FERRONICKEL SLAG

HOW THE MINING AND METALLURGICAL INDUSTRY CAN CONTRIBUTE TO THE CIRCULAR ECONOMY MODEL

Le SLAND
Le Nickel - SLN

Presentation to the **ADB**
2019.06.27
Thibault de Saint-Vaulry

ERAMET AT A GLANCE

French mining and metallurgical group operating in 3 divisions and listed on Euronext Paris.

ERAMET Nickel:

- ≠1 ferronickel producer worldwide
- ≠3 high grade nickel producer worldwide

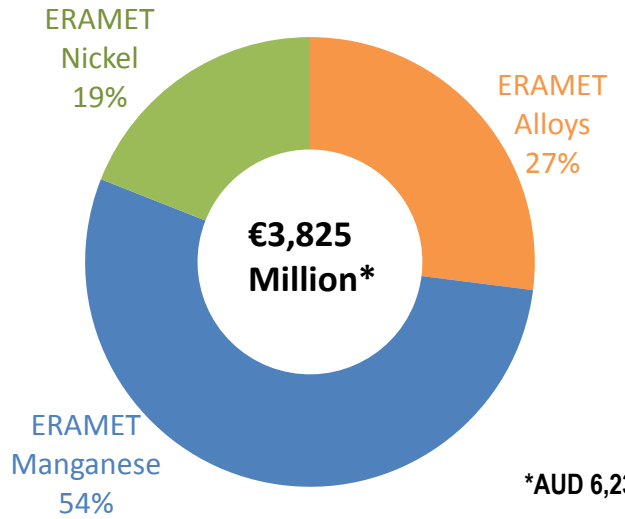
ERAMET Manganese:

- ≠2 of high-grade manganese ore worldwide
- ≠1 refined manganese alloys producer worldwide

ERAMET Alloys:

- ≠2 closed-die forging parts producer
- ≠1 gas-atomized powders producer

Sales breakdown per division (2018)



*AUD 6,232 Million

13 000 people in 20 countries

SLN AT A GLANCE

- **137 years** of nickel industry in New Caledonia
- **Largest historical ferronickel plant** worldwide with a production capacity of 60KT Ni/year
- **Integrated producer** with 5 mines currently in operation

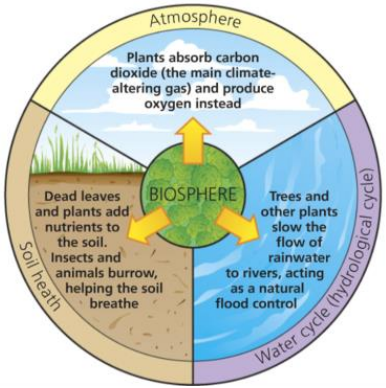
ISO 9001 & ISO 14 001 compliant

What can we see on this picture?

Decades of historical by-product from the Nickel smelting industry being stockpiled…

TYPICAL SIGN OF LINEAR ECONOMY MODEL…

A linear model we created to support expansion of Capitalism so different from the natural equilibrium existing since billions of years



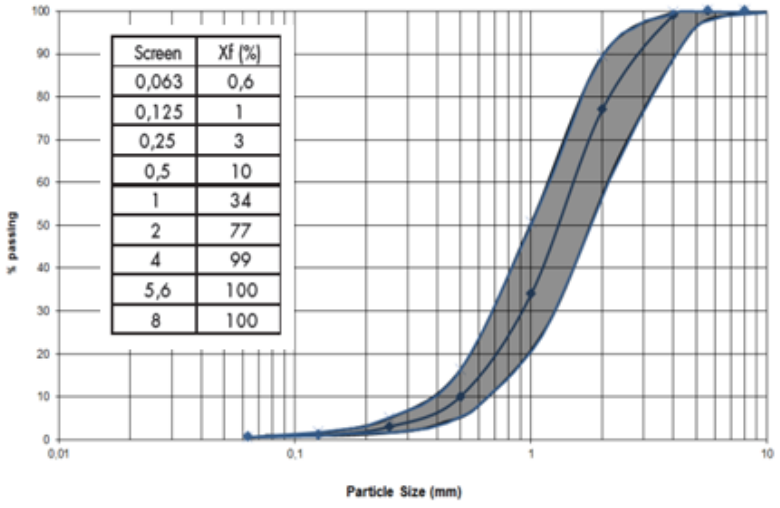
But Natural resources are in fact limited!
Industry and human activities do impact the environment!
Management of waste affects the quality of life!

IDENTITY CARD OF AN INDUSTRIAL SAND

Typical chemical composition

$SiO2$	MgO	Fe_2O_3	Al_2O_3	MnO	CaO
53%	33%	11%	2%	<1%	<1%

Grain size distribution



- Specific gravity: 2.95t/m^3
- Bulk density: 1.4t/m^3
- Water absorption: 0.68%
- No organics, no clay, no sugar
- Homogeneous and continuous production

SAND SUPPLY, A GROWING ISSUE GLOBALLY

Sand is the 3rd most used resource and the world is running out of it!

Yearly consumption worldwide: 70billion tons

The world is running out of sand — and you'd be surprised how significant that is

Financial Post – September 2017

World is running out of SAND and it's creating deadly SAND MAFIA - 'Completely depleted!'

Express.co– April 2019

The Economist explains

Why there is a shortage of sand

The Economist – April 2017

The world is running out of sand

Business Insider UK – September 2017

This issue induces, environmental damages smuggling and political tensions and… cost rise!

Sand mafias and vanishing islands: How the world is dealing with the global sand shortage

The Independent – December 2017

Indonesia, Vietnam ban sand sale to Singapore

The Malaysian Insight – October 2017

Cambodia bans sand exports after environmental group pressure

Reuters – July 2017

Urbanisation-led sand shortages fuelling violent conflict and environmental disasters

The Fifth Estate – September 2017

ISN'T IT TIME FOR NEW ECONOMICAL MODELS

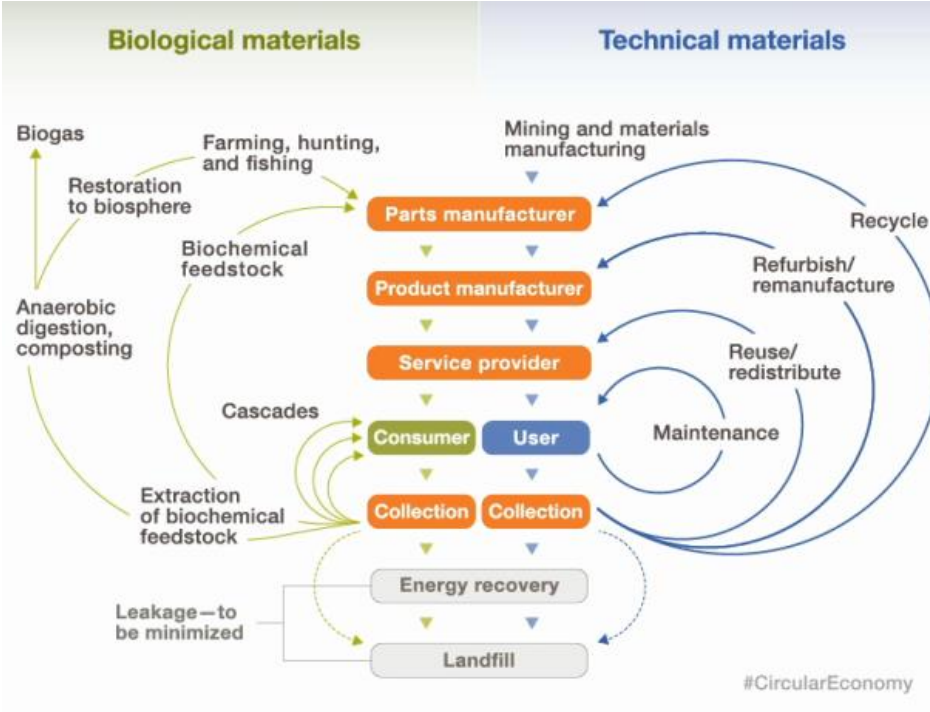
3 R driven:

Reduce – **R**euse - **R**ecycle

- Keep products and materials at highest value at all times
- Develop continuous cycle to optimize natural capital.
- Can be developed at every scale

Many names – one principle

- By-Product Synergy
- Industrial Symbiosis
- Industrial Ecosystem Development
- Circular economy
- Blue economy



Circular economy principles

Ellen MacArthur Foundation

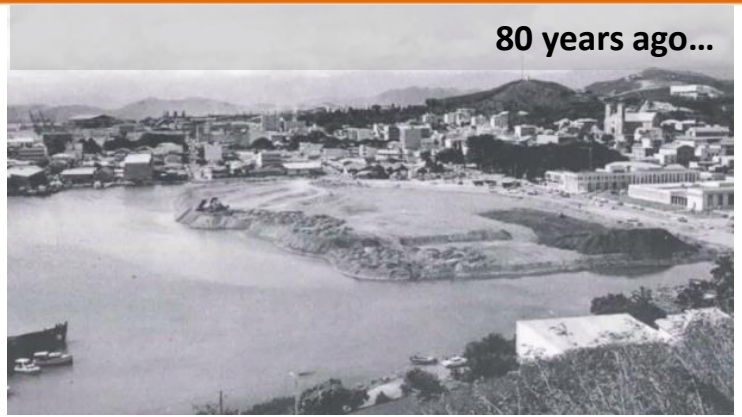
Now look back and take another look!

What we can see:

- Over 25 Mt storage of manufactured sand ready for opportunities
- 1,6 Mt of construction material produced every year as by-product from Nickel Industry
  This is FerroNickel Slag (FNS) traded as Le SLAND

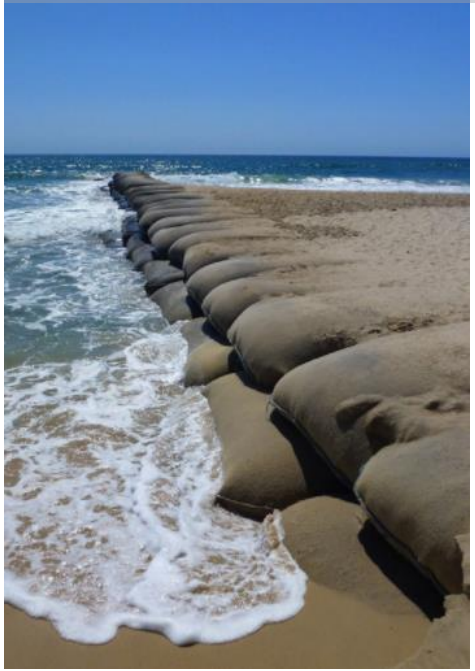
APPLICATIONS: LAND RECLAIMING AND BACKFILL

- New Caledonia land reclaiming works performed for **80 years** with SLN Le Sland and for more than **1000 hectares**
- **20% of Noumea** city is built on Le Sland
- Properties in land reclaiming:
  - Low compaction ratio
  - Hardening properties when mixed with sea water, lime, etc…
  - Highly draining material



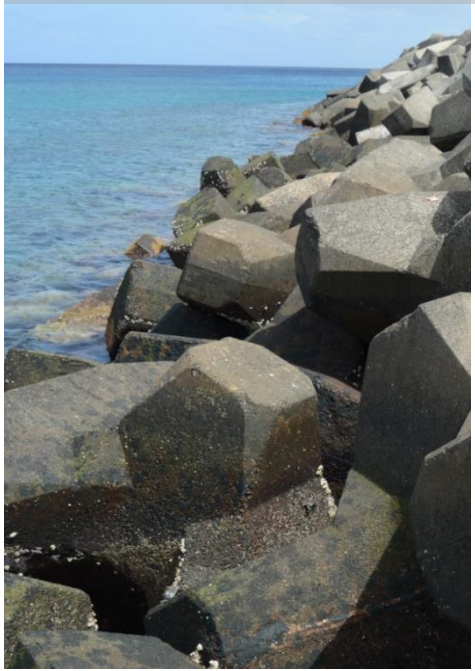
APPLICATIONS: COASTAL PROTECTION

Geotextile bags



- Approved material for the Vanuatu project
- Studies undergoing to adapt further the bags to this specific material

Tetrapod



- Taking advantage of the high density and hardening properties
- In Maré Island since 20 years with no cracks

APPLICATIONS: CONCRETE & MASONRY

Blockworks

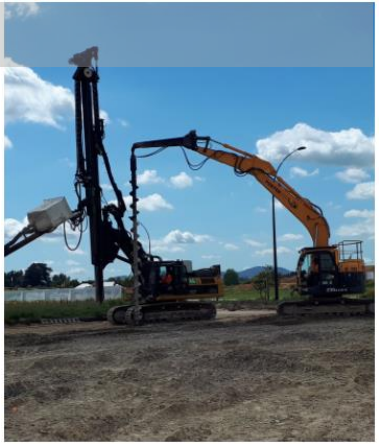
- 100% of sand replacement
- Simple process and management
- Easily duplicable BM in the Pacific islands

Ready-mix concrete

- Allow up to 50% replacement of the natural sand in concrete mixes
- Excellent durability proven by extensive researches with CERIB, Curtin Uni and UNSW
- Compliant with French and Australian Standards

APPLICATIONS: ROADS & LAND STABILIZATION

Land stabilization



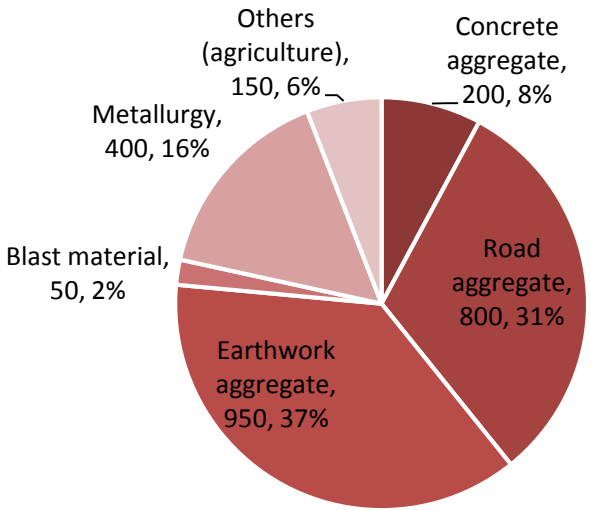
- Highly draining, well suited for land stabilization
- Product quality proven in Vanuatu

Roads applications

- Can be used as a road base or sub-base
- Past researches and recent trials have proved that grain size can be optimized up to 90% of sand mix

GLOBALLY USED MATERIAL

- **Japan** recycles 100% of its yearly production of Nickel slag (2550kt - SMM, PAMCO) in a broad range of applications:



- Ferronickel slag is not categorized as a waste anymore but as a product in **Europe** and is widely used in road making and concrete (Larco, Cunico).
  It is referenced under the REACH regulation.
- Used in many earthwork applications in **South Korea** (POSCO)
- Widely used for road making in **South America** (BHP, Vale)
- Used as sandblasting media, foundry sand, concrete aggregate, tile making and road making in the **US** (Green Diamond).

HEALTH, SAFETY & ENVIRONMENT

Environmental risks

- Le Sland can be used and stored without any soil contamination risk
- Tests conducted in 3 independent laboratories show that the product is not leachable under normal conditions
- French authorities in NC and NSW EPA have confirmed it is a non-hazardous good and authorized the outdoor storage
- No organic, no sugar, no clay in the material

DIMENC
Direction de l'Industrie, des Mines et de l'Energie

NSW EPA

Health & Safety risks

- XRD conducted by 2 independent laboratories show the product contains 0% of free reactive silica
- No risk of silicosis
- The product is abrasive and requires to be handled with the proper PPE

CONTROLLED AND MONITORED QUALITY

Analysis description	Note	Standard	Frequency
Particle size distribution	In-house analysis by our lab technicians	EN 933-1	Each 35,000T Lot (as per sampling above) + Random on loading
Bulk density	In-house analysis by our lab technicians		Each 35,000T Lot (as per sampling above) + Random on loading
Chloride content	In-house analysis by our lab technicians	Conductivity on leachate	1 per month
Chloride content	External lab for MTR emission	EN1744-1	Prior each loading
Particle size distribution	External lab for MTR emission	AS1141.11.1	1 per year
Bulk density (loose/compacted)	External lab for MTR emission	AS1141.4	1 per year
Particle apparent density	External lab for MTR emission	AS1141.5	1 per year
Water absorption	External lab for MTR emission	AS1141.5	1 per year
Sodium sulfate soundness	External lab for MTR emission	AS1141.24	1 per year
Clay end fine split	External lab for MTR emission	AS1141.33	1 per year
Sulfates	External lab for MTR emission	AS1141.20	1 per year
Presence of sugar	External lab for MTR emission	AS1141.35	1 per year
Organic impurities other than sugar	External lab for MTR emission	AS1141.34	1 per year
Petrographic Analysis	External lab for MTR emission	ASTM C295	1 per 3 year
AMBT testing	External lab for MTR emission	AS1141.60.1	1 per 3 years
Prism testing	External lab for MTR emission	AS1141.60.2	1 per 3 years

- A **commercial stockpile** is established within the plant to perform all the required testing as per our **Quality Protocol**
- Test can be conducted internally or externally

RELIABLE EXPORT LOGISTICS

- **Dedicated owned berth within the plant**
- **Ship loader** now operational (Max loading rate: 600t/h)
- **Long term contracts** with ship-owners available in the area
- **Experienced logistic team** available to assist projects with full delivery schemes

BUSINESS CASE

- **22Kt exported** to Vanuatu in April 2018 for a project co-financed by the World Bank/ Asian Development Bank (Ring Road Project) for land stabilization (stone columns) and coastal protection
- Product **more competitive** than imported aggregates
- **Reduced lead-time**
- Complete logistic **solution** was offered

LE SLAND – Are we ready to change?

- **Proven, economical and high quality material** with several decades of use in New Caledonia
- **Stable and homogeneous** material over the years
- **Stockpile of 25 MT** available ~1,200 nautical miles from East Australia and close to most Pacific Islands
- A **green** concrete aggregate with **excellent durability** bringing a **competitive advantage**

Think Different Think Circular !

Why deplete environmental resources?