2023
TNFD Report

Photos: Ricardo Teles

Introduction

The **TNFD** (Taskforce on Nature-related Financial Disclosures) is a science-based global initiative led by institutions connected to the financial market, and supported by governmental institutions. The main objective is to provide businesses with a structure designed to manage and disclose risks related to nature, using a set of recommendations and orientations to identify, measure and report their dependencies, impacts, risks and opportunities.

The TNFD's disclosure recommendations and orientations are based upon four pillars: Governance, Strategy, Risk Management and Impacts, and Disclosure Metrics and Targets. These pillars are connected to the **'LEAP' approach – Locate, Evaluate, Assess and Prepare** – which underpins the identification, management and disclosure of the nature-related issues.

In 2022, Vale began engaging with the TNFD, participating in its discussion forum, collaborating with feedback for the construction of the framework, and developing pilot projects to test its application. This report presents the results of the application of the LEAP approach to our direct operations in Brazil using the TNFD v0.4 version.

L

Locate the interface between the organization and nature.

Where are its assets and direct operations located, including its activities in the value chain?

Which biomasses and ecosystems have an interface with these activities, and what is the integrity and importance of these ecosystems and their degree of priority for conservation?

E

Evaluate the organization's nature-related dependencies and impacts.

Identify the environmental assets and ecosystemic services upon which the organization is dependent, as well as its impact drivers.

Identify these dependencies and impacts as well as their scale.

A

Assess the business' nature-related material risks and opportunities.

Identify these risks, what mitigation measures are already being applied and which need to be applied.

Define which risks and opportunities should be disclosed.

P

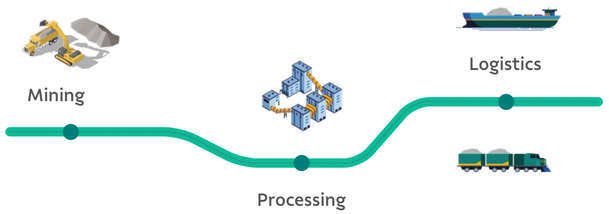
Identify what strategy and resource allocation decisions should be made.

Define directives and targets to measure progress.

Prepare the information that should be disclosed and how it is to be presented to the public.

Scope

2023 Scope The pilot that was developed in 2023 involved Vale's direct operations located in Brazil (mining, including processing and logistics – railroads and ports), taking into account iron ore and base metals, with a total of 50 assets being analyzed.



Data: The analyses used data relating to the impact drivers reported annually by the sites forming part of the indicators related to the GRI, SASB, TCFD and ICMM PE standards, covering the period 2018 to 2022 (the most up-to-date data available at the time the pilot was developed), relating to the issues of water, biodiversity, emissions, pollutants, waste, impacts, and recovery and conservation actions. Also used were secondary data available in public databases and tools suggested by the TNFD framework itself.

Tools consulted/used: ENCORE, Biodiversity Risk Filter, GLOBIO, Aqueduct 3.0, MapBiomas, Ecosystem Services Valuation Database (ESVD) and the SBTN Materiality Screening Tool.

The pilot was the result of the integration of different areas within Vale: engagement and transparency, biodiversity, water resources, traditional communities and indigenous peoples, climate change, risks, financial, supply and operations.

LEAP Approach

Locate

To assess the interface that our direct operations assets have with nature, a SIG was used for the intersection of the location shapes of these assets and for marking off their **area of influence**, with overlapping layers related to:

Area of influence

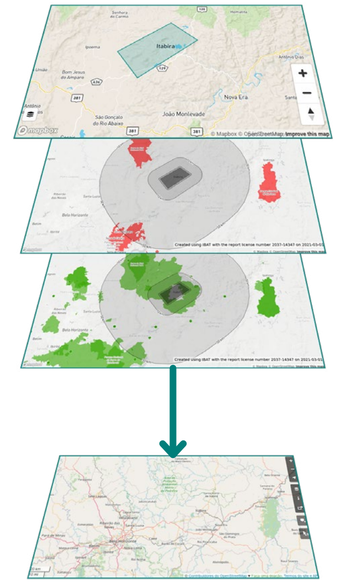
3 km buffer | 1 km buffer

*Manual for the Creation of Studies for Licensing with Environmental Impact Assessment (Cetesb, 2019)

Key

Mine | Railroad | Port

	Source	Geospatial information
	Supplied by Vale	**Area directly impacted by assets/operational sites**
Land Use	MapBiomas	Land use and coverage (2022)
	CECAV ICMBIO	Characteristics established by Speleology
	CECAV ICMBIO	Identification of Caves
	IBGE	Characteristics established by Geomorphology (2021)
	Embrapa	Classification of Brazilian soils (2021)
	Wildfinder Database	Identification of land ecosystems
	UNI Queensland	Ecosystem Integrity Index (Beyer *et al.* (2019))
Protected and prioritized areas	Funai	Location of Indigenous Lands (2021)
	Incra	Location of Quilombola Communities (2022)
	Incra	Location of agricultural reform settlements
	MMA	Protected areas (2022)
	MMA	Conservation of Biodiversity Priority Areas
	MMA	Ramsar Sites (2022)
	Supplied by Vale	Key Biodiversity Areas (KBA) (2017)
Water	Wildfinder Database	Identification of continental waters ecosystems
	Aqueduct	Basal water stress (2019)
	ANA	Hydrographic Regions (2022)
Species	GLOBIO	MSA (Mean Species Abundance) (Schipper et al., 2020)
	*species*Link	Distribution of species by selected area
	Supplied by Vale	Threatened species (IUCN, 2017)



Schematic diagram of the identification of the intersections of the priority interface tiers with the assets

LEAP Approach

Locate

The direct operations totaled an area of 65,000 hectares, with 37 operational units located in the Atlantic Rainforest biome (~26,000 ha) and 13 operational units in the Amazon biome (~39,000 ha). The area of influence covered around 780,000 ha.

The area of influence of the assets interfaces with 18 types of land use and occupation, with 46% involving native vegetation. The most abundant types were Forest Formation (38.37%) and Pastureland (31.55%).

It was established that 38 assets interface with Priority Areas for Biodiversity Conservation, four assets interface with Ramsar Sites,* and four assets are located in regions of high water stress.

The areas of influence of 40 assets interface with protected areas.

Prioritization Criteria

- High integrity locations and areas of rapid decline (Ecosystem Integrity Index)
- Interface with legally protected areas
- Interface with areas hosting threatened species (CR, EN, VU)
- Areas of high biodiversity value (KBAs, areas prioritized for conservation)
- Known water stressed areas

All the operational assets in Brazil are priority.

Prioritization requires analyses involving new attributes in the Evaluate phase.

Photos: Gabriel Rangel Lordello Souza

*Ramsar Site: a wetland site designated to be of international importance under "The Convention on Internationally Important Wetlands" (Ramsar Convention).

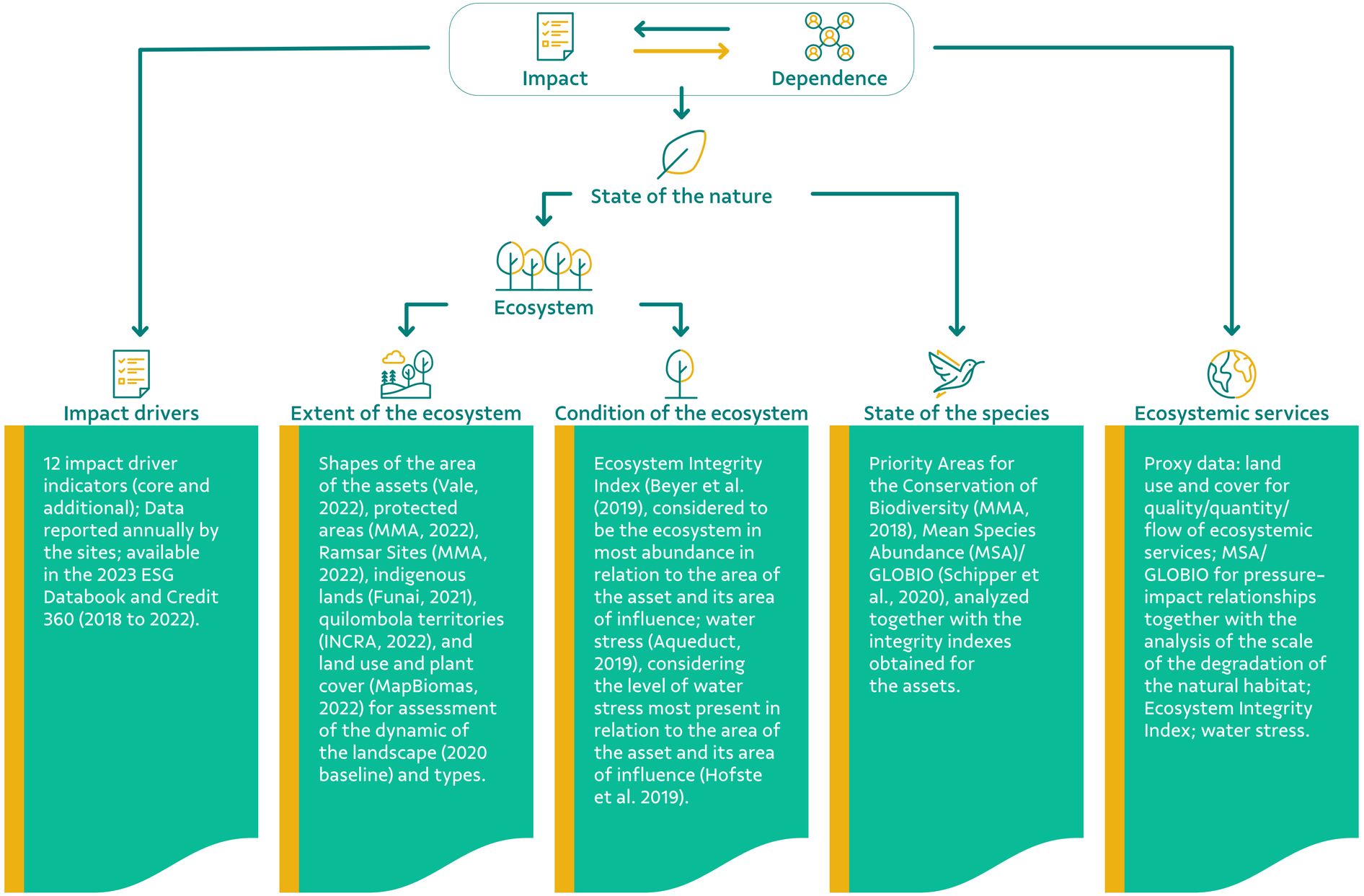
LEAP Approach

Evaluate

The impact drivers were measured using data relating to emissions, water use, pollutants, waste and biodiversity that are reported annually by the operations and are available at corporate level in the 2023 Vale ESG Databook. The data used was that available covering the period 2018 to 2022 (the most up-to-date data available at the time the pilot was developed).

Focusing on the State of Nature for the measurement of Extent of the Ecosystem, data was used relating to Protected Areas, Ramsar Sites, Traditional Communities and Land Use and Cover; for the Ecosystem Condition, the data used was drawn from the Ecosystem and Water Stress Integrity Index; whilst to measure the State of the Species, data were used from the Priority Areas for Conservation of Biodiversity and Mean Species Abundance (MSA).

For ecosystemic services, the assessment was performed by means of proxy data, using measurements relating to the ecosystems and the species. Based upon these data, a score was calculated that reflects the general condition of these services in relation to the location of the assets.



LEAP Approach

Evaluate

The SBTN materiality tool and ENCORE were used for assessment of the production processes and the materiality of the impacts and dependencies.

The main impact drivers associated with the production processes are related to the **water use and alterations to ecosystems**, these being directly related to the reality of the business.

The assets are largely dependent upon **water provision (ground and surface)**, whilst also of importance is **climate regulation, mass stabilization and erosion control**.

Vale's production process with the greatest amount of material impacts is mining, followed by ports and railroads.

Railroads and ports are Vale's production processes with the greatest **number** of material dependencies, although **mining** has the greatest amount of **high materiality** dependencies.

Key

Vale production processes

Mine | Railroad | Port

Materiality*

Very high | High | Moderate | Low | Non-material

Impact drivers	Materiality of the impact
Water use	Very high
Use of continental water ecosystems	Very high, Low
Use of marine ecosystems	Low
Use of land ecosystems	Very high, Low
GHG emissions	High, Moderate, Low
Non-GHG emissions	High, Moderate
Water pollutants	High, Moderate, Low
Soil pollutants	High, Moderate, Low
Solid waste	High, Low

	Ecosystemic services	Materiality of the dependence*
Provision	Ground water	High, Moderate, Low
Provision	Surface water	High, Moderate, Low
Maintenance	Water flow maintenance	High, Low
Maintenance	Quality of the water	Low
Maintenance	Climate regulation	High, Moderate, Low
Maintenance	Floods and storm protection	Moderate, Low
Maintenance	Mass stabilization and erosion control	High, Moderate, Low

*Materiality analysis based on ENCORE.

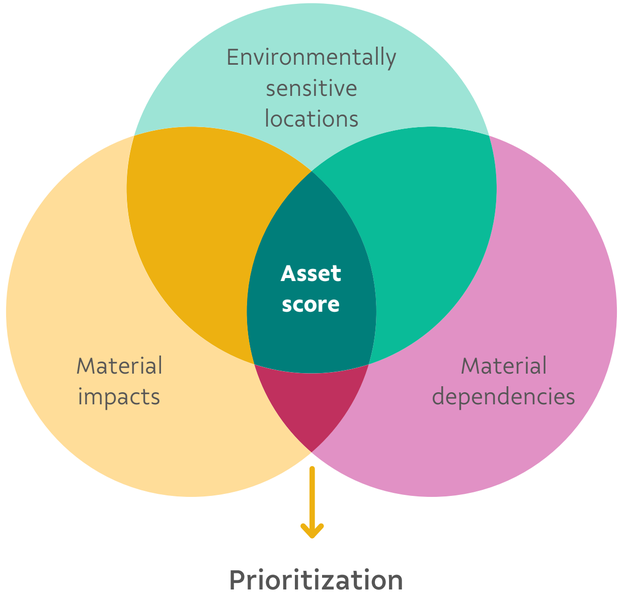
LEAP Approach

Evaluate

Based upon the materiality of the impacts and dependencies connected to the environmental sensitivity of the areas in which the operations are located, the prioritization was refined. A score was created as well as a ranking which identified the most sensitive areas where Vale's operations have the potential to cause the greatest environmental impacts (areas of greatest Nature Integrity), as well as where the integrity of nature has been historically affected, resulting in a scarcity of ecosystemic services (regions of less Nature Integrity).

We prioritized the two most extreme contexts which, connected to the impacts and dependencies, create an environment that is conducive to the development of risks, these being surveyed and presented in the next stage.

The table on the right shows the ten operations prioritized using this assessment.



	Position	Asset	Production process	State
Assets located in areas of greater natural integrity	1	Manganês do Azul	Mine	PA
	2	Salobo	Mine	PA
	3	N4 N5	Mine	PA
	4	S11D	Mine	PA
	5	Timbopeba	Mine	MG
Assets located in areas of less natural integrity	1	Tubarão Complex	Port	ES
	2	Vitória–Minas Railroad (stretches 1 to 5)	Railroad	MG and ES
	3	Carajás Railroad (stretches 1 to 6)	Railroad	PA and MA
	4	Minas do Meio (Itabira)	Mine	MG
	5	EFC 6	Railroad	MA

Key

Mine | Railroad | Port

LEAP Approach

Assess

1

Identification of risks

Using the impact and dependency relations, it was possible to identify those risks related to nature in each stage of Vale's production process and catalog two types of risks: physical risks and transition risks.

2

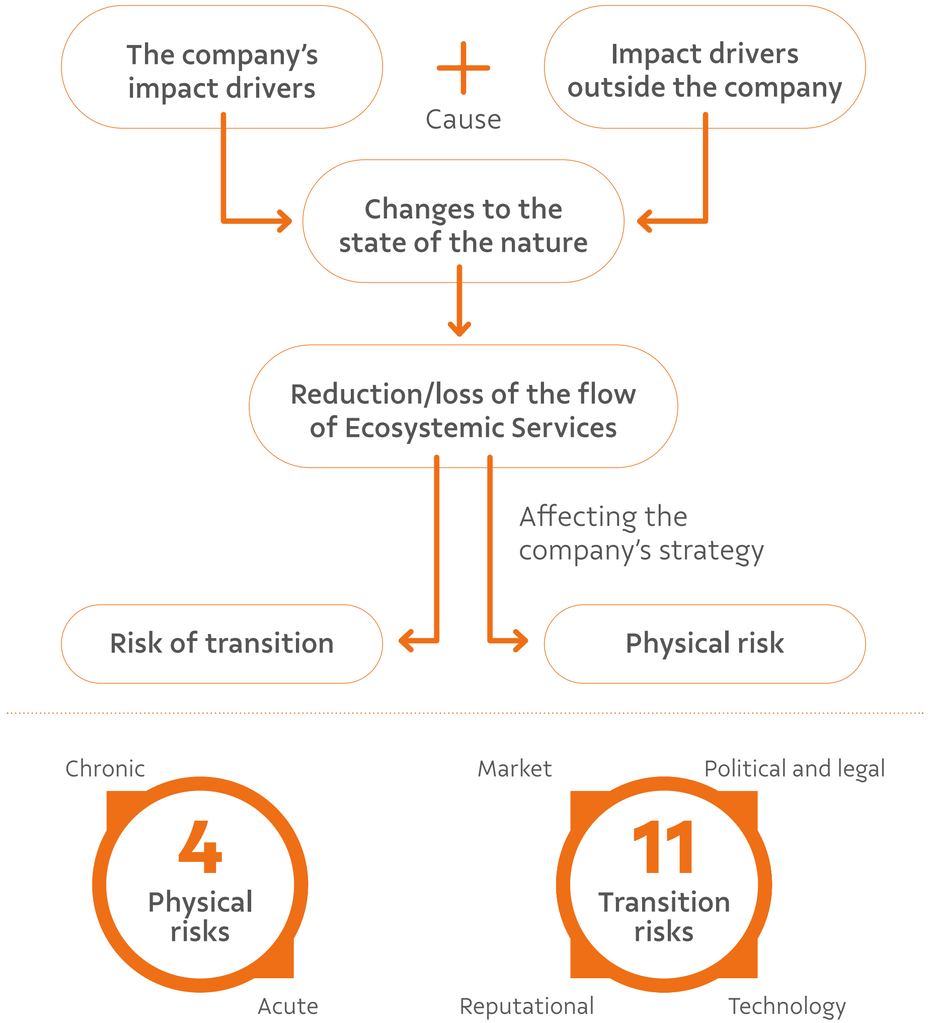
Risk mitigation measures

Based upon the nature-related risks identified, Vale's mitigation measures relating to such risks were analyzed.

3

Identification of opportunities

The opportunities related to nature were identified based upon the orientations provided by TNFD v0.4 and the risks identified.



Each physical risk was related to the main Ecosystemic Service upon which the production process depends and which will be affected in the event the risk materializes, along with the main impact drivers that cause the risk. Next, the physical and transition risks were described and classified according to their nature and the defined categories. Finally, the length of time the impact of the risk would last, if it were to materialize, was estimated.

Data and tools consulted/used:
Assessment of Environmental Impacts and Aspects (LAIA) and those of Vale's risks that have already been mapped, Integrated Report, EY Climate Risk Universe (EY's climate risk tool), ENCORE, Biodiversity Risk Filter, Biodiversity Risks and Opportunities in the Apparel Sector (Aiama et al. 2016) and the Natural Capital Leaders Platform (Cambridge University).

Below are details on the main risks mapped, with the different types of classifications and risks associated to the actions mapped for mitigation and control.

LEAP Approach

Assess

Risk	Classification	Manufacturing Process	Environmental Asset	Mitigation/Control
Reduction in the availability and flow of the water necessary for the production process	Physical – Chronic			Expansion of the water monitoring network; Management for a reduction in the use of water; Water Target; storage and reuse; innovation to reduce withdrawal of new water; ITV studies
Interruption of operations due to the reduction of the capacity of nature (structure of the ecosystems) to protect against floods and storms.	Physical – Acute			Vale Climate Forecast; Installation of radar systems; ITV Studies (climate, water resources); periodic analyses of operational risks
Loss of access to markets due to non-compliance/ failure to adhere to new commitments related to nature	Transition/Market			Stakeholder engagement program; relationship with investors; mapping and implementation of market trends
Exposure to litigation related to new regulations related to nature	Transition/Legal Political			Stakeholder engagement program; Compliance measures and monitoring of the external environment
Scrutiny and loss of investments due to the impacts on critical ecosystems and/or areas of essential importance to the conservation of biodiversity	Transition/ Reputational			ITV and partner studies (biodiversity, ecosystemic services, genomics, recovery); Biodiversity management plans (hierarchy of mitigation of impacts); Stakeholder engagement program; relationship with investors

Key

Mine Railroad Port *Habitat* Water Atmosphere Species

LEAP Approach

Assess

Category	Opportunities
Performance on sustainability – Protection, restoration and regeneration of ecosystems	Work on the conservation of protected areas, such as the Vale Natural Reserve; Recovery of areas through investment in sustainable productive systems (Forest Target); Investment in research and conservation of biodiversity (Vale Technology Institute and partnerships)
Performance on sustainability – Sustainable use of natural resources	Expansion of the water monitoring network and search for new technologies for the efficient use of water resources in the operations; Development of new technologies that reinforce the prevention of wildfires; Adoption of short, medium and long-term strategies for the responsible and transparent management of water resources; Sentinela Project, Artificial Intelligence for the optimization of diesel consumption by trucks off the highway
Performance in business – Efficient use of resources	Reuse of iron ore tailings at the Gelado Dam, in Carajás (PA); Reuse and commercialization of the sand generated from the iron ore tailings; Pico Blocks Factory, pilot unit producing products for civil construction using waste from the mining activities; Development of new operational technologies for the treatment of solid waste, wastewater and atmospheric emissions; Waste to Value Program
Performance in business – reputational capital	Stakeholder engagement program; ESG Portal, Community Relations Plans, active participation in forums, entities and associations related to sustainability and nature
Performance in business – products and services	Investment in businesses with a positive socio-environmental impact (Vale Fund), *Jornada Amazônia, Floresta Viva* (BNDES and companies), initiatives related to the generation of income and socio-productive inclusion (e.g. *Quebradeiras* Project)

LEAP Approach

Prepare

*Principal indicators and core measurements related to already published indicators**

65,000
ha of total area impacted in Brazil

38,000
Amazon Region

27,000
Atlantic Rainforest

49,000
Mines and structures

13,000
Railroads

3,000
Ports

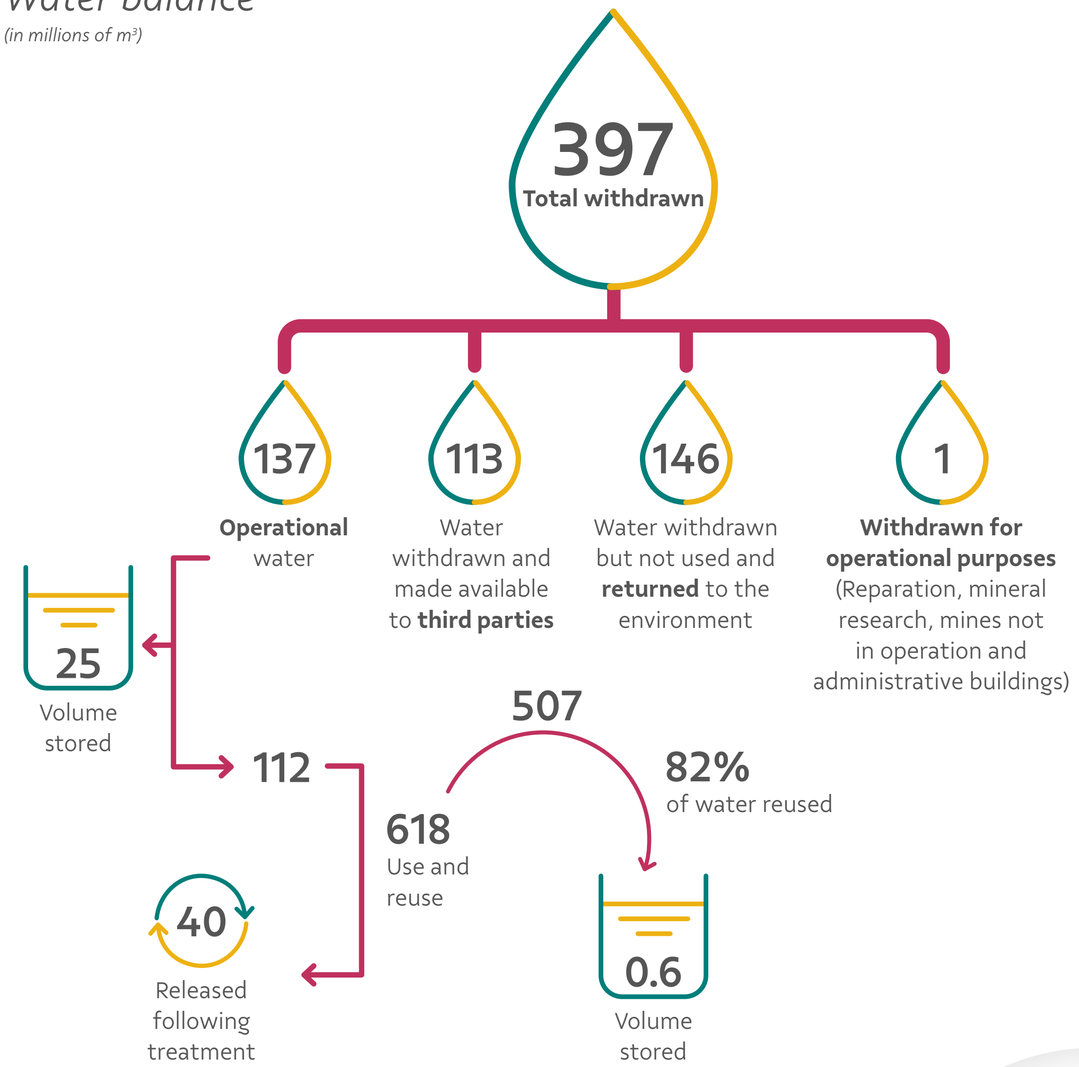
956,000
ha of protected areas

799,000
Obligatory

165,000
voluntary

For each ha altered/ impacted in the world we protect 11 ha

Water balance
(in millions of m³)



*Indicators published in the 2022 Integrated Report, 2022 ESG Databook, 2022 CDP (the most up-to-date data available during the creation of the pilot) (2023).

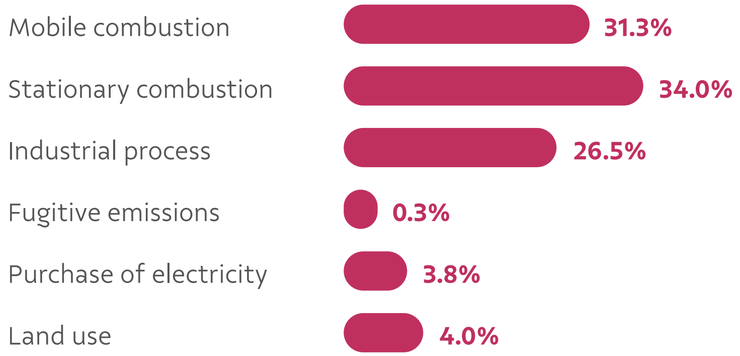
LEAP Approach

Prepare

Scopes 1 and 2 GHG emissions

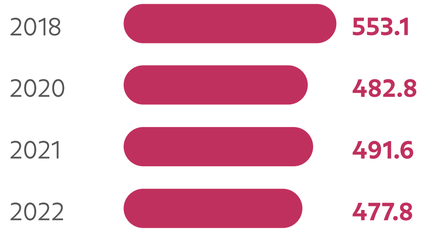
(in millions of tons of CO_2e)

Emissions/Year	2017 (base year)	2020	2021	2022
Scope 1	10.9	8.4	8.7	8.6
Scope 2 (market based)	1.3	0.4	0.3	0.3
Total	**12.2**	**8.8**	**9.0**	**8.9**



Scope 3 GHG emissions

(in $MtCO_2e$)



Emissions of particulate material (PM)

(in kt)

	2019	2020	2021	2022
Nickel	6.6	7.3	3.3	2.6
Pelletizing	2.1	1.6	1.4	1.6
Manganese	0.4	0.1	0.1	–
Total	**9.1**	**9.0**	**4.8**	**4.2**

Emissions of SO_x

(in kt)

	2019	2020	2021	2022
Nickel	71.0	90.2	66.1	66.5
Pelletizing	11.4	7.5	8.2	7.1
Logistics	2.3	0.5	2.0	1.9
Other businesses	1.5	0.9	1.2	0.2
Total	**86.2**	**99.1**	**77.5**	**75.7**

Emissions of NO_x

(in kt)

	2019	2020	2021	2022
Nickel	12.2	15.2	8.0	5.7
Pelletizing	11.5	14.1	18.1	19.8
Logistics	1.6	0.5	3.0	2.9
Iron ore	11.8	16.5	18.3	15.6
Other businesses	3.2	0.9	1.4	0.8
Total	**40.3**	**47.2**	**48.8**	**44.7**

N.B.: The reduction of NOx emissions, noted in the nickel business, is due to the reduction in the production at PTVI in 2022 and operational improvements.

*Indicators published in the 2022 Integrated Report, 2022 ESG Databook, 2022 CDP (the most up-to-date data available during the creation of the pilot) (2023).

Photos: Marcelo Coelho

Next steps

The results of the pilot allow us to arrive at the material impacts and dependencies that are already known, but are now assessed using a systematic and globally recommended methodology.

We have identified that the risk assessment methodology and processes used by Vale and established in its regulations that have already been applied by all the areas adhere to the methodological processes proposed in the framework.

We have verified that the principal material risks that have been mapped relating to climate, water resources and communities are already known and managed as part of the processes currently implemented at Vale, their assessment having been complemented by the methodology. Furthermore, the results are supporting a review of the biodiversity risk management process, with more in-depth analyses and management.

In relation to the next steps, in 2024 we are adapting our ESG Portal in accordance with the disclosure recommendations, and we are working together with the supply team to construct a capacity-building and knowledge sharing process to our suppliers.

We have committed ourselves to being TNFD Early Adopters, meaning that by 2026 (2025 data) we will disclose our nature-related risks in connection with the company's business reports.

Credits

Vale | **Maria Luiza Paiva** – *Executive Vice-President of Sustainability*
Hugo Barreto – *Director of Climate, Nature and Cultural Investment*
Patrícia Daros – *Director of Nature-Based Solutions*
Bianca Conde – *Manager of Engagement and Transparency in Sustainability*
Letícia Guimarães – *Biodiversity Specialist*
Luiz Felipe Campos – *Technical Manager of Biodiversity, RAD and Liabilities*
Marina Carmona Hernandes – *Biodiversity Consultant*

EY | **Leonardo Dutra** – *Sustainability and Climate Change Partner*
Mariana Faria – *Executive Director of Sustainability and Climate Change*
Camila Chabar – *Manager of Sustainability and Climate Change*
Diogo Costa – *Senior Consultant on Sustainability and Climate Change*
Alan Marini – *Consultant on Sustainability and Climate Change*
Alexandre Carmo – *Consultant on Sustainability and Climate Change*
Gabrielly Rauch – *Consultant on Sustainability and Climate Change*
Lara Vitali – *Consultant on Sustainability and Climate Change*
Rafael Esteves – *Specialist Consultant*

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VALE