VALE

Open Innovation

Futures Screening

Outside-In Innovation

Partner's Briefing Deck
July 2021

We are Vale

- A value's driven **global** mining company**.**
- We **exist to improve life and transform the Future, Together.**
- **Innovation** is one of our key leavers.
- Company with **strategic** assets across the work.
- One of the world's **largest global producers** of **iron ore, copper and nickel.**
- **We operate logistic systems integrated** to mining activities, including railways, maritime terminals, and ports.
- We have **interests** in energy and steelmaking assets.

Photo: Ricardo Teles

Learning together

Our Purpose

We exist to improve life and transform the future. **Together.**

WHY do we exist?

Values

- **Life** matters most.
- Act with **integrity.**
- Value **the people who build our company.**
- Make it **happen.**
- Respect our **planet and communities.**

WHAT do we believe **IN?**

Key Behaviours

- **Obsession with Safety and Risk Management.**
- **Open and Transparent Dialogue.**
- **Empowerment with Accountability.**
- **Ownership for the Whole.**
- **Active Listening and Engagement with Society.**

HOW do we act?

Our Levers

- Safety
- VPS
- People
- Innovation
- ESG

Our Ambitions

A great company recognized by society for being:

- Benchmark in **safety.**
- Best in class **reliable** operator.
- **Talent** driven organization.
- Leader in **low carbon** mining.
- Reference in **creating and sharing value.**

WHAT do we look for?

VALE

Ores in our daily lives

- Iron
- Nickel
- Manganese
- Copper
- Coal

Photo: Pedro Rubens

Our presence

To meet **global demand** for ore, our operations, research labs, projects and offices are present in **five continents**.

Life Matters Most

By 2025, we will make **our people, communities, and processes safer** by achieving our journey to zero and becoming a leader in safety and risk management.

"without safety, there is no production."

Mining

We are committed to maintaining our **leading position in the global markets** by increasing production capacity, lowering costs and optimizing our production chain in both out open pit and underground operations

Photo: Ricardo Teles

Logistics

To ensure the **fast** and **safe** transportation of ore, our logistics network integrates our **mines, railroads, ships** and **ports.**

Photo: Tadeu Bianconi

Energy

Energy is one of the **fundamental** inputs for the sustainability of our **activities.**

Vale invests in **renewable resources**, such as **electricity** from **hydro**, **wind sources** and **biodiesel.**

Photo: Paulo Arumaá

Discover what we don’t know that we don’t know

Looking beyond to find new opportunities and solve our problems in a more innovative way, searching for the gems and spotlighting them as opportunities for our business

About

Futures Screening

Innovation is one of Vale's 'Levers' and a key capability in our cultural transformation.

Future screening is an **internal service from Vale Technology,** who on behalf of a range of Vale teams **actively scouts and screens** the external ecosystem **looking for innovative products, and solutions** across a range of key themes assigned by the business.

High potential opportunities that the service identifies are registered in a **searchable database which is open to all teams within Vale** i.e. Procurement, Corporate Venture, Technology, Engineering etc. Additionally, a **curated Pitch Day is held regularly**, giving an opportunity to **showcase the standout products and services** the team has discovered to their internal colleagues.

The Future screening service **provides a highly skilled, dedicated team** who utilize a systematic approach to scan and scout across a wide ecosystem. This approach allows Vale to gain access and insights to products, service, and entrepreneurs which it would have not normally had visibility nor access to.

The Why we are doing Future screening

Discover new possibilities and present to Vale

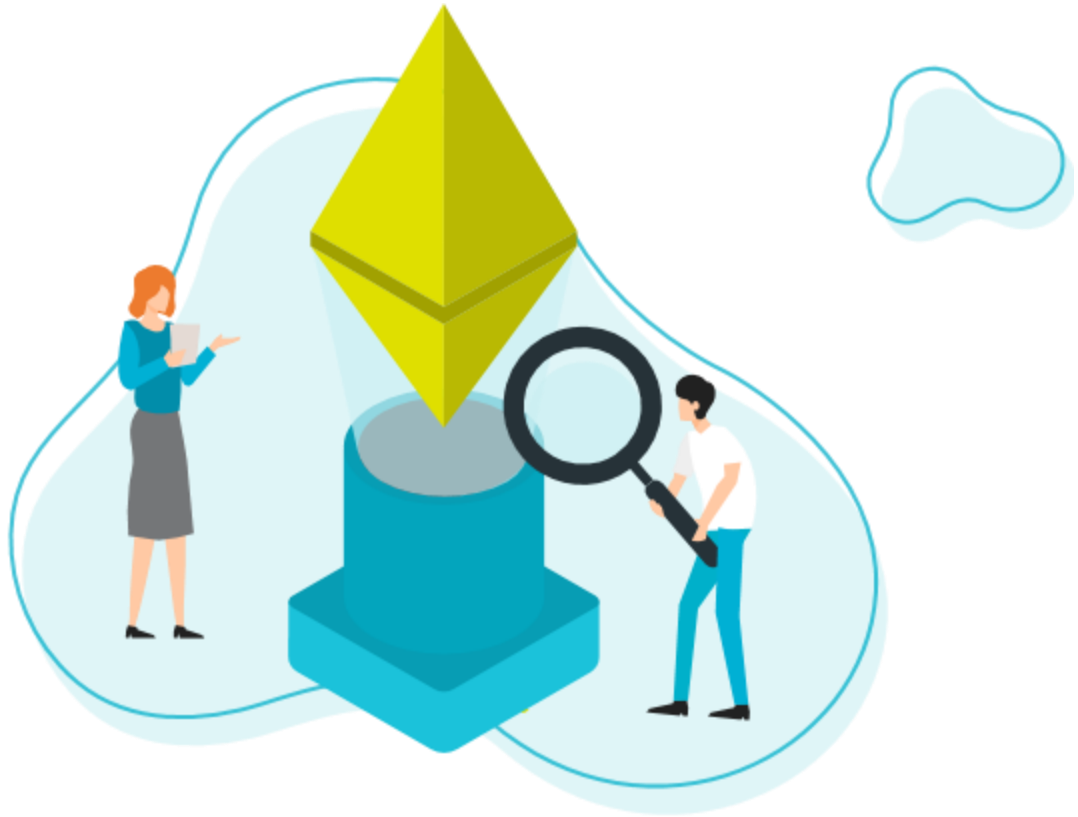
We want to know the innovations carried out by other markets, companies and ecosystems to confront our bias and build the future through the most innovative solutions in the world.

Deliver a serchable database for all Vale

We want to optimize the search for solutions and promote good ideas from a unified Vale innovation database.

Leverage our discovers internal and externally

We want to leverage the innovative solutions we find, presenting them to external market players who have similar problems, strengthening our ties and sharing value with the ecosystem.



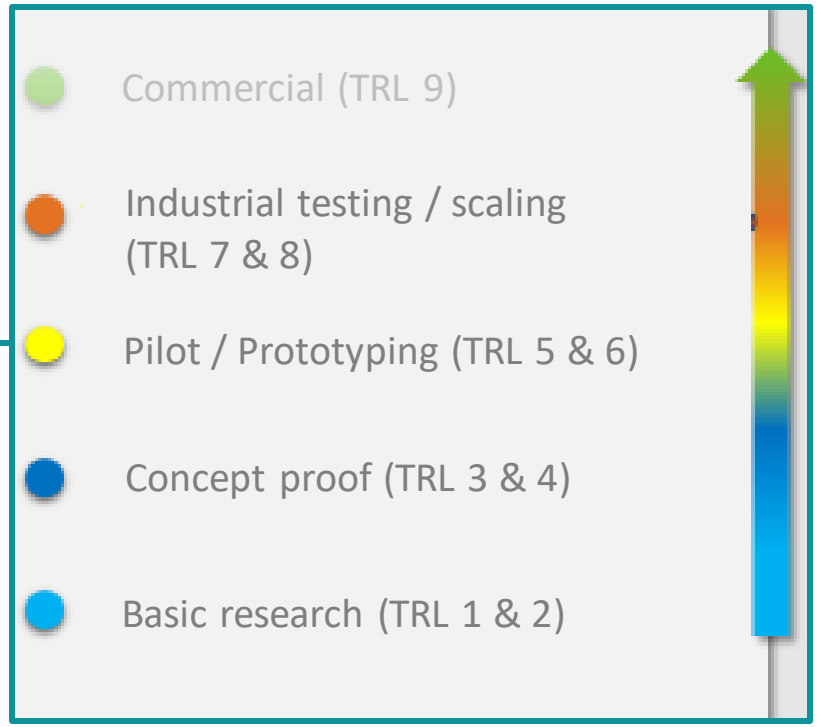
Vale Futures - Screening scope

We are looking for both solutions and innovation concepts.

What sort of enterprisers are we seeking out?

We are seeking to unearth solutions and enterprisers (Gems) who would not normally come to Vale attention via the primary procurement method

- **Thematic Groups match**
  A match to Vales key focus areas
- **Market Segment**
  Connected with heavy industry and related
- **Business Stage**
  Series A onwards, with annual revenue <$100M
- **Diversity of founding team**
  Woman, indigenous, veteran founded
- **Solution Readiness**
  Pilot / Prototyping
  (those not POC ready will be tracked in till stage reached)
- **Sustainability**
  Meets sustainability policies and milestones



*Vale's unified maturity scale

How Futures Screening works?

1. We actively seek and identify high potential companies through a variety of channels and Partnerships.

2. In collaboration with Vale Business Units, we identify 4-5 high potential entrepreneur to present their solutions in our monthly Pitch Day. In attendance will be our sensor leaders and key sponsors for each theme.

3. Where there is interest, we facilitate conversations / activities between our Business Units and entrepreneur.

Pitch Day model

Each entrepreneur is allcoated 20 minutes:
12 minutes to present their solution
8 minutes for Q&A from Vale's participants

Potential outcomes

Registration

The entrepreneur will become part of our global database, increasing the chances of connections within Vale.

Deeper dive

Follow up meetings either virtual or in-person with Vale Business Leaders to identify synergies and agreed next steps.

Commercial Opportunities

Commerce a POV (Proof of Value), POC (Proof of Concept), Pilot, Co-investment and / or white labeling opportunities.

Themes

Prime focus

Tertiary focus

Safety

Achieve our zero damage goal through an integrated approach - addressing the hierarchy of controls through processes and technology and ultimately allowing new behaviors

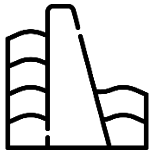
Futures screening themes - Domains

- New ways of working to eliminate risk scenarios
- Anomaly detection and prevention
- Risk management

Technologies

- Big Data, Analytics, Machine Learning, AI, Telematics and Wearables, Robotics and Automation, AR/VR, Digital Twins, Smart Sensors, IoTs

Dams



Enable a management of geotechnical structures more robust, reliable, connected and that aims at safety in the first place. As well as, in some cases, enabling the decharacterization of geotechnical structures

Futures screening themes - Domains

- Dam monitoring for predictive security
- Crisis simulation systems and alert systems
- Containment of tailings
- Access to dams and remote/autonomous drilling
- Mining of tailings

Technology

- AI, Drones, IoTs, Nano Robotics, Satellites and Radars, Extended Reality, Digital Twins, Analytics, Machine learning, AR/VR, Smart Sensors, Graph Analytics, Unmanned equipment, Nanotechnology, Advanced Materials

Low Carbon

Reducir by 33% of the company's carbon emissions by 2030 and 15% of its supply chain emissions by 2035.

Futures screening themes - Domains

- Forests and Biodiversity
- Emission Reduction
- Renewable Energy and Energy Efficiency
- ESG Gaps

Technologies

- AI, Analytics, Machine learning, AR/VR, Advanced Materials, Nanotechnology, BioTechnology, Blockchain, CleanTechs, EnergyTechs

Insights across Value Chain

Leverage mine planning and geoscience practices to world-class standards and integrate them into the operational plans and schedules of the value chain.

Futures screening themes - Domains

- Geological knowledge
- Value chain integration
- Precision planning
- Decision-making optimizers
- Quality traceability and prediction

Technologies

- There Big Data, Analytics, Machine Learning, Robotics and Automation, Georeferenced systems

Digital Inclusion

Connect and strengthen digital empowerment, generating opportunities for communities

Futures screening themes - Domains

- Connectivity to railway lines, surrounding communities, trains and stations
- Community capacity building and digital literacy

Technologies

- Satellites and Radars, EdTechs, Mobile and Connection Technologies,

Digital Workforce

Rethink the workplace, now more digital than ever, to optimize individual and team productivity, collaboration and overall experience

Futures screening themes - Domains

- Productivity, collaboration and agility in remote work
- Secure, low-cost connectivity, including remote regions

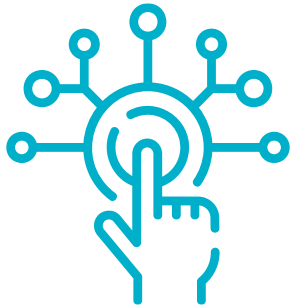
Technologies

- Cybersecurity, AI, AR/VR, Immersive workspaces, Cloud, Collaborative Tech, Automation, Analytics, Big Data

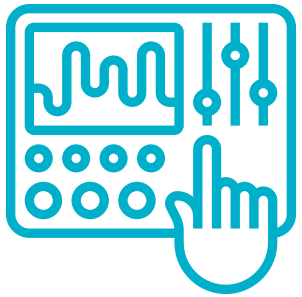
How to engage and assist us

If you have a product or service which you feel fits our needs, then we would like to hear from you.

1) Go to our website at the following link www.vale.com/openinnovation



2) Register on the AEVO, our innovation management platform



3) Complete the online form to tell us about the company and its product / service

4. Each day we screen and evaluate the ideas which are registered. looking for the high potential to explore in more detail

The Safety Theme

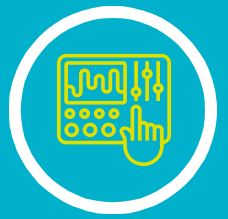
Safety Overview

Aspirations and Goals

A Safety Transformation…
Radically driven to Maximize Safety Impact.

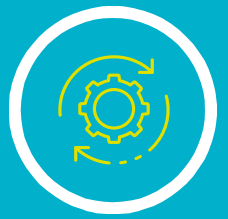
Guiding Principles

More Integrated: ***Full Alignment on risk / safety plans as common approach & singular priority;***
Precise Metrics ***for quantifying impact / benefits.***



Accelerate implementation of "Mitigation / Controls"

Eliminate risk scenarios by removing people from line of fire



Change Processes, to reduce exposure of people still on field

Reinforce Right Behaviours and guarantee it´s execution

Screening Scope - Safety

To face the complex challenges that are involve in the journey to zero harm, we need to take advantage of the full range of different sectors experiences, highlighting solutions and concepts that are currently being used by others. We could transplant these solutions to the mining industry and drive our goal of zero harm.

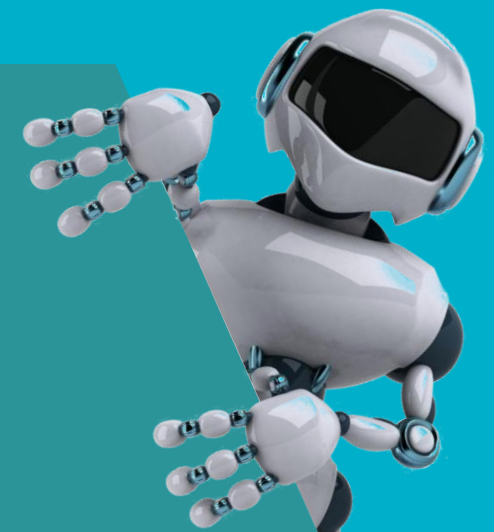
Safety Scope

Domains:

Key areas of interest

	Operation and maintenance of yards	Explosives Handling	Autonomous pelletizing	Safe rail operation
Details	Make the operation and maintenance of the yards autonomous, including inspection and control of the stock, industrial cleaning and drainage of the yard.	Make the explosives handling process as safe and autonomous / remote as possible, from manufacturing, loading the truck to loading the blasting mesh.	Automate the pelletizing process, from end to end, making it safer and more reliable. (Steps such as: grinding, filtering, pelletizing, burning, stacking, among others)	Make the railroad's remote, autonomous and intelligent operating activity for accident prevention with the asset operation and maintenance teams.
Examples	• Ore moisture monitoring • Control of drainage efficiency • Visual inspection of the patio and its components (video analytics, drones, etc.) • Industrial cleaning (conveyor, channel, among others) by remote or autonomous equipment	• Autonomous loading trucks • Explosives handling robots • Detonation inert to external risk factors (electrical discharge, overheating)	• Autonomous inspection and maintenance of the oven • Remote process monitoring • Industrial cleaning by autonomous / remote equipment (floor, equipment)	• Loading of ores on the wagons autonomously; • Maintenance robots • Remote railroad monitoring • Intelligent and autonomous locomotives

The Dams Theme



Dams Monitoring - Overview

Understanding the context for dam monitoring

We seek solutions for and with the Geotechnics area. Our goal Right enable a management of geotechnical structures more robust, reliable, connected and aimed at safety in the first place. We will be a great team that will leave a legacy of cultural transformation and new mentalities!

Zero losses from **Failures of geotechnical structures**

towards...

assure the **social, environmental and operational integrity**

Lives	+	**Environment**	+	**Community**	+	**Operation**	=	**Zero losses**

The risk is inherent to the operation, for this we must predict possible geotechnical failures and...

... act towards **avoid** that these **Failures** Occur...	... but if they do, make sure that **there is no loss.**

Dams descharacterization - Overview

Understanding the context behind the need for dam descharacterization

Mine tailings are a major waste stream generated in mining operations. Tailings are the waste material left over after the valuable component has been removed through processing. They include ground-up rock or sand, and the chemical reagents and process water used to extract the commodity. Tailings dams, also referred to as tailings storage facilities, are the most common method used to store this material. Most of the existing dams at Vale were built according to the "Upstream dams" method. In recent years, the company has been making several efforts in order to descharacterize some of its dams, making them inactive, to eliminate eminent rich breaches

Upstream dams

What is it?

The upstream raising method is the method of constructing dams where the raising massifs rest on the tailings or sediment previously released and deposited. Also being included in this category are the massifs formed on tailings of reservoirs already implanted;

Current goal:

After the dam rupture in Brumadinho, Vale announced a decharacterization plan to eliminate the risk related to other dams built with upstream alteamento method;

Uncharacterized structure:

It is a structure that does not permanently receive the contribution of tailings and/or sediments from its end activity, which ceases to have characteristics or perform a dam function, according to a technical project.

Screening Scope
Dams

One of the main challenges related to dams is in Safety, since we are dealing with extremely sensitive structures and with a high degree of risk for the people involved in the process. All fronts of opportunity are linked to increasing security, either for the people involved in the process or to increase the stability of these structures. We could translate these solutions for the mining industry and drive our goal of bringing insights due to this theme.

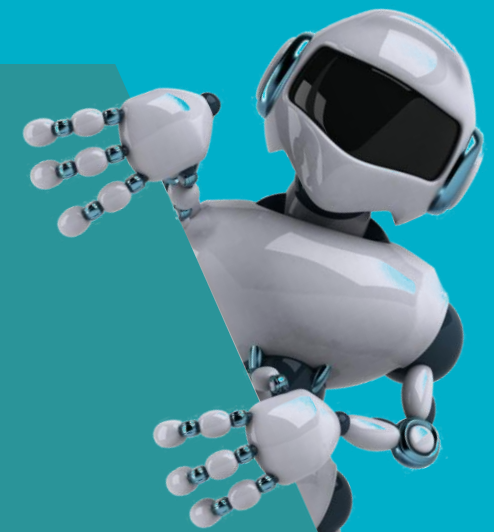
Dams

Domains:

Main areas of interest

	Safety in operations	Collecting dam information	Increased security and stability of structures	Simulated and Alert Systems
Details	Identify safe ways to access with people structures that are at the critical level and systems that are able to rescue people in an extreme case of disruption. As well as, map suppliers with integrated solutions of unmanned equipment for use in earthworks.	Seek alternatives for the monitoring of dams (active, interdicted and in decharacterization), either by innovative or traditional solutions in order to enable a management of geotechnical structures more robust, reliable, connected and aimed at safety in the first place.	Evaluate alternatives to increase the safety factor of the dam, either by waterproofing/increasing tailings resistance, by lowering the water level of the structure or by removing tailings.	Ensure and increase the safety of the affected population by: • Simulation simulated to train Vale and Communities employees in emergency cases. • Effective alert systems (including remote regions and no access to technology and connectivity)
Examples	• Lift Lines, rope Ways, basket with crane, Jet Suits • Unmanned trucks, tractors, excavators, loaders and motor graders • Solution with the automation kit already integrated into unmanned equipment	• Equipment capable of conducting surveys, tests CPTu, collection of unformed samples and installation and maintenance of instruments remotely • Confirm the current resistance parameters of the materials that make up the dams • AI, Robots, IOTs, drones, video Analytics digital twins, AR, RV • nanotechnology	• Water level/water table lowering alternatives in critically-level structures in a safe manner, avoiding people • Chemical injections • (FS is directly related to material saturation). • Dredges • Remote pumping systems • Amphibious excavators	• Communication technology/ Inclusive communication (for remote areas and devoid of technology, people with special needs) • Simulated table top and face-to-face • Alert systems (apps, automatic activation of sirens, radios, TV, SMS, drones or other systems)

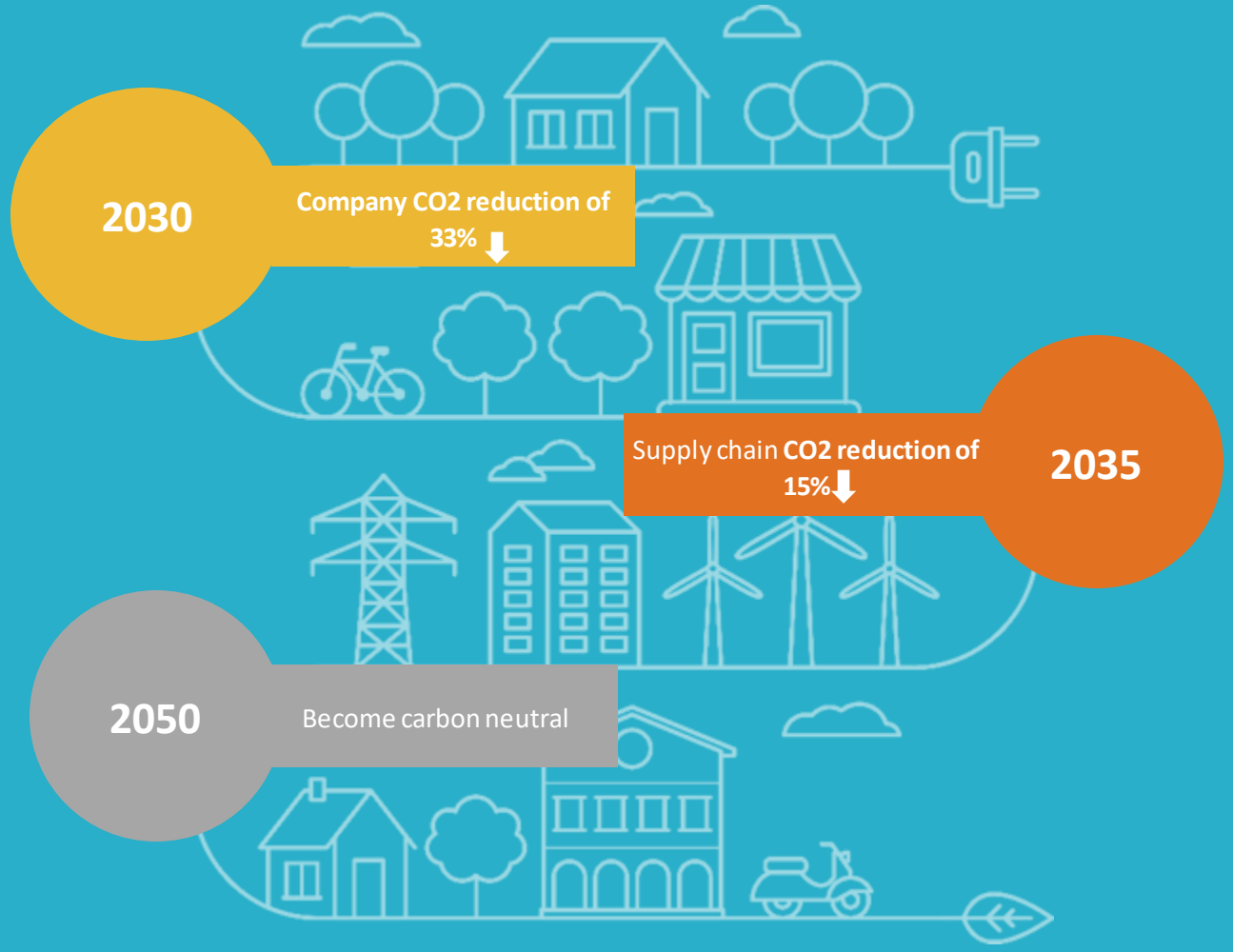
The Low Carbon Theme



VALE ESG's INITATIVE OVERVIEW

Taking responsibility with bold decarbonization goals

Vale carbon reduction objectives:



Vale scope definition:

Scope 1

Emissions from our operations due to the consumption of diesel, natural gas, coal, and gasoline, for example. These are the **emissions under our (Vale) control and management.**

Scope 2

These are **indirect emissions from the consumption of electric power** or steam. We do not manage directly but we can be more efficient and reduce emissions indirectly.

Scope 3

Emissions from the value chain, that is, emissions from our suppliers, outsourced transport, and our customers. Emissions from the steel industry, for example, are classified as Scope 3.

Vale Futures

Screening Scope
Low carbon

To tackle the complex challenges of decarbonization an energy intense operation like Vale's, we need to take advantage from the full range different industries, by highlighting solutions and concepts that are currently being used on other verticals, we could translate those solutions to the mining industry and boost our goal of neutralizing carbon

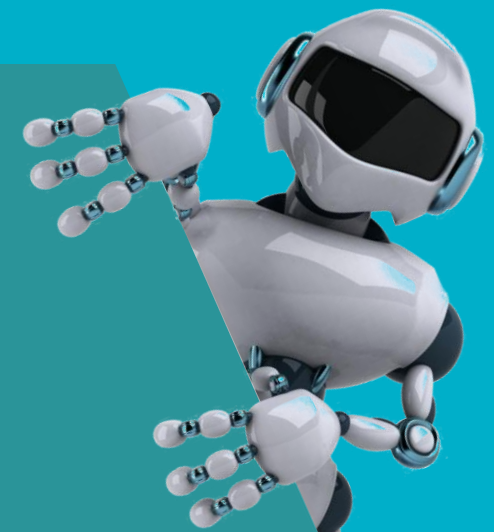
DOMAINS:

Main areas of interest

	Material and cargo transportation	Process and Fuel optimization	Long haul logistics	Energy generation	ESG – Platform and data analytics
DETAILS	Use of electrical vehicles and mine equipment, including studies for infrastructure and battery recharging, in addition to assessing the use of alternative fuels	alternative fuels that can substitute current solutions, new processes and new energetic fuel applications	Railways, shipping, aerial routes and others. Electrification studies, use of artificial intelligence, alternative fuels, hybrid technologies and carbon offset solutions.	Prospecting and acquisition studies for new projects on electricity generation based on renewable energy sources;	Data analytics tool, focused on Carbon Emission control and management, prediction and scenario modeling, as well as MAC curve

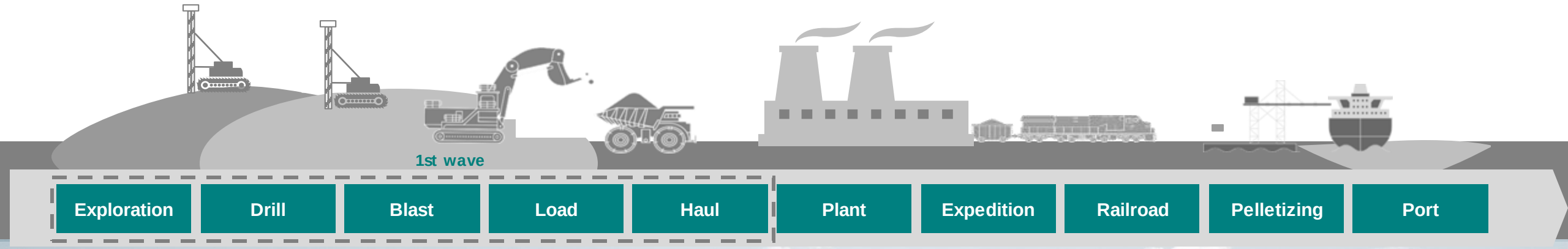
EXAMPLES	• Enabling technologies for: Electrification, fuel efficiency, alternative fuel
	• Charging/energy supply solutions for: electric engines, heavy duty and moving machines
		• Natural gas substitution:
		  • Biomass
		  • Hydrogen
		  • Plasma burners
		• Heavy Oil substitution
		  • Bio-oil
		• Biofuels
			• Alternative fuels technologies
			• Battery electric powertrain and/or support
			• Hybrid approaches
			• Alternative propulsion technologies
				• BESS - Battery Energy Storage Systems, to support intermittent renewable energy generation and other applications
				• Enablers for sustainable energy transition
					• Better tools for data entry across multiple areas and scenarios
					• Facilitated data analysis and modeling
					• Able to use legacy data
					• Sustainability and emission control focused

The Insights Across Value Chain Theme



Insights Across Value Chain- Overview

Leverage our Mine Planning & Geoscience practices to world class standards and integrate them to value chain operational plans and schedules



Scope Integrated Mine Planning

Promote Geoscience Collaboration and Integration, Long and Short Term Mine Planning and other areas (e.g. Process, Laboratories)

Structuring areas

Checks & balances for risk management (feasibility) and search for opportunities - **2nd Layer**

Integration and Standardization of Processes, Systems and People and **integrated discussion of KPIs**

Vale's Maturity Assessment and Action Plan for Evolution towards global benchmarking

PMO for control of assumptions, and monitoring of milestones and initiatives

Screening Scope

Insights Across Value Chain

To face the complex challenges that involve the integration of the value chain operation, from mine to plant, we need to take advantage of the full range of different sectors, highlighting solutions and concepts that are currently being used in other verticals. We could translate these solutions for the mining industry and drive our goal of bringing insights to an integrated and optimized value chain.

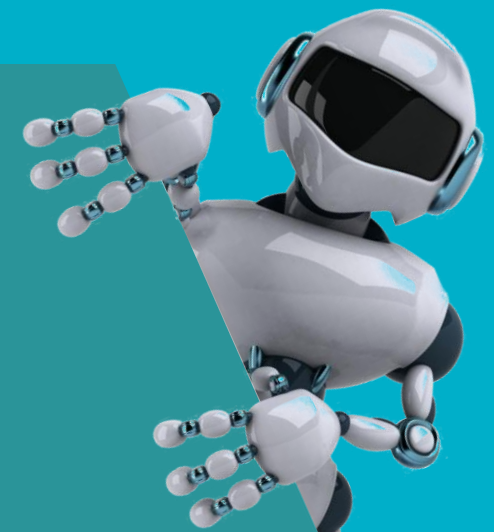
Insights Across Value Chain- Overview

Domains:

Main areas of interest

	Geological knowledge	Precision Planning and Topography	Traceability and prediction	Integration and decision-making optimizers
Details	Increase geological knowledge in the short term to allow decision making and stability in the mine planning, programming and operation processes.	Mine planning integrated across different horizons (long to short term) with reliable assumptions, unified data repository and reliability analysis of plans.	Constant, real-time monitoring of quality and traceability information at the mine, plant and yard stages.	Optimization for decision making of different natures: • Analysis of unexpected events and the suggestion of a route to resume the axis • Optimization in the allocation of mine resources • Integration and optimization of mine plans between different operational units
Eexamples	• Litological demarcation • Rock information: Type; Content (geochemistry); Toughness; Geometallurgy; Geophysics • Technologies for rock sampling, quarting and analysis • Video analytics • Data analysis	• Data repository of unified assumptions and plans • Dynamic update of topography data: drones, video analytics, UAVs • Prescriptive analysis of mine plans based on historical data: bigdata, AI, analytics, clous, etc.	• Dispatch systems (truck fleet) integrated with mine quality information • Power plant video analytics • Digital Twin • Automation • Machine Learning for plant equipment	• Analytics • IA • Big Data

The Digital Inclusion Theme



Digital Inclusion - Overview

Availability of educational content for free

Digital platform that can be used to share educational content for the communities where Vale is located

Technologies to ensure connectivity in remote areas, such as balloons, unmanned aerial vehicles, satellites, optical fibers, radios, 4G, among others

Technologies for interaction and engagement with users, which promote connectivity in a healthy way and allow interaction between providers in a gamified or personally constructive manner

Low cost ways to transmit data to remote areas

Digital content distribution solutions focused on digital inclusion. Benchmark: systems that run on commercial aircraft (BR)

Software and hardware solutions capable of ensuring communication over long distances, connectivity infrastructure in general, etc.

Low-cost devices for digital accessibility: Tablets, Computers, Cell Phones, Arduino and Raspberry Pi (circuit boards that allow the construction of very low-cost computers)

Screening Scope
Digital Inclusion

One of the main challenges for digital inclusion is to provide infrastructure, as well as educational content for the communities around Vale's operations in order to foster social development. Face this complex challenges we need to take advantage of the full range of different sectors, highlighting solutions and concepts that are currently being used in other verticals. We could translate these solutions for the mining industry and drive our goal to foster digital inclusion.

Digital Inclusion

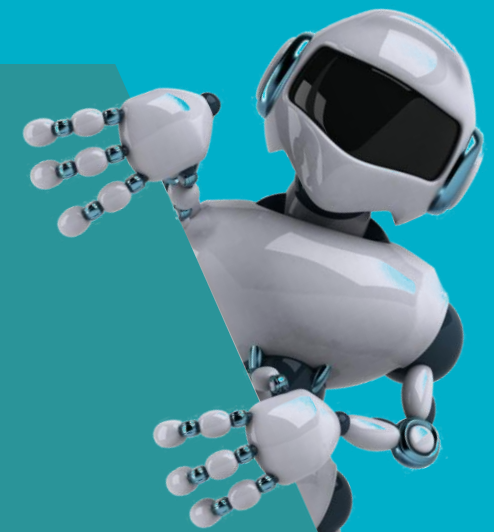
Domains:

Main areas of interest

	Connectivity to communities, surrounding Vale operations	Community capacity building and digital literacy by content	Community capacity building and digital literacy by a platform	Devices para accessibilities digital
Details	Delivery of connectivity to large regions, sometimes remote and that have the capacity to serve a large number of people, in addition to being able to guarantee communication over long distances	Solutions that deliver content for digital literacy	Educational content for communities	Solutions that deliver devices
Eexamples	• TV/Satellites • Optical fiber • 4G e 5G • LTE • Radios • Peer-to-peer communication	• Platforms that can be accessed by a large number of students • Platforms with diversified content on basic topics to access opportunities in the job market	• Differentiated business model that strengthens the sustainability and scalability of the solution • Companies that produce educational content	• Tablets • Computers • Smartphones • Arduino and Raspberry pi (circuit boards that allow the construction of very low-cost computers)

VALE

The Digital Workplace Theme



Digital Workplace - Overview

Taking responsibility with bold decarbonization goals

Vale's Journey
Vision and Principles

Tech Future Vision

Our Purpose

- Risk reduction
- Improve productivity
- Inclusion and easier attraction of global talents
- Digitalization of everything
- New ways of interaction
- **Zero** Non-ops functions on opp sites;
- **Large scale** usage of Remote Work
- **Leaders empowered** to redesign work, supported by the program

What we aim for

Connectivity

Digitally enable workforce

Productivity

Cyber Security

Screening scope
Digital Workplace

One of the main challenges for a digital workplace is to set technologies, tools and practices that allow work collaboratively and productively. Face this complex challenges we need to take advantage of the full range of different sectors, highlighting solutions and concepts that are currently being used in other verticals. We could translate these solutions for the mining industry and drive our goal to foster digital workplace.

Digital Workplace

Domains:

Main areas of interest

	Productivity and agility in remote work	Communication, location and access to information	Accessibility for people with special needs (PCD)	Employee well-being
Details	Tools that allow collaborative and digital work, reducing the need for manual / repetitive activities, in order to generate greater productivity and agility.	Promote effective communication, with simple and efficient access to diverse information, including the location of employees geographically separated and to locations with different infrastructure, including remote locations.	Provide accessibility and inclusion for people with special needs within the context of remote and digital work.	Avoid employee burnout, promote more accessible monitoring in relation to the health of employees and increase the engagement and satisfaction of the teams as a whole.
Examples	• RPA (robotic process automation) • Analytics (general mode) • IA • Immersive workspaces • Collaborative tech	• Devices • Mobile Solutions • Connectivity • TV / Satellites • Optical fiber • GPS • Cybersecurity • IOT	• Simultaneous translation • Automatic caption • Audio description • IA • AR / VR	• New methodologies • Productivity Tools • Well Being Tools • IA • AR / VR

Let’s go together?

#bethechange
#valefutures

www.vale.com/openinnovation