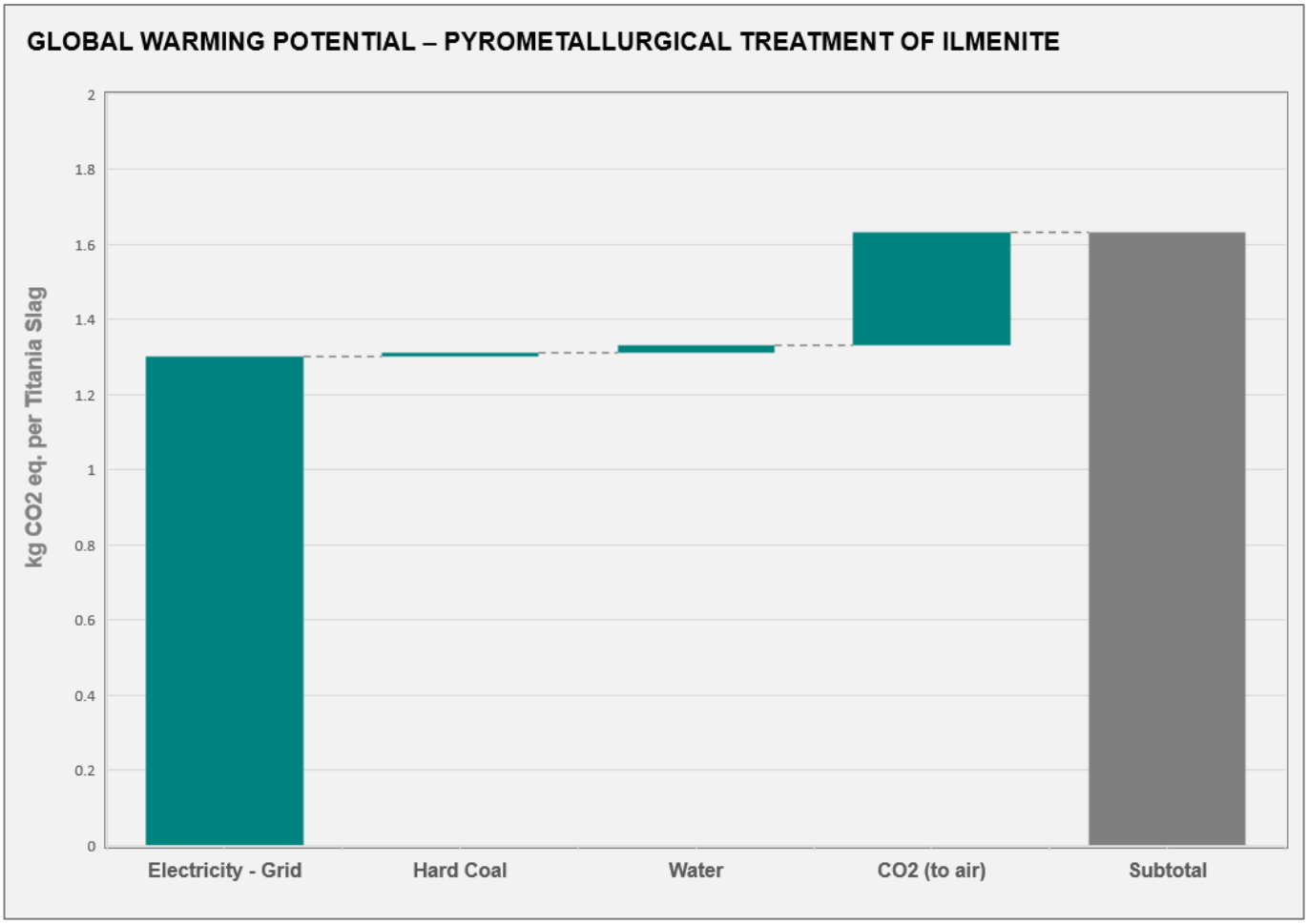

Figure 11. Contribution analysis for the production of titania slag to the overall Global Warming Potential *(Source: Minviro)*

Competent Person Statements

The information in this report that relates to Metallurgical Results (rutile) is extracted from an announcement on 9 September 2020. This announcement is available to view on www.sovereignmetals.com.au. The information in the original announcement that related to Metallurgical Results was based on, and fairly represents, information compiled by Mr Gavin Diener, a Competent Person who is a member of the AusIMM. Mr Diener is the Chief Operating Officer of TZMI, an independent mineral sands consulting company and is not a holder of any equity type in Sovereign Metals Limited. Mr Diener has sufficient experience that is relevant to the style of mineralisation and type of deposit under consideration and to the activity being undertaken, to qualify as a Competent Person as defined in the 2012 Edition of the 'Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves'. The Company confirms that it is not aware of any new information or data that materially affects the information included in the original market announcements. The Company confirms that the form and context in which the Competent Person's findings are presented have not been materially modified from the original market announcement.

Forward Looking Statement

This release may include forward-looking statements, which may be identified by words such as "expects", "anticipates", "believes", "projects", "plans", and similar expressions. These forward-looking statements are based on Sovereign's expectations and beliefs concerning future events. Forward looking statements are necessarily subject to risks, uncertainties and other factors, many of which are outside the control of Sovereign, which could cause actual results to differ materially from such statements. There can be no assurance that forward-looking statements will prove to be correct. Sovereign makes no undertaking to subsequently update or revise the forward-looking statements made in this release, to reflect the circumstances or events after the date of that release.