



Waste to Wealth

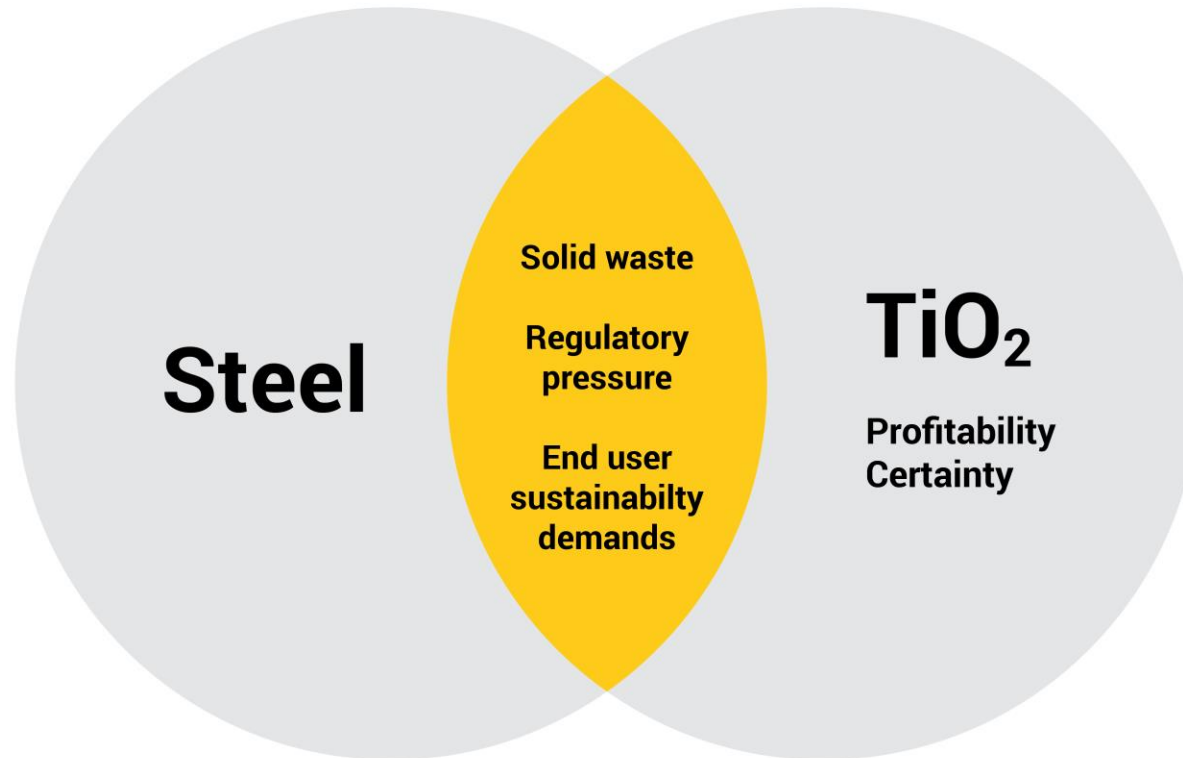
LCANZ Conference | 27 NOV 2019



Avertana's technology
converts industrial waste



Avertana's technology addresses shared pain points

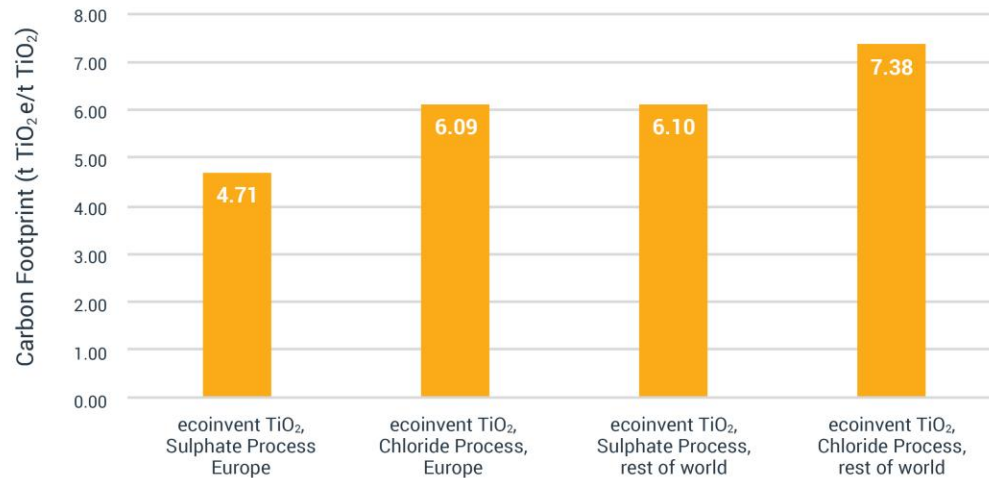


Environmental impact

Red Gypsum Utilisation in China



Source: CNCIC, August 2019



Source: ERM Report June 2016 (CO₂e data supplied by ecoinvent.org)

- 6-10 tonnes of red gypsum produced per tonne of TiO₂ in Sulfate plants in China
- 80% = landfill
- Limit for future sulfate expansion
- Chloride process requires carbon for two process steps
- Challenge for CO₂ reduction

Increasing TiO₂ demand

- Positively correlated to GDP
- Emerging middle class
- No substitute



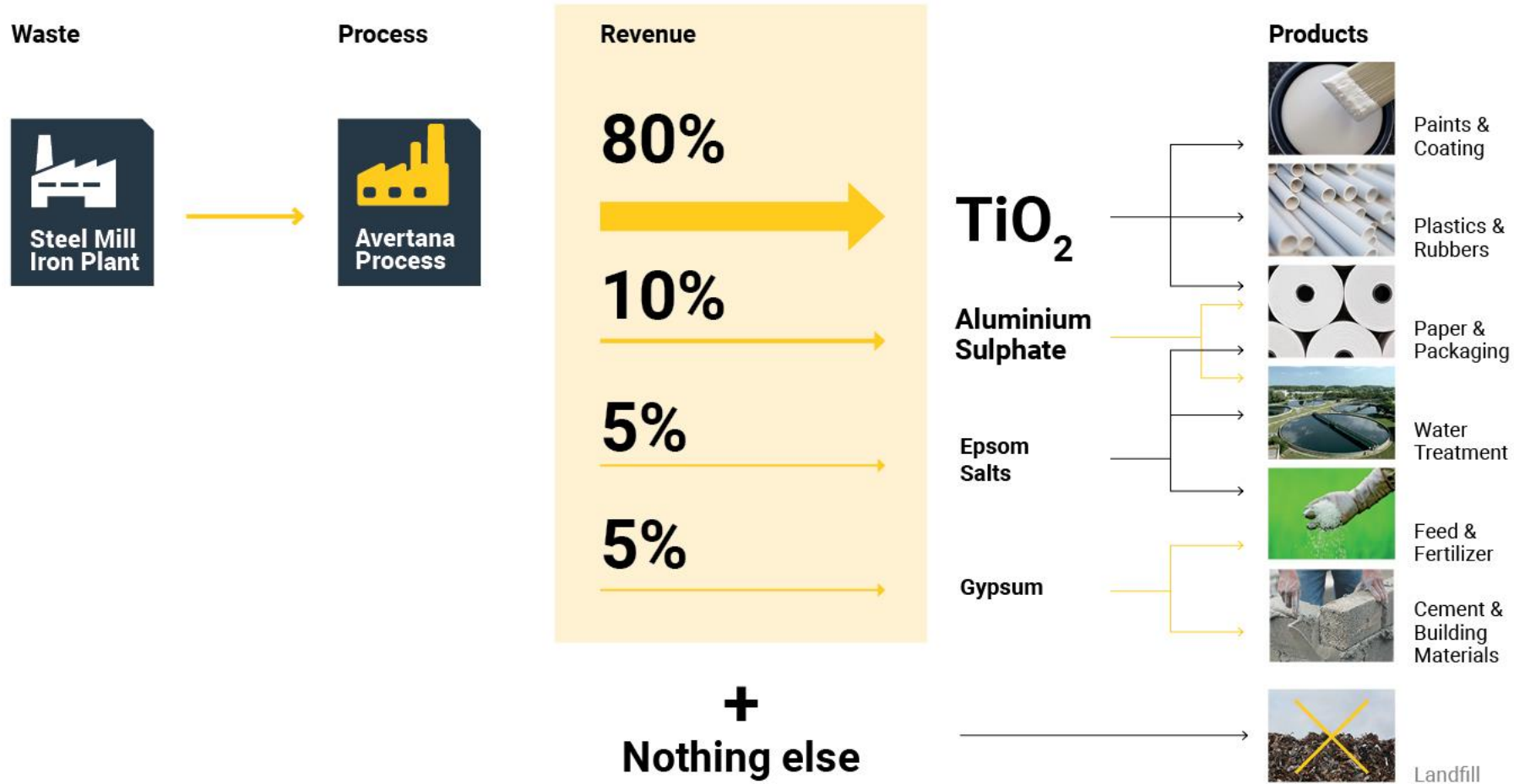
Avertana solution

- › Simple solution – technology that deconstructs slag
- › All components converted into marketable products
- › Nothing left – zero solid waste
- › Superior economics to current TiO₂ industry
- › First Quartile cost advantage

Our process is
a **world-first.**



Multi-product, Multi-market



Global Resources

100's of millions of tonnes of unconventional titanium opportunities globally



Avertana's Demonstration Plant: Operating



Pre-commercial plant testing scale-up of novel process steps using off-the-shelf equipment

Why is this valuable?



- › Highly profitable, global scale opportunity



- › Can retrofit and turn around distressed TiO_2 plants



- › Governments shutting down polluting industry



- › End users seek secure, sustainable supply

Introducing Our Team





Team of 33

Non-executive roles include

- › 4 PhD's
- › Process Scale Up Engineers
- › TiO₂ Crystal Morphologist
- › Analytical Chemists
- › Operations Managers
- › Process Engineers
- › Finance
- › Project Planning and Execution
- › In-house Patent Attorney



Awards & recognition

2015	2016	2017		2018	2019
 <p>Entrepreneurs' Challenge 2015 Winner</p> <p>University of Auckland led awards for innovative, high-growth businesses</p> <p>High profile, largest prize of any NZ business award</p> <p>Avertana a 2015 winner, received NZ \$0.25m equity investment</p>	<p>NEW ZEALAND INNOVATION AWARDS * 2016</p> <p>HIGHLY COMMENDED INNOVATION EXCELLENCE IN RESEARCH</p> <p>NZ Innovation Awards 2016 Highly Commended</p> <hr/>  <p>IChemE Global Awards, 2016 Finalist</p>	<p>Sanitarium 2017 NEW ZEALAND INNOVATOR OF THE YEAR SEMI FINALIST #1 NEW ZEALANDER OF THE YEAR AWARDS</p> <p>NZ Innovator of the Year 2017 Semifinalist</p> <hr/>  <p>IChemE Global Awards, 2017 Finalist</p>	<p>Deloitte FAST50 In partnership with bnz</p> <p>Rising Star One to watch Auckland and upper North Island</p> <p>Deloitte Fast 50, 2017 Rising Star</p> <hr/>  <p>ICIS Innovation Awards, 2017 Shortlisted</p>	 <p>One of the 25 companies on the 2018 APAC 25 list recognising sustainable innovation in the Asia Pacific region</p>	 <p>IChemE Global Awards 2019 Winner of Sustainability category</p> <hr/>  <p>ANZOLF Trans-Tasman Innovation & Growth Awards FINALIST 2019</p> <p>ANZLF Trans-Tasman Innovation & Growth Awards Finalist</p>

Process Design Basis

Avertana process development deliberately constrained within five parameters:

1. Zero solid waste - co-products must be saleable (meet specifications)
2. Significant reduction in CO₂ emissions per tonne TiO₂ over incumbent options
3. Attractive manufacturing cost (CCOP) for TiO₂
4. Equivalent CAPEX on a like-for-like basis
5. Process at scale consentable under NZ RMA 1991 = international scalability

Why do LCA?

Internal Drivers

- Environmental performance fundamental to Avertana's value proposition and mission
- Very important to shareholders, stakeholders
- Understanding how we stack we are relative to incumbent technologies
- Guides further process development, improvement

External Drivers

- Product end-users (all markets) under increasing pressure to be more sustainable
- 3rd party validation of environmental essentials
- Solid waste, water demand now showstopper permitting or closure risks for industry
- CO₂ firmly on corporate risk registers
- Tipping point in mining-metals-minerals space

LCA Approach

- Prepared by ThinkStep, based on ISO 14001 methodology
 - Covers CO₂e, waste, water
 - Not yet peer reviewed - next step

- Inputs
 - Avertana process mass/energy balance (based on design, lab/pilot/demo data)
 - GaBi datasets
 - Benchmarking and literature assumptions where required, as not yet at scale

Preliminary LCA Findings

	Avertana Process (NZ Case)	Avertana Process (China Case)
Indicative CO₂ Emissions <i>Tonnes CO₂ per tonne TiO₂</i>	1.8	2.0
CO₂ Emissions Reduction <i>Basket of products vs. conventional</i>	32%	26%

- › Industry average emissions (TDMA) 4.9 - 5.7 tonnes CO₂ per tonne TiO₂
- › Process/regional emissions (EcoInvent) 4.7 - 7.4 tonnes CO₂ per tonne TiO₂
- › TDMA uses bespoke methodology (not publicly available), EcoInvent figures dated, so comparability an issue



Sean Molloy
CEO & CO-FOUNDER

M +64 27 700 8124

P +64 9 281 4330

E sean@avertana.com

www.avertana.com