Helping you extract value from Mine Waste

Create products

Sorting

Carbon Capture

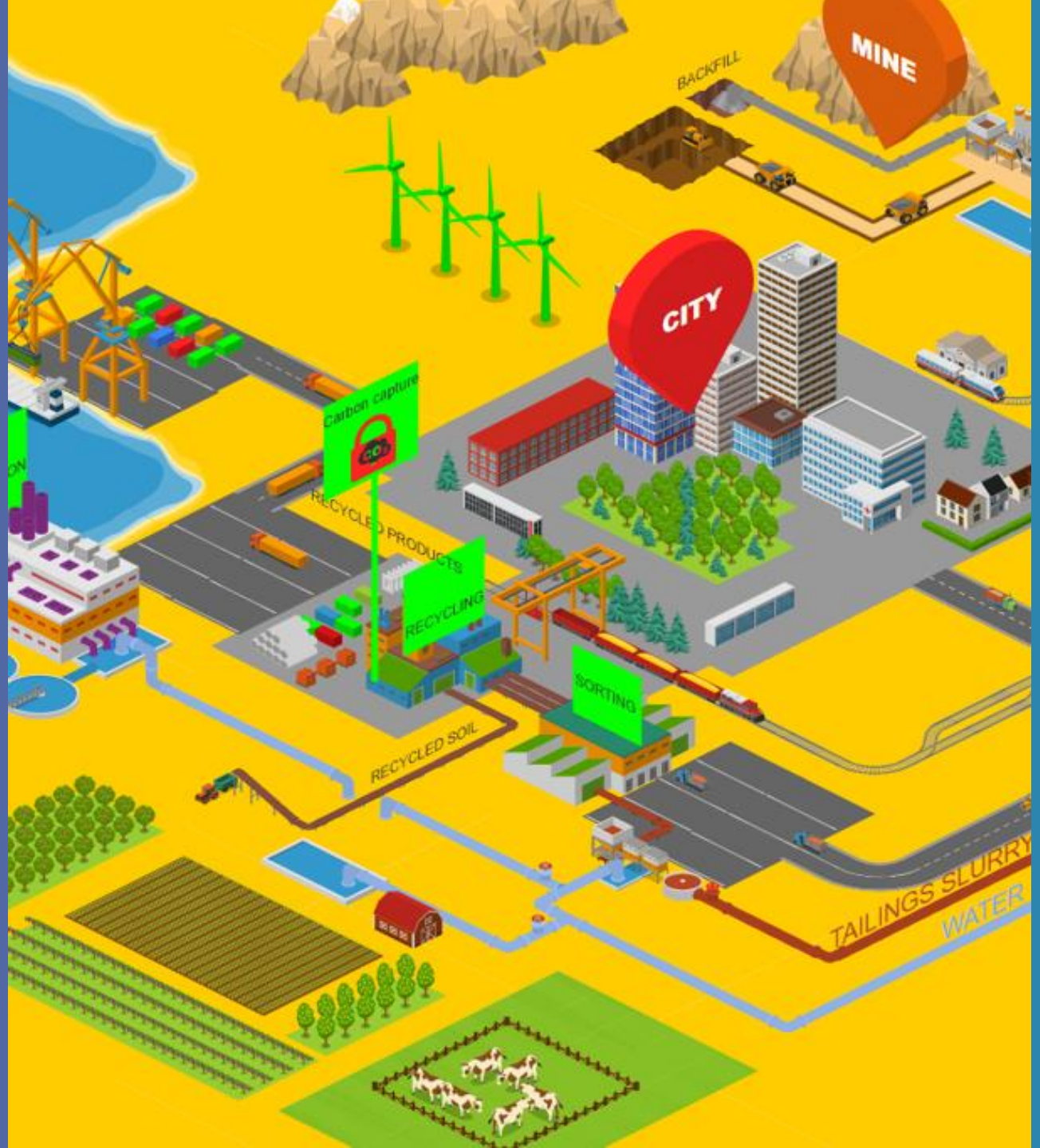
Removing contamination

Extracting Metals & Minerals

Separate liquid from solids

Testing & Planning

Soil rehabilitation



The Circular Mine Consortium

Extracting value from the Mine Waste

Sept 2020

About us

Mincore

- Australian processing consulting company which has completed many projects to reduce mine waste and remine tailings across Australia, Asia and Africa.

BRGM

- leading institution in the analysis and the development of ecotechnologies for the treatment of waste and primary raw materials with the aim of accelerating the transition to a circular economy.

VITO

- leading multidisciplinary research center whom owns state-of-the-art characterization equipment and is capable of performing testing of construction products according to ASTM and EN standards.

SoilCyclers

- Innovative soil amelioration and remediation contractor specialising in physical, chemical and biological changes to material to make topsoil, structural fill and fix contamination issues.

MEKS Solution

- Engineering consultants with experience in large global mineral processing project work including tailings dewatering.

Adivero

- Business consultants based in Brisbane, Melbourne and Paris, helping International businesses providing solutions to the mining and energy industries.

Our Mission & Vision

Gathering some of the most advanced practical engineering knowledge in recycling and mining to eradicate the environmental footprint of mine waste.

Our core capabilities

Technical

- Mining
- Metallurgy
- Processing
- Sorting
- Mechanical Engineering
- Electrical
- Geotechnical
- Water Management
- Waste and Tailings
- Mineral and material characterisation
- Construction material & associated industry

Management

- Project management
- Approval & certification processes
- Legal & IP
- Training & Education
- Accounting & Finance
- Logistics

Commercial

- Marketing
- International Business development & Sales
- Multilingual teams (Spanish, English, French…)
- Fundraising

Current and Past Sustainability Projects

BRGM

- Development of innovative bioprocesses for the treatment of ores – FP6 BIOSHALE and FP6 BIOMINE, ANR ECOMETALS collaborative projects
- Development of Nano-particle products from new mineral resources in Europe – FP7 PROMINE
- Development of mineral and metallurgical processing techniques for the recovery of Rare Earth Elements in legacy tailings – ERAMIN ENVIREE project
- Bioleaching of sulphide ores for the mining industry – KCCL company
- Development of bioprocesses for the extraction of metals process from printed circuit boards
- Sampling, crushing, sorting of solids from different wastes flows
- Environmental assessment of products and processes (LCA)

VITO

- Clean & sustainable technologies
- Circular economy
- New value chains from alternative feedstock
  - Synthetic aggregates
  - Carbonation technology
  - Supplementary cementitious materials
- Recycling of inorganic waste streams
  - Mine tailings
  - Metallurgical slags
  - Dredging sludges
  - Incineration ashes

SoilCyclers

- rapid soil amelioration for infrastructure revegetation involving dispersive, acid sulphate and sodic soils.
- use of locally available waste streams to develop alternative commercial revenue models for mine site tailings recycling.
- exclusive distributor for innovative binding agents to address heavy metal contamination in tailings.

Mincore MEKS Adivero

- Tailings dams digitalisation.
- Integrated management of mine waste from mining to closure
- Dry stack tailings 1500TPH
- Integration of mine with local urban, industrial and farming communities.
- Small scale filtered tailing module concept with sorting capabilities for repurposing, This module could be used to clean up abandoned tailings dams in Australia and other countries. For low income countries, this could form part of the world bank, IMF, EBRD... initiatives

Transformation process

Step 1

- Extracting the remaining minerals
- Decontamination

Step 2

- Classification
- Dewatering
- Sorting

Step 3

- Capturing CO_2 in calcium silicate minerals

Step 4

- Production of construction and backfill materials

Step 5

- Transformation of the remaining tailings into organic soil suitable for rehabilitation

From tailings to income

Tailings Characterisat-ion

Utilisation Options

Feasibility and Verification

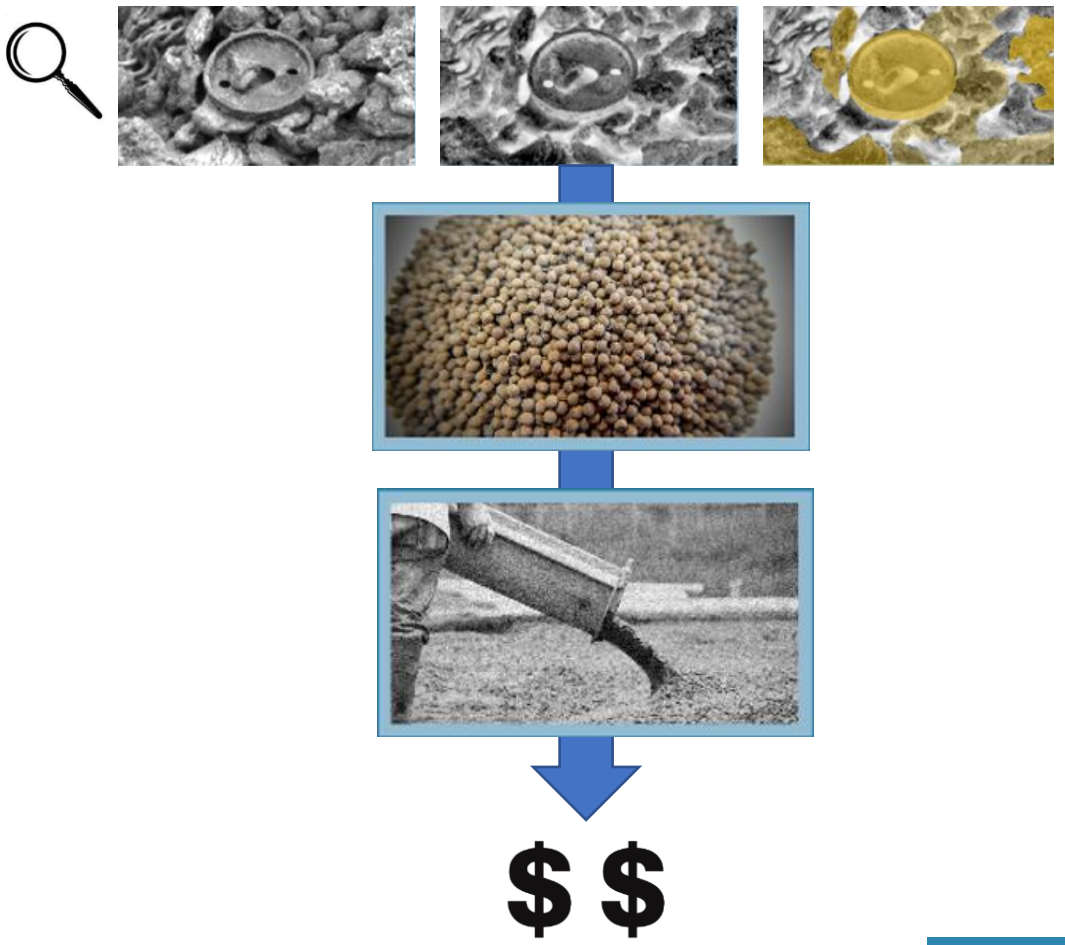
Approach Industry Partners

Product Development

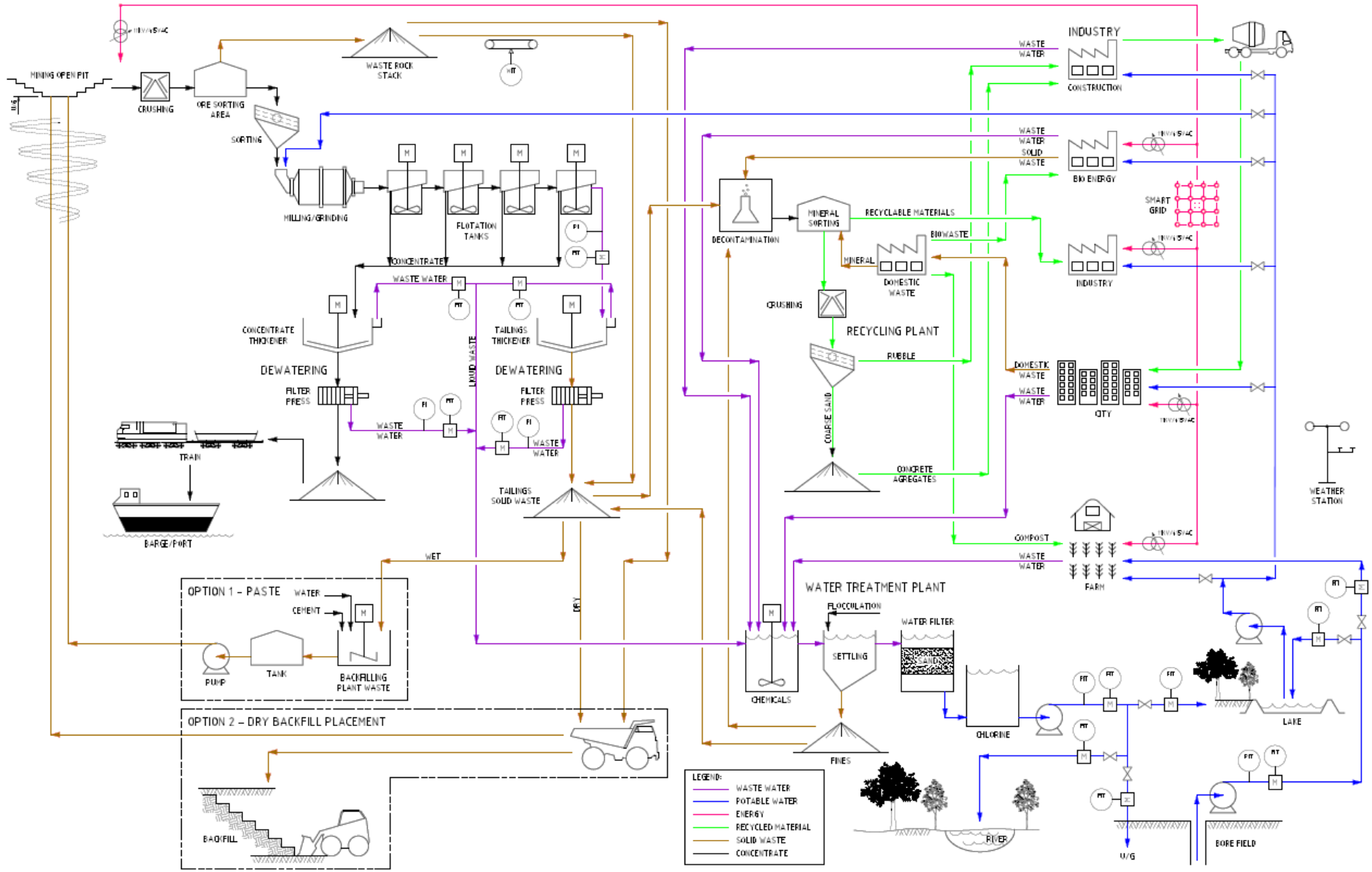
Certification

Production

Commerciali-sation



Integrated Solution



Typical Output

Tailings

- 30 to 60% backfill
- 20 to 30% construction material
- 10 to 50% soil rehabilitation

Revenue

- Extracted metals and minerals
- Carbon Capture – $40/Tonne
- Construction material - $100/tonne
- Topsoil – $10/tonne

Other benefits

- No tailings dams
- No closure costs

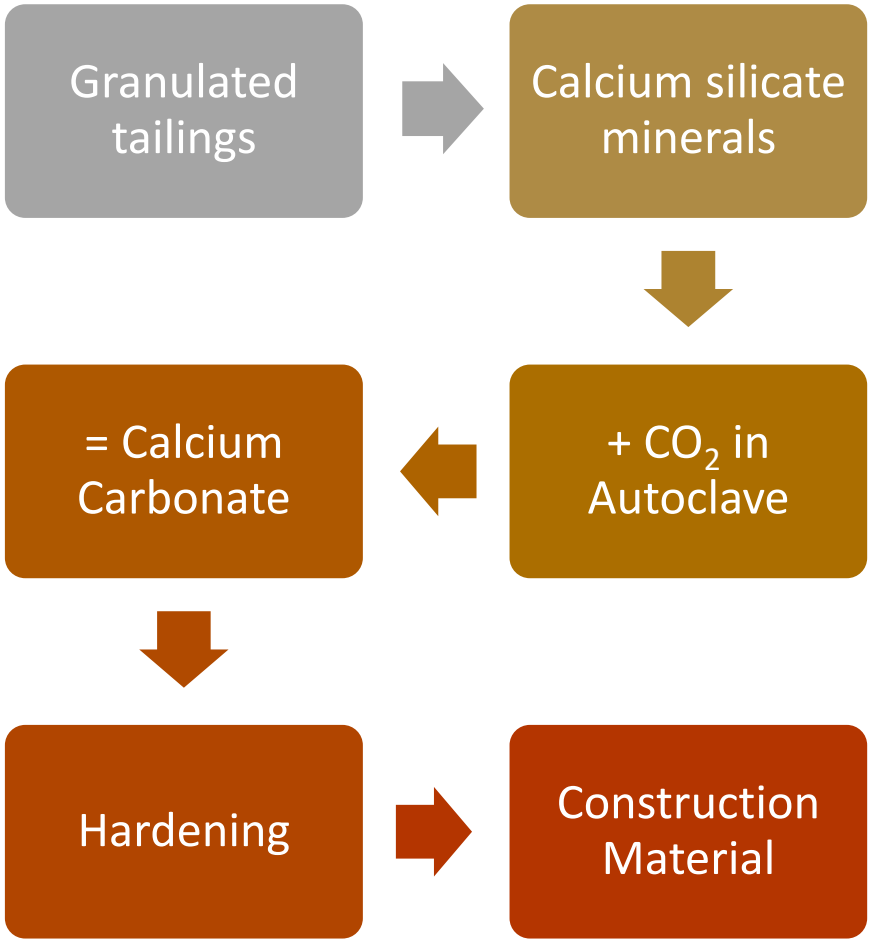
Bio Leaching *(BRGM to modify and improve)*

- **Suited for**
  - Sulphide minerals
  - leaching of low grade copper ores
  - pretreatment of pyritic gold ores and concentrates
- **Pond bioleaching reactor***
  - Cu, Pb, Ni, Sn
  - Co, Al, Mg
- **Benefits**
  - Low Capex
  - Flexible
  - Low maintenance
  - Neutralisation

… from lab scale trials to pilot scale continuous operations …

* Patent EP3152337B1 - PROCEDE ET INSTALLATION DE BIOLIXIVIATION – L'AIR LIQUIDE, BRGM, Milton Roy Europe

Carbon capture and utilization in construction



… from lab scale testing to industrial implementation…

BRGM

Geoscience for a sustainable Earth
brgm

Novel expertise

For mineral resources and waste

- Characterization & sampling
- Process development & optimization:
  - Comminution
  - Concentration
  - Thermal treatment
  - Hydrometallurgy
  - Biological treatment
- Management of process water
- Technical & environmental assessment of processes and resources and waste management

24
Researchers - Engineers - Technicians
(Process engineering, Mineral processing, Environmental analysis, Biotechnology, Sampling, Characterization, Process modelling)

Our fields

Primary resources
- Metal ores
- Unconventional resources (polymineral and polymetallic concentrates, tailings)
- Industrial minerals

Secondary resources
- Post-consumer waste (WEEE, ELV, etc.)
- Metallurgic waste (slag, fly ash, etc.)
- Construction & demolition waste

Effluent, industrial sludge and sediment

We're ready to help

- R&D and innovation projects (private-public collaborative projects)
- Commercial services
- Public policy support
- Training

Tools for innovation

A 2 000 m² technology development facility
From grams to several tons

catalogue available upon request

- Samplers
- Crushers
- Gravity separators
- Magnetic separators
- Eddy current separator
- Flotation cells
- (Bio)leaching reactors
- Furnaces

Charaterization and monitoring laboratory
- Significant volume DTA/GTA (up to 100 g)
- Portable IR, fluoX
- Texture analysis
- etc.

Modeling tools
- COMSOL, HSC, USIMPAC
- LCA software
- Environmental evaluation

VITO

45 NATIONALITIES

268 SCIENTIFIC PUBLICATIONS

86 PHDS AND POSTDOCS

MORE THAN 400 PATENTS

> €170 MILLION TURNOVER

79 FLEMISH SME'S

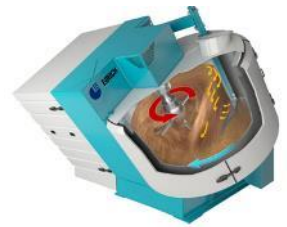
29 NEW PATENTS

959 EMPLOYEES

Experts
Projects
Experts and Projects

WASTE RECYCLING AT VITO:

- Recycling of inorganic waste streams
  - Mine tailings
  - Metallurgical slags
  - Dredging sludges
  - Incineration ashes
- Product development
  - Synthetic aggregates
  - Cement constituents
  - Carbonation technology
  - Advanced characterization and hydrometallurgical separation



SoilCyclers

Capability Statement

SoilCyclers are mixing specialists, ameliorating topsoil, amending subsoils and blending materials with contaminated soils to generate cost effective, environmentally friendly solutions for our construction, waste and mining industry clients. We help clients make the specification materials they need out of the unsuitable materials on their site. Our mobile crews can work throughout any site in Queensland, New South Wales, Victoria, the ACT or the Northern Territory recycling around 1000m³ of soil per crew per day. Amelioration results guaranteed. Lowest oversize rates guaranteed.

Topsoil amelioration
Turn unsuitable materials, subsoil and coal mine overburden into spedfication topsoils including AS4419, MRTS16, R178 and custom sports field growing media.

Geotechnical soil amendments
Adjust particle size distribution, plasticity index, compactibility and more to turn site materials into specification fill for dam wall upgrades, landfill liners and highways.

PFAS soil remediation
Permanently immobilise PFAS in soil and reduce PFAS leachate levels to undetectable levels or to a level where it can be safely disposed of in landfill or even reused onsite.

Acid sulphate soil remediation
Accurately blend lime so acid sulphate soils are able to be reused onsite instead of disposed of.

Asbestos contaminated soil remediation
Separate non-friable asbestos and other C&D waste from soil so it can be reused onsite.

Waste reduction
Separate waste from soil to reduce the amount of waste being disposed of offsite or reduce the classification and cost of waste disposal.

Landfill mining
Sorting and processing of old landfills and illegal tip sites to reduce the cost of relocation and recover usable resources.

Mobile composting
Run temporary licensed composting facilities to turn an infrastructure or subdivision site's green waste into MRTS16 or AS4454 compliant soil conditioner or compost.

Treat and remove soil from fire ant zones
Treat and remove soil from within fire ant zones into a different fire ant zone or outside the fire ant zone under our Statewide Biosecurity Instrument Permit.

Core competencies

- fully mobile recycling operation with crews available to mobilise Australia-wide
- sieve, aerate and mix materials without the need for double handling
- thorough mixing through the entire soil profile including heavy clay soils

Key differentiators

- more than 2,000,000m³ of soil ameliorated
- road registered, trailer mounted trommel screens
- huge 38m² screen area (flatdeck screen ~4m²)
- aeration, waste removal and amelioration in the one process without double handling
- independent validation testing (we do not do in-house testing or amelioration recommendations)
- 15+ years' experience blending and mixing soils with trommel screens
- wet, heavy and clay-based soils are our speciality
- full safety and quality documentation suitable for large highway projects and mine sites
- all environmental permits

Our guarantees

- lowest oversize or wastage rates guaranteed
- guaranteed compliant materials for amelioration and remediation jobs

Productivity & capacity

- throughput rates are 500m³ to 1500m³ per day per crew for a standard 10 hour day (rate varies depending on material, screen size and site conditions)
- with current staffing and equipment we have the capacity to ameliorate more than half a million cubic metres per year
- capacity could be increased to one million cubic metres per year with addition of nightworks and extended operations

Corporate data

- SoilCyclers Pty Ltd (established 2009)
- ABN 98 135 167 314 ACN 135 167 314
- ICN company ID # 114636
- Department of Environment & Science Suitable Operator #708411 Environmental Authority #EPPR01384513

Our awards

- The Australian Business Awards – Best Eco Product
- Civil Contractors Federation Earth Awards – Finalist Earthmover & Civil Contractor Environmental Choice Award
- CivinexQ – Winner Best Green Site
- NAWIC Crystal Vision Awards – Civil Contractors Award for Achievement in Civil Construction

Our equipment

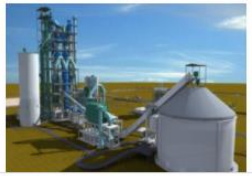
Our crews are completely mobile and work on our clients' sites throughout Queensland, New South Wales, the ACT, Victoria and the Northern Territory. Each crew is equipped with a Doppstadt SM620 trommel screen (road-registered and trailer-mounted), a 25 ton Volvo excavator, a 5 ton skid steer (Cat or Kubota), radial stacker or stockpiler and two operators. All our equipment receives daily electronic pre-start checks and is regularly maintained with documented service histories. All our equipment has full Plant Risk Assessments, Safe Work Methods Statements and machinery maintenance records suitable for use on mine sites and large infrastructure projects.

Mincore

MINCORE

We specialise in services to the minerals processing industry

PROJECT LISTING





Engineering Services

Mincore engineers and constructs other process related industrial plants and manufacturing facilities. Additionally Mincore provides specialist consulting engineering

Estimating & Feasibility

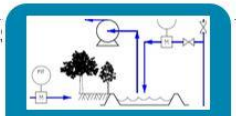
The success of a project often depends on the extent of scope definition prior to project approval. Major project decisions must be

Value Engineering

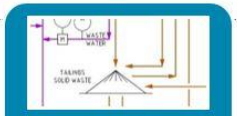
Mincore prides itself on client centric services that ultimately deliver value to you and your project. We aim to deliver innovative and practical solutions to

OUR EXPERTISE IN WATER AND WASTE

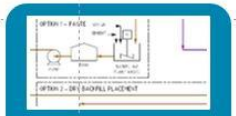
MINCORE



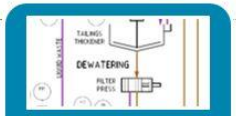
WATER
Hydrogeology
Hydrology
Process water
Storage
Water balance



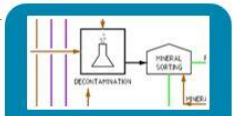
WASTE
Store
Co-dispose
Filter
Recycle
Clean



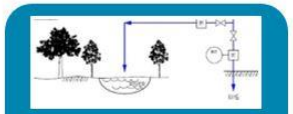
GEOTECHNICAL
Dam
Stability
Investigate
Erosion
Backfill



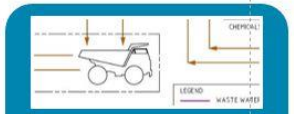
MECHANICAL
Pumps
Pipes
Thickners
Fliters
PID PLC



CONTAMINATION
Identify
Monitor
Contain
Eliminate
Dilute

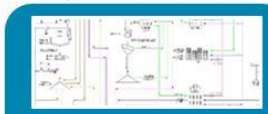


ENVIRONMENT
Analyse
Monitor
Integrate
Collaborate
Protect
Compliance & EIA



MATERIAL HANDLING
Plan
Improve
Optimise

RISK
Identify
Remove
Forecast
Emergency
Flood - ARD



INTEGRATION
Link
Measure
Communicate
Connect

MEKS

MEKSSolutions

MEKSSolutions

Engineering management consultants with experience across:

- *infrastructure,*
- *mining,*
- *oil & gas,*
- *rail and*
- *renewable energy industries.*

Our capabilities stretch across many areas including project management, maintenance and contract management, enabling us to use our problem-solving skills to deliver mutual benefits.

We believe in enjoying what we do and building long lasting professional relationships that deliver results. Our aim is to keep it simple with a focus on the future that is innovative and sustainable.

ADIVERO

business accelerator

Adivero Australia is a boutique consultancy based in Brisbane, Melbourne and Paris, helping businesses providing solutions to the mining and energy industries to grow their business in Australia

Getting ready

- Definition of export project
- Development of marketing tools in French

Finding local partners

- Selection of a potential partner / agent / distributor
- Partnership contract

Support

- Technical support
- Staff recruitment

Representing Companies

- Business development
- Project Management

adivero

NEMO

VITO and BRGM are partners of the European NEMO project

The NEMO project "Near-zero-waste recycling of low-grade sulphidic mining waste for critical-metal, mineral and construction raw-material production in a circular economy'" is a EU H2020 Innovation Action project (IA, call SC5-14b). Using a "4 PILOTS – 2 case-studies" concept, NEMO develops, demonstrates and exploits new ways to valorise sulphidic mining waste.

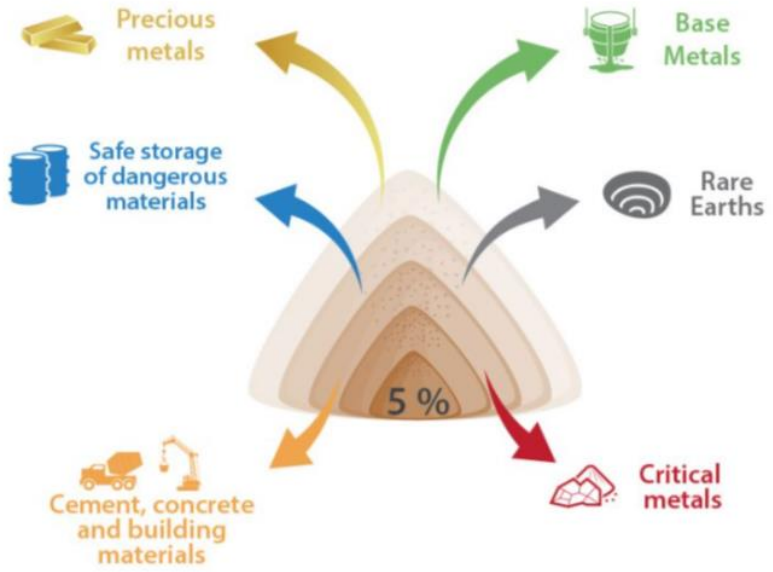


Figure: The NEMO concept. Sulphidic mining residues are at present times typically deposited in tailing storage facilities. NEMO aims at further treatment of these residues to recover valuable metals and minerals, while concentrating hazardous elements and using the residual matrix in cement and construction materials.

https://h2020-nemo.eu/

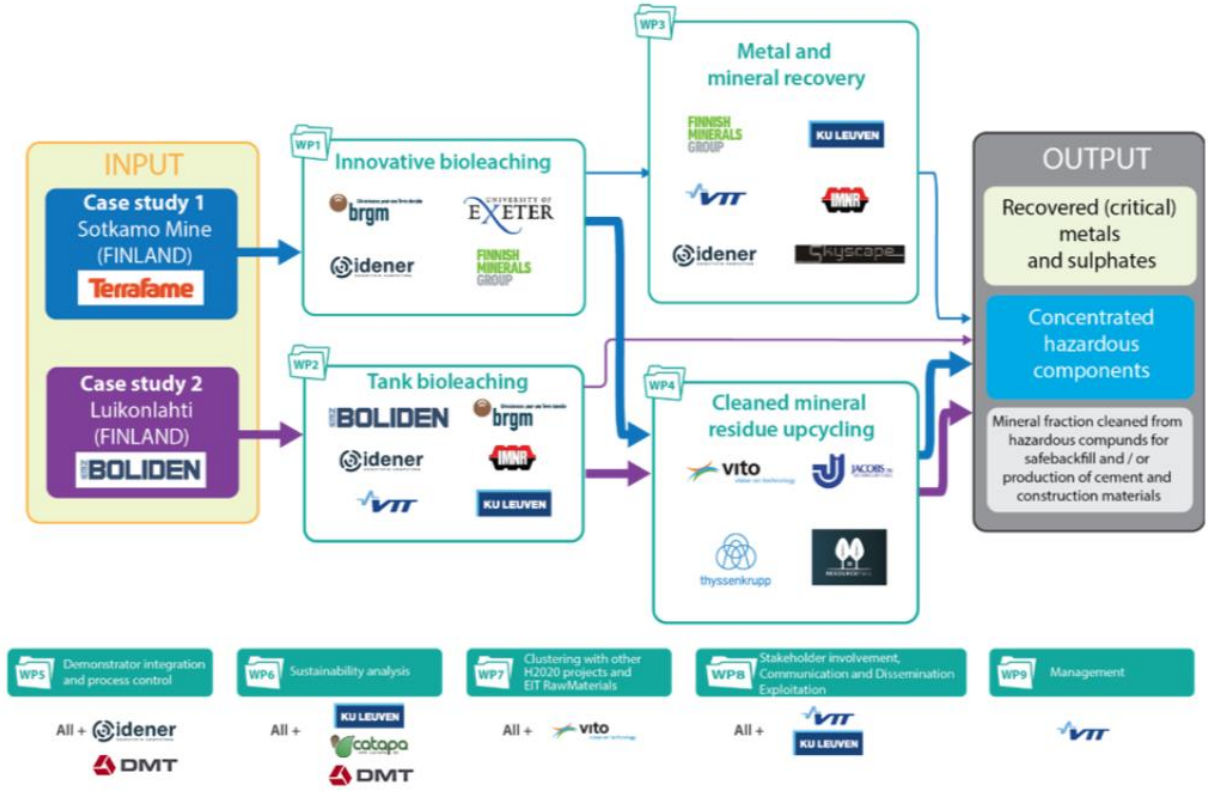


Figure: NEMO case studies and work package structure

This project has received funding from the European Union's EU Framework Programme for Research and Innovation Horizon 2020 under Grant Agreement No 776846

SULTAN

VITO works as a partner in the European SULTAN project

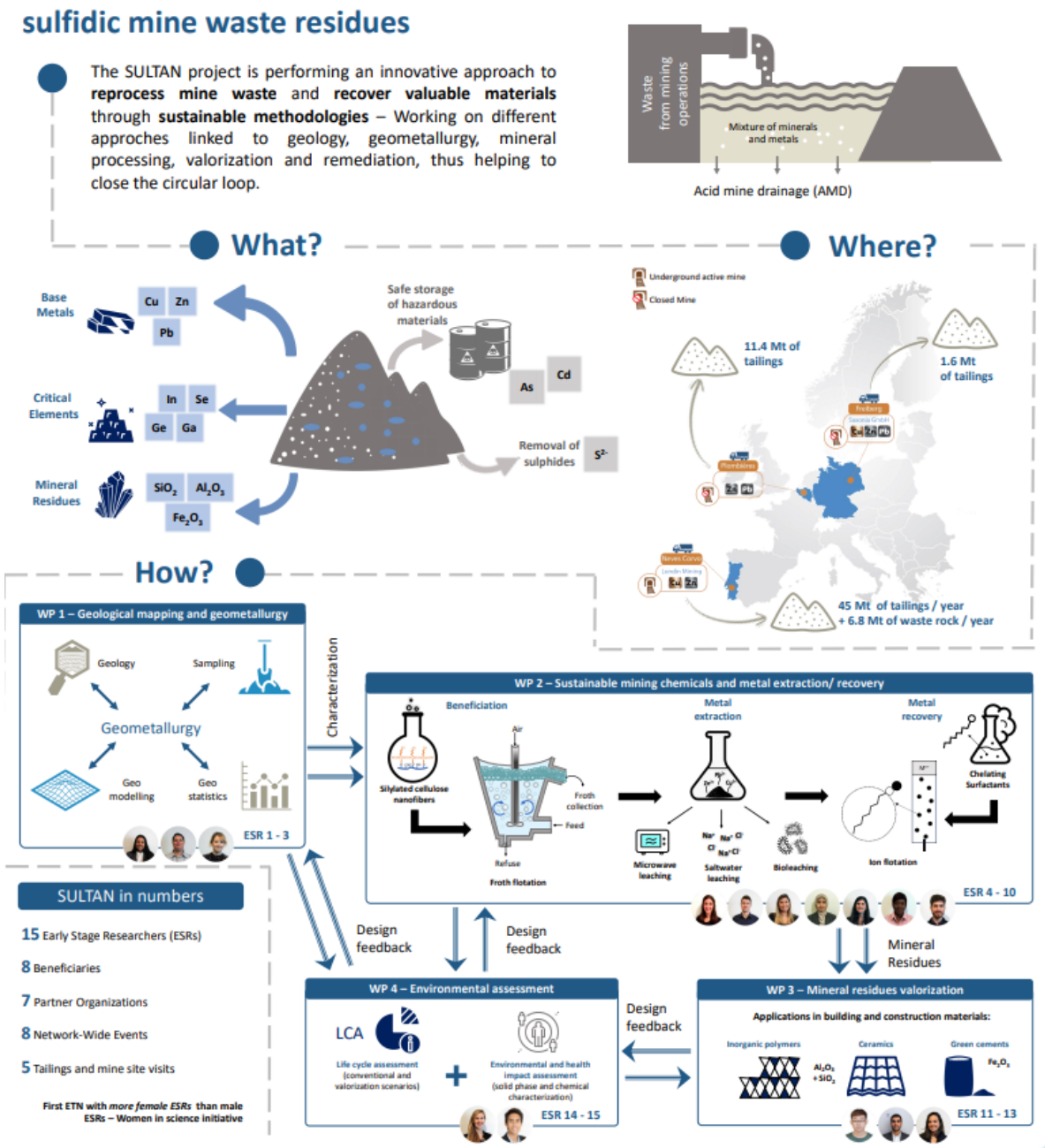
MSCA-ETN

SULTAN

"Waste of the past, material of the future"

European Training Network for the Remediation and Reprocessing of Sulfidic Mining Waste Sites

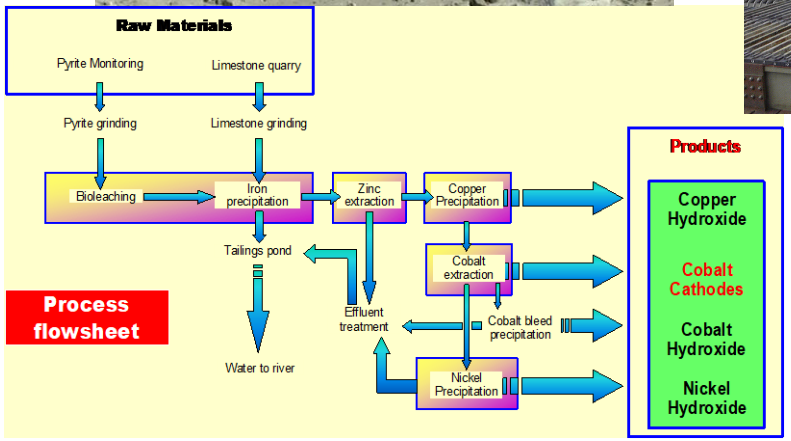
https://etn-sultan.eu/



This project has received funding from the European Union's EU Framework Programme for Research and Innovation Horizon 2020 under Grant Agreement No 812580

KCC industrial project – a bioleach success story for BRGM

- 1989-91: Pre-feasibility study
  testwork on bioleaching at lab-scale (2L stirred tank reactor, batch)
  -> main operating parameters (temperature, pH) and microbial monitoring)
- 1992-1993: Feasibility step I
  bioleaching pilot testwork in BRGM process hall (100L STR, 5 kg/d)
  -> residence time, solid load, mass transfer (pulp homogeneity, gas dispersion), energy transfer (thermal regulation), pH regulation…
- 1993-96: Feasibility step II and basic engineering
  Complementary testwork on bioleaching, zinc solvent extraction and electrowinning
  Bioleaching pilot testwork: 1t per day in Uganda - 65 m3 tank
  Environmental impact study & Power supply (hydroelectric)
  Engineering and economic evaluation, feasibility report and auditing
- 1996-98: Detailed engineering
- 1998-99: Construction and start-up -> first Co cathode in June 1999
- 2002: Monthly cobalt production reaches 67 tons (~ 2% of the world Co production)
- 2014: End of the operation – All the tailings stockpiles have been treated and the site environment has been restored!!!



TEAM

Patrick D'Hugues

Patrick d'Hugues is a microbiologist with an engineering degree in biotechnology. In 1996, he got a PhD in Applied Microbiology & Biotechnology with a work on gas analysis & process optimisation of a continuous bioleaching process. Patrick joined BRGM in 1999 and carried out R&D activities in Biotechnology, Biogeochemistry and Microbial ecology.

From 2004 to 2010, Patrick d'Hugues was Project Manager at BRGM. He was the General Coordinator of the EC-FP6 European R&D project Bioshale "Search for a Sustainable Way of Exploiting Back Shale Ores Using Biotechnologies". He was also a member of the Management Committee of the FP6 integrated project (BioMinE): "Biotechnology for Metal bearing materials in Europe". In 2009, Patrick took the responsibility of coordinating the WorkPackage4 on "ecoefficient metal production methods and utilization of secondary materials in the frame of the 4 years EC-FP7 R&D project PROMINE.

At present, Patrick is the director of the BRGM scientific program "Mineral Resources and Circular Economy".

Dr. Liesbeth Horckmans

Liesbeth Horckmans is an experienced team leader involved in the coordination of many research and development projects. Her PhD in Sciences (geology) at KU Leuven (2007) and early research career involved environmental studies of soil, groundwaters and waste materials. At VITO since 2011, she has worked on the valorisation of a wide variety of industrial residues in terms of mineral processing, hydrometallurgy and matrix valorisation. She coordinates multiple projects such as the H2020 project CHROMIC (www.chromic.eu, 4.8M€), the European FP7-project REFRASORT (www.refrasort.eu, 2.4 M€) and is work package leader in the H2020 project NEMO (h2020-nemo.eu, 12.5 M€). As team leader at VITO, she is responsible for the organization of the Waste Recycling Team in terms of budget, planning and project follow up and strives for continuous improvements and general well-being of the members of the team.

Dr. Arne Peys

Arne Peys graduated in 2014 as a materials engineer at KU Leuven (Belgium). He did his PhD and 1 year of post-doc at the same department on the valorisation of iron-rich slags in alkali-activated materials. The PhD research was focused on the reactivity and structure of these iron-rich slags and their reaction mechanism towards the binder. Additionally, work during his master thesis and a side track during his PhD and post-doc involved the use of biomass ashes as activator in alkali-activated materials. During the post-doc year, slag valorisation was studied more general, for instance including a study on the valorisation of steel slags in various binder systems. At VITO since September 2019, Arne is involved in several research and development projects on aggregate and binder development (e.g. on the valorisation of mine tailings in H2020 NEMO) and has performed studies on the use of secondary raw materials as supplementary cementitious materials for the Flemish waste agency OVAM.

Alison Price

Founder and Managing Director of SoilCyclers, Alison Price has a Bachelor of Business (Marketing) from QUT and is regularly called on to speak to business students including at the recent QUT/MIT Bootcamp with entrepreneurs from all over the world gathered at a world-recognised entrepreneurship program. Alison's background in knowledge management and automated IT systems makes her ideally suited to managing additional rapid growth for her business. Alison also holds a number of Board roles including Director of Austmine, and Board Member for the Waste Recycling Industry Association of Queensland. Alison is a former Director and Vice Chair of the Board for the National Association of Women In Construction.

Dr. Ruben Snellings

Ruben Snellings has demonstrated expertise in the development and testing of cementitious materials. After his PhD in Sciences (geology) at KU Leuven (2011) he worked as a post-doc at the Magnel Laboratory for Concrete Research and as a Marie Curie IEF Fellow at the Laboratory of Construction Materials of EPFL (Switzerland). There he specialised in X-ray diffraction and electron microscopy analysis of cementitious materials, including limestone-calcined clay blended cements. Since 2014 he works at VITO as R&D professional, and from 2016 as senior researcher taking charge of scientific coordination of VITO activities in mineral residue upcycling projects (e.g. H2020 Metgrow+, H2020 NEMO, H2020 EnDurCrete, EIT KIC Raw materials FLAME). His main field of expertise is the development of novel binders incorporating mineral and inorganic waste streams (zeolites, slags, fly ashes, thermally activated clays). In 2016, he received the RILEM Gustavo Colonnetti medal for his contribution to construction materials science as a young researcher. As co-chair of RILEM TC 267 TRM "Tests for reactivity of Supplementary Cementitious Materials" and participant in the CEN/TC 51 on Cement and Building Lime, he is actively involved in pre-normalisation test work and in the preparation of the new cement industry standards.

Charles Vuillier

Charles Vuillier has over 25 years international experience in geotechnical engineering, mining, water and tailings management. He holds a Master of Engineering in Civil and Geotechnical Engineering and qualifications in project management, marketing, investment and finance.

He has been involved for the past 10 years in mine waste management providing strategic advice to assist the mining industry to become more sustainable and to address the environmental impact of past mining activity. He has provided business development support to innovative businesses to connect with the changing mining industry and help their digital transformation. In addition, he has assisted European investors, services and goods suppliers to develop strategies to target local companies in the Australian mining industry. He promotes cross industry and international collaboration to further the circular economy.

He is a committee member of the Australasian Institute of Mining and Metallurgy, Women in Mining, and the French Australian Chamber of Commerce and a member of Engineers Australia.

Anne Gwenaelle Guezennec

Dr. Anne-Gwenaelle Guezennec, Project Manager, has a Ph.D. in process engineering. She has extensive research project management experience across a broad spectrum of metallurgical process engineering. She has lead national and European R&D projects in the field of technology development for the mining industry. Dr. Guezennec is an expert in bio-leaching and bio-leaching process design. She has developed new reactor designs for bio-leaching processes that are currently being patented.

Michael Ingwersen

Michael is a result driven tertiary qualified business and technical professional with over 20 years of international experience with a focus on delivering the most cost-efficient fit for purpose solution for clients. Michael has Bachelor of Engineering (Mechanical) and MBA with academic achievement excellence in entrepreneurship. Michael is part of the regional advisory committee for Institute of Managers and Leaders and parent representatives on Belmont High School council.

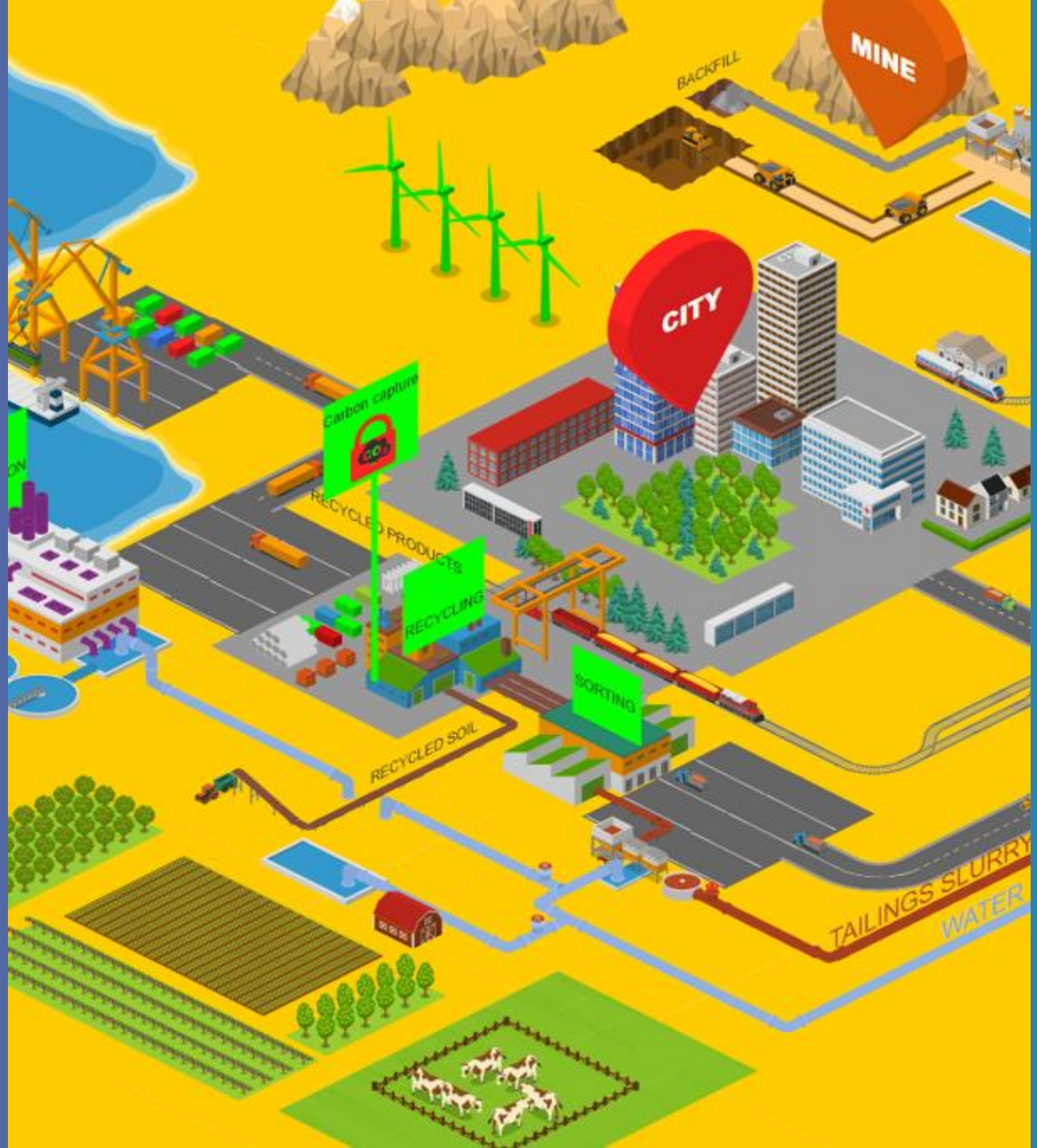
Michael is a practical individual with a "can do" approach. A proven track record of getting the job done; thinking laterally to solve problems; negotiating win-win outcomes; developing relationships at all levels through competence, ability and trust; aligning business to the strategic goals while providing pragmatic leadership.

Yannick Menard

Doctor Engineer in Process Engineering, Yannick Menard has over 16 years of experience in the development of techniques for primary raw materials processing (ores, mining residues and beneficiation tailings) and secondary raw materials recycling (waste from the extractive metallurgy, construction waste, electronic waste).

His expertise covers the development of weakening / fragmentation techniques, the development of physical and physico-chemical processes for the treatment of mine drainage, polluted soils, waste and raw materials, the design of extractive metallurgy bioprocesses, the design and development of multi-scale pilots for the processing of minerals and waste and the environmental assessment of products and processes. This expertise also includes the mathematical modeling of processes including mechanistic approaches (computational fluid dynamics) and systemic (mass balances, thermodynamic calculations).

For 10 years, he has been responsible for BRGM's research activities dealing with the development of innovative techniques for the exploitation of mine and urban mine resources. For the last 2 years, he is the team manager of the waste and raw material team of the French Geological Survey. This R&D team of 24 people (Process and environmental engineers, researchers and technicians) works on process development & environmental analysis (including LCA) in the field of mining waste management, recycling, water management and primary resources treatment (mineral processing & extractive metallurgy).



The Circular Mine Consortium

AUSTRALIA & OVERSEAS

Charles Vuillier
Mine Sustainability Manager
Mobile: + 61 435 087 562
Email: cvuillier@mincore.com.au

Michael Ingwersen
Principal Consultant
Mobile: +61 407 709 988
Email: mingwersen@mekssolutions.com