



Climate Change Report **2021**



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Letter from the CEO

Over the past few years, we have seen an increased recognition of the urgency to address the climate challenge once it represents a threat for our industry and for the society. Vale exists to improve life and transform the future. And, together with our stakeholders we are facing this challenge. The low carbon mining is one of our priorities, with a value chain cross agenda.

For scope 1 and 2 emissions, our goal is a 33% reduction up to 2030, although our increasing projections on iron ore production in the next years. This commitment is aligned with the Paris Agreement goal of limiting global average temperature rise to well below 2 degrees Celsius.

One important component to deliver that reduction is achieving 100% renewable electricity consumption in our operations. We will do that in Brazil within only 4 years, by 2025, and globally, by 2030.

For our scope 3 challenge, we were the first among our peers to set a quantitative target for scope 3 emission reductions – we will reduce our net scope 3 emissions in 15% by 2035, compared to 2018 levels. And, we are well-positioned to help our clients to reduce their carbon footprint.

Today, almost 90% of our iron ore products have the high-quality required for the transition, representing less fuel consumption and emissions in the steel-making process. Our nickel products are among the lowest CO₂ intensive in the industry, contributing to much lower carbon emissions in its value chain.

And we carry out sustainable mining practices together with forest conservation worldwide. As an example, over 60% of our iron ore is produced within the Amazon region. There, we are responsible for protecting 800,000 hectares, an area five times the size of London. And we are developing projects that generate income and positive socioeconomical impacts in local communities.

To reach our climate commitments, we have defined a robust climate governance. Our Board of Directors provides us with its strategic guidance, and it is supported by a Sustainability Committee, comprised of Board members and an external independent member.

Through the first Climate Change Report, we transparently disclose the results achieved so far by our initiatives and how we are preparing, together with all our stakeholders, for the next challenges towards our purpose: we exist to improve life and transform the future.

Eduardo Bartolomeo, CEO

At Vale, we are changing how we mine to serve a changing world.



Amanda Neves Lírio
Canaã dos Carajás, Pará

Executive Summary

What are our **climate change strategic goals?**

Leading the transition towards low carbon mining based on our net zero strategy

Reduce scope 1 and 2 emissions by
33% by 2030



100% electric locomotive, EFVM railway, ES

100% renewable electricity
in Brazil (2025) and globally (2030)



Folha Larga Sul wind plant, Campo Formoso, BA

Reduce net scope 3 emissions by
15% in 2035



Complexo Vargem Grande, Nova Lima, Minas Gerais (MG),

Net zero
scope 1 and 2 emissions by 2050



Electric excavator, Itabira, MG, Brazil

What differs us?

Vale's competitive advantages

High-quality portfolio

Supporting steel decarbonization and powering the energy transition



High-grade Iron Ore and Nickel portfolio

Leader in renewable energy

~90% renewable electricity globally in 2020



Karebbe hydroelectric plant, Indonesia

Sustainable mining

1 million hectares of forests protected, ~80% in the Amazon



Carajás National Forest, PA, Brazil

Reducing our **operational emissions**

Scopes 1 and 2

Vale's first pillar of climate action is related to minimizing our operational emissions. We have a goal of reducing scope 1 and 2 emissions in 33% by 2030, aligned with the Paris Agreement goal of limiting global average temperature rise to well-below 2°C.



2025

Short-term target

Consume 100%
renewable power in Brazil

2030

**Medium term
Paris-aligned target**

Reduce 33% of scope 1
and 2 absolute emissions

Guarantee 100%
renewable energy
consumption globally

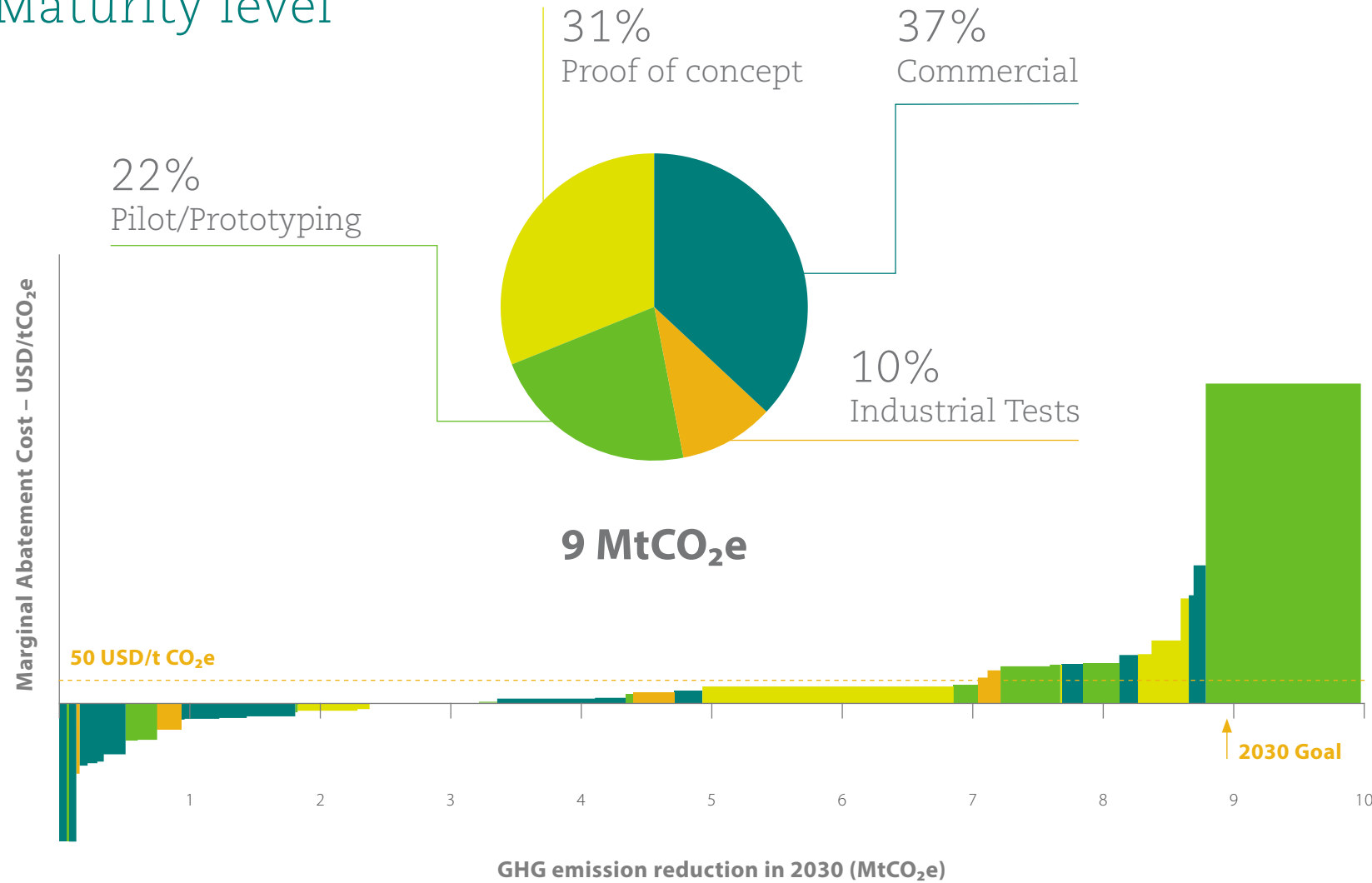
2050

Long-term target

Achieve net zero
scopes 1 and 2 emissions



Maturity level



To achieve our Scope 1 and 2 emission reduction commitment, we have announced in 2021 that we will invest USD 4-6 billion until 2030. In order to prioritize the most cost-efficient initiatives to be implemented, the company has an annually updated **marginal abatement cost curve (MACC)**. We are committed to developing and implementing innovative lower carbon technologies, ~50% of commercial initiatives mapped in our MACC are already entering Front-end loading (FEL) stage, **~80% of initiatives mapped are NPV positive¹ at the considered shadow price.**

In 2020, investments in projects to reduce Greenhouse Gases (GHG) emissions totaled USD 81 million. Examples include pilots for bio-oil and biocarbon use in pelletizing furnaces, underground battery electric vehicles and electric locomotive pilots. More details in page 13 – Reducing operational emissions – scopes 1 & 2.

¹ As of June 2021. Values include assumptions for low maturity technologies, carrying uncertainties.

How will Vale reach net zero (scopes 1 and 2) by 2050?



Prioritization of operational emission reductions

- Continuously reduce scopes 1 and 2 emissions through innovative processes, technologies and partnerships



Nature-based solutions with socioenvironmental co-benefits

- Vale differentials – Fundo Vale impact investing strategy, leveraging local opportunities
- NBS and removals as additional lever for climate change mitigation



High-integrity carbon markets for residual emissions

- Guarantee of additionality and permanence
- Positive socioenvironmental impact, contributing to SDGs
- Careful accountability based on international best practices
- Transparency on credits used and projects supported



To reach our net zero by 2050 target, our number one priority is to continuously reduce our operational emissions,

through innovation and technology. Science recognizes that, as a hard-to-abate sector, we may also rely to a limited extent on carbon offsets and removals. We will leverage on our expertise and know-how to address sound nature-based solutions. And we will also count on high-quality and credible carbon markets, aligned with international best practices.

At Vale, we have a forest vocation. Globally, Vale supports the conservation of approximately 1 million hectares of forests, that currently store up to 600 million tons of CO₂e. We have been operating in the Amazon for more than 30 years helping to protect approximately 800 thousand hectares of rainforest.

In 2019, Vale set a target of protecting and reforesting 500 thousand hectares of native forests up to 2030, beyond its borders. We believe that Vale can be a catalyst for “impact carbon” projects that generate carbon sequestration or storage, as well as avoided emission from forest degradation, with significant socioenvironmental benefits.

Our scope 3 strategy

We recognize that we can only lead the mining industry towards a low carbon economy if we induce our value chain on the same direction.

About 97% of these Scope 3 emissions are downstream in our value chain, mainly in steelmaking.

In late 2020, Vale set the first quantitative scope 3 target among our peers. **We will reduce net scope 3 emissions in 15% by 2035, based on development of new products, nature-based solutions, partnership and engagement with clients and suppliers.** Vale will review its scope 3 target by 2025 and every five years, given the uncertainties regarding low carbon technologies and climate policies. We will achieve this target through three main pillars: our high-quality portfolio, partnerships with clients and suppliers, and limited use of high-integrity carbon credits.

Iron ore quality premia will be pushed higher by:



Higher fuel costs per ton in ironmaking



Demand for high productivity, resulting from bottlenecks in low CO₂ iron production capacity

Vale is naturally well positioned for a market that values high quality and low CO₂ emission products

Vale will benefit from the decarbonization trend by:

1

Developing **low to zero CO₂ iron ore agglomeration products for the blast furnaces** at an accelerated pace.

2

Using proprietary technology to offer more of **the top-end premium products (>68% Fe)** necessary to the EAF production route.

3

Establishing with partnerships for the use of leading technologies to help accelerate the transition away from BFs to lower CO₂ ironmaking routes.

Vale has a **robust climate governance**



Executive Board and Sustainability Committee:

Strategic oversight and support



Low Carbon Forum:

C-level monthly meetings to track
performance and ensure delivery



Climate-aligned executive incentives:

Climate-related compensation: 5% of short-time
(out of 10% related to Sustainability) and 6% of
long-term compensation (out of 20% ESG-related)



Eduardo Bartolomeo
CEO (Chief Executive Officer) of Vale

Vale consistently manages climate risks and opportunities according to **Task Force on Climate-Related Financial Disclosures (TCFD)** guidelines

In 2020, Vale conducted a change climate scenario analysis of its portfolio based on the International Energy Agency (IEA) scenarios. In this challenging context of decarbonization, our key commodities will be at the forefront of the challenges and opportunities posed by the climate crisis. Copper and nickel will fully support the energy transition, representing key materials for building up the necessary renewable infrastructure and supporting the transport electrification through the electric vehicles (EV). Steel, produced from iron ore and metallurgical coal, will continue to be the material of choice for wind turbines, transmissions lines, and the necessary

infrastructure to grant universal access to electricity and alleviate extreme poverty. Thermal coal, among other fossil fuels, will have to be gradually displaced by alternative energy sources while retaining share under special circumstances especially when combined with, and supported by Carbon Capture, Usage and Storage (CCUS) mechanisms. **Under several climate change scenarios, Vale's EBITDA performs in a range of 90% to 140% in relation to base case.** Such resilience is the result of a flexible portfolio; capable of adapting to different market conditions and well aligned with energy transition trends. Get more details on our climate scenario analysis at page 31.

Vale's EBITDA in 2040

Base Case¹ = 100




- This analysis was performed based on the production volume considered in the Strategic Plan in 2040;
- The simulations considered, in addition to the volume, other implications from each scenario, such as commodity prices and cost impacts;
- The STEPS and SDS scenarios embrace the maximization of high-quality ferrous products and opportunities for additional volumes in nickel and copper.

¹ Base case – Strategic plan volume in 2040, considering Wood Mackenzie price in September.

Vale is also driving physical climate resilience in our operations through **Vale Climate Forecast, a methodology for analyzing short and long-term risks and opportunities related to climate change.** Vale Institute of Technology downscaled the global warming models referenced by the Intergovernmental Panel on Climate Change (IPCC) to the Brazilian reality. This allowed Vale to identify changes in rainfall patterns and volumes, and temperature variation for all operations in Brazil. The RCP 4.5 and 8.5 models were regionalized. Read more about it in page 36.


Causes

 **Atmospheric discharge**
Strong winds
Temperature increase

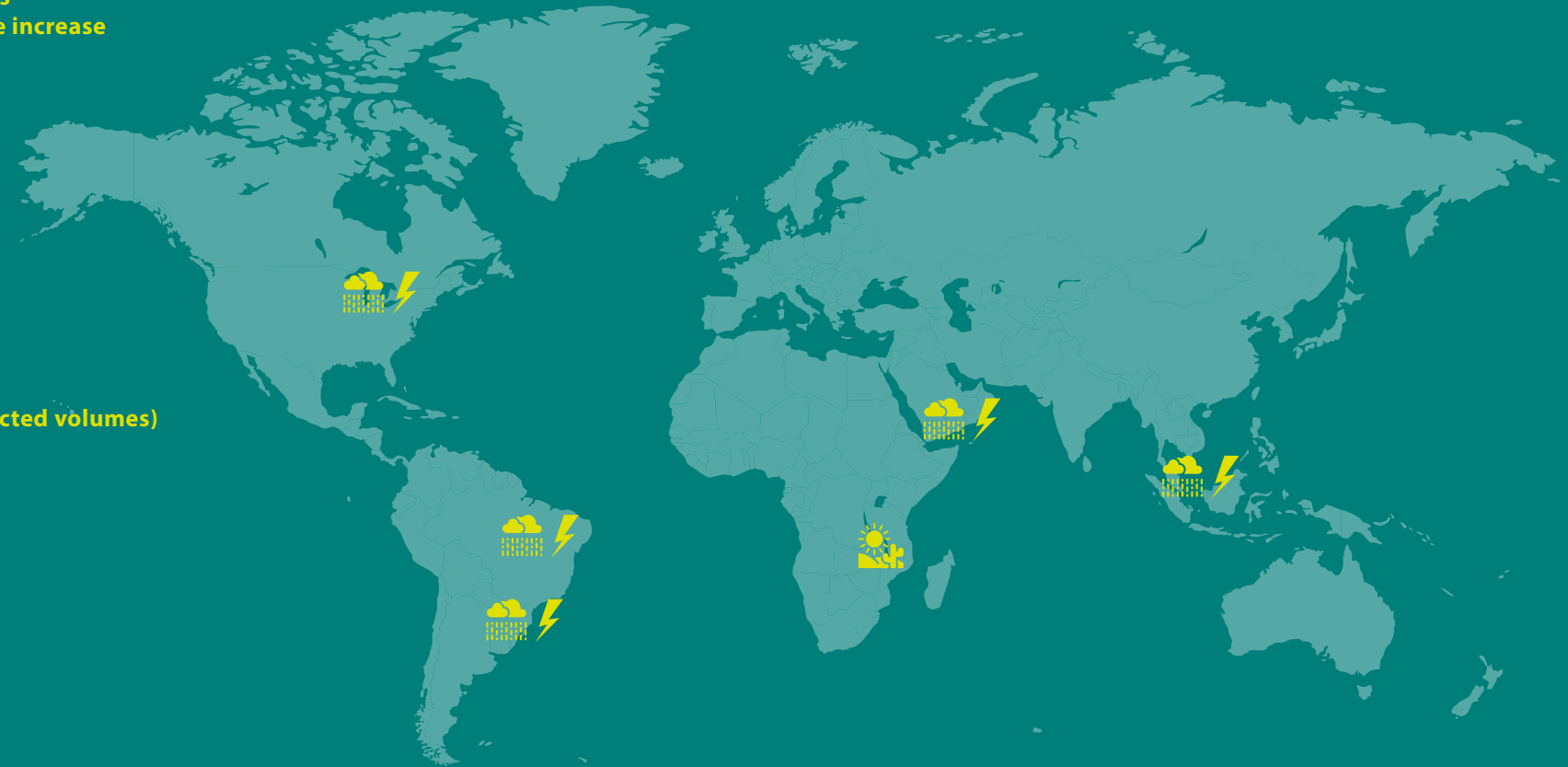
Itabira
North Corridor
Railroads (EFC and EFVM)
Mariana
Tubarão Port
Tubarão Pelletizing
Oman and Malasya
Canada

 **Heavy rains**
(above expected volumes)

Itabira
Brucutu
Vargem Grande
Serra Sul Ferrous
EFC and EFVM
North Corridor Plant
Minas Pelletizing
Oman and Malasya
Canada

 **Water restriction**

Mozambique





Serra Sul Complex
Canaã dos Carajás, Pará

Our response to Climate Change

Reducing Operational Emissions – Scopes 1 & 2

Our plan for emission reduction by 2030

Vale's first pillar of climate action is related to minimizing our operational emissions. **We have a target of reducing scope 1 and 2 emissions in 33% by 2030, aligned with the Paris Agreement** goal of limiting global average temperature rise to well-below 2 degrees Celsius.

This is stated in the UN's Emission Gap Report as follows: "global GHG emissions in 2030 need to be approximately 25 percent and 55 percent lower than in 2017 to put the world on a least-cost pathway to limiting global warming to 2°C and 1.5°C respectively."



Sossego
Canaã dos Carajás,
Pará, (PA), Brazil

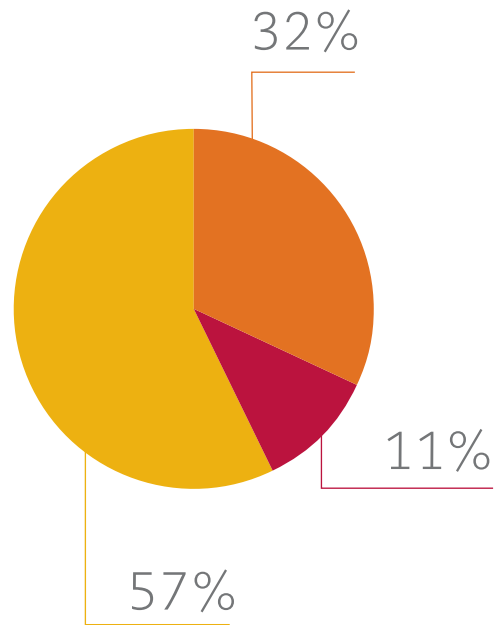
Currently, 57% of our scope 1 and 2 emissions comes from our pelletizing and metallurgy processes, mainly due to fossil fuel consumption in the furnaces. This is followed by mining and railway (32%), and electricity consumption (11%).

To achieve our Scope 1 and 2 emission reduction commitment, we have announced in 2021 that we will invest USD 4-6 billion until 2030. Four main technological routes will be leveraged for our climate transition plan:

- In the short term, we are prioritizing energy efficiency and a switch to renewable energy.
- We will also increase the role of bioenergy as a transition fuel for our operations.
- For the longer term, we will count on both electrification and innovative processes.

Scope 1 and 2 emissions by process

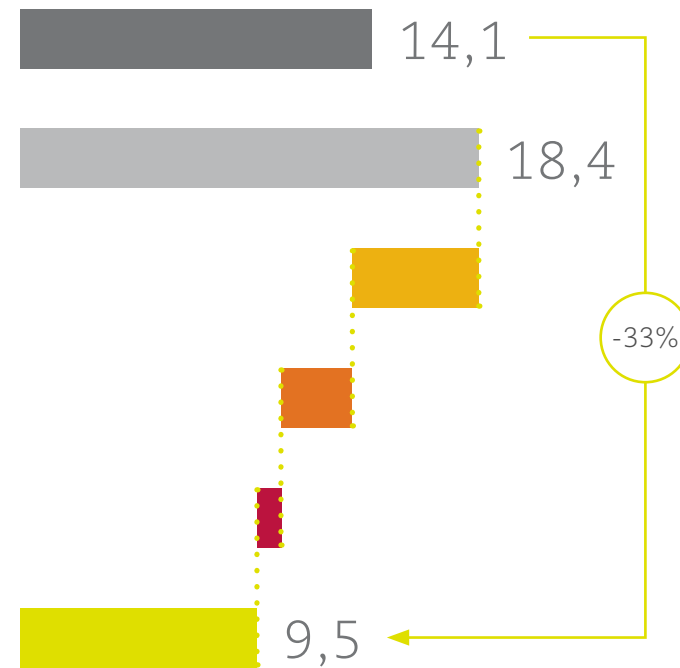
BAU¹ (%)



- Pelletizing & Metallurgy
- Mining, Railway & Others
- Scope 2





¹ Baseline 2017. BAU stands for Business as usual.

Target to reduce 33%¹ of scope 1 and 2 absolute emissions by 2030 MtCO₂e



- 2017
- 2030 BAU
- Pelletizing & Metallurgy
- Mining, Railway & Others
- Scope 2
- 2030 Goal

Main technological routes to drive decarbonization

-  Energy efficiency and renewables
-  Bioenergy
-  Electrification
-  New processes

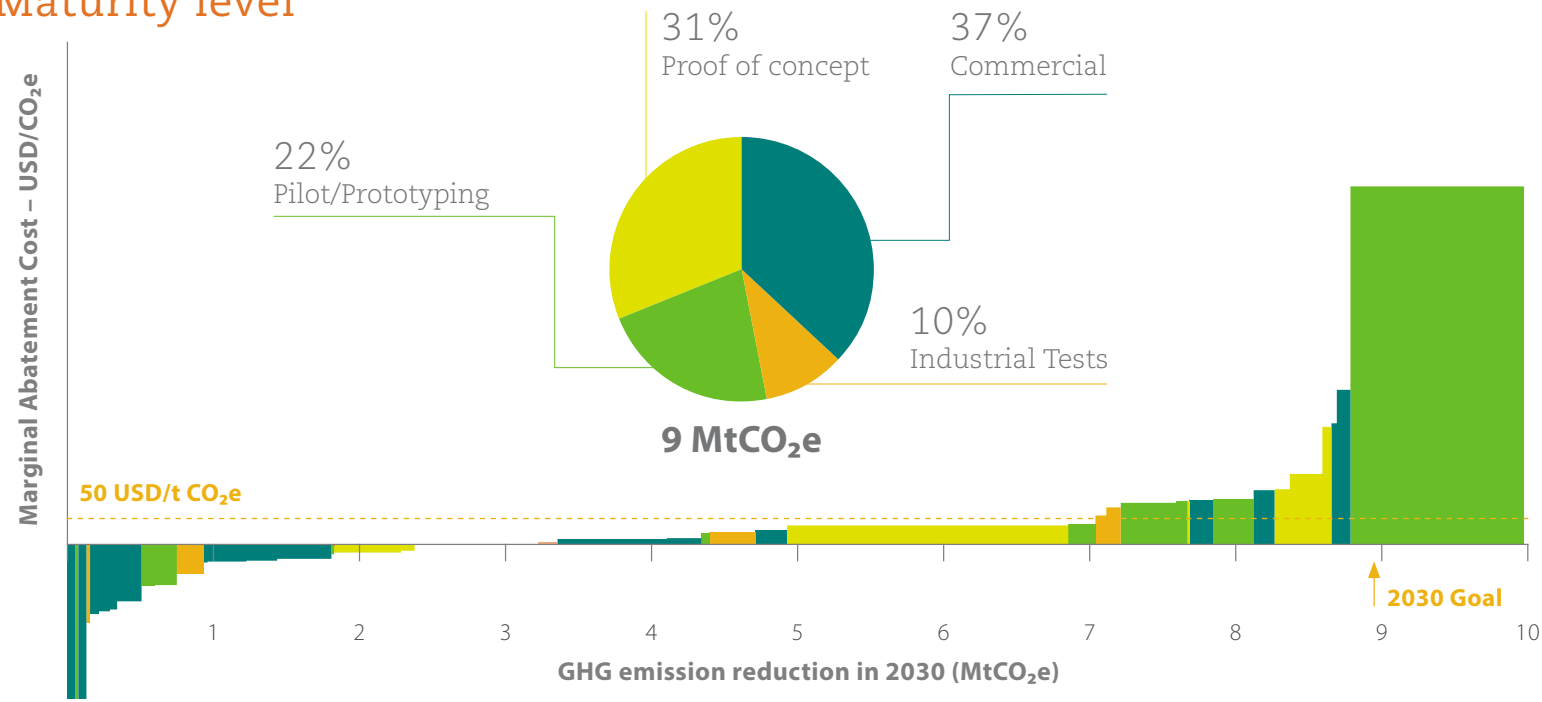
In order to prioritize the most cost-efficient initiatives to be implemented, the company has an **annually updated marginal abatement cost curve (MACC)**. In its 2021 update, we have increased the number of initiatives mapped from 30 to 40+, while increasing their technology maturity through the implementation of pilots.

We are committed to developing and implementing innovative lower carbon technologies, and ~50% of commercial initiatives mapped in our MACC are already entering FEL stage. Also, **~80% of initiatives mapped are NPV positive² at the shadow price of USD 50/tCO₂e**.

- As for the MACC, the projects NPV positive should be implemented sooner rather than later. For example, most of our renewable electricity projects are included in this group.
- The projects in the middle section of the curve are competitive when we use our internal carbon price.
- And, lastly, the projects that need deeper studies and partnerships to be competitive, such as those related to the usage of some renewable fuels (hydrogen, hydrotreated vegetable oil etc).

² As of June 2021. Values include assumptions for low maturity technologies, carrying uncertainties.

Maturity level



Values include assumptions for low maturity technologies, carrying uncertainties.



In 2020, investments in projects to reduce GHG emissions totaled USD 81 million. These initiatives are at different stages of maturity, from conceptual studies, pilot projects, or already implemented, with a longer implementation timeframe for those considered disruptive. Some examples of initiatives under implementation for the implementation of scope 1 and 2 emission reduction are provided below.

Pelletizing and metallurgy

57% of scopes 1 and 2 emissions in 2020

Pelletizing, Vargem Grande Complex, MG



Pelletizing and metallurgy are responsible for more than half of Vale's emissions and the main decarbonization solutions are: **increased use of bioenergy, electrification through the use of plasma to substitute fossil fuels, and energy efficiency gains.**

Vale has been piloting the substitution of coal and other fossil fuels and the use of **biocarbon and bio-oil shall be tested in 2021.**

Mining, railway and others

32% of scopes 1 and 2 emissions in 2020

Stockyard, Serra Norte, Carajás, PA



In our mines, we are already using conveyors to replace haul trucks for long distances. It has a potential to reduce mining emissions, which are approximately 2 million tons of CO₂e per year.

We also have 30 Battery Electric Vehicles - BEVs operating underground in Canada, with 40+ by the end of 2021.

Mining trucks can also have their emissions reduced through increased automation, aiming for autonomous trucks, since they lead to higher productivity and reduced diesel consumption. **We have successfully employed autonomous mining trucks in our Brucutu mine, as well as drillers in Carajás and Itabira.** Vale is currently evaluating the roll out to other sites.

For railways, we are implementing pilots, such as the electric locomotive that is already operating in the Southeast of Brazil. **A new, 100% electric, battery-powered shunting yard locomotive has been developed in partnership with Progress Rail.** It is currently in the testing and commissioning phase. The equipment also reduces noise emissions. The company will start another pilot for the North operation in 2021.

Finally, partnerships with suppliers and peers are key to **develop electric mining trucks at scale,** such as the "Charge On" challenge for electrical trucks charging system.

Electricity consumption

11% of scopes 1 and 2
emissions in 2020

Folha Larga Sul, Campo Formoso, BA



Electricity represented 30.8% of Vale's energy consumption matrix in 2020, of which 87% came from renewable sources. In Brazil, of the total of 6.7 TWh electricity contracted and consumed by operations via the national grid, 99% are from renewable sources. Vale's self-generation had an installed capacity of 2.3 GW in 2020, mainly from hydroelectric generation assets located in Brazil, Canada and Indonesia.

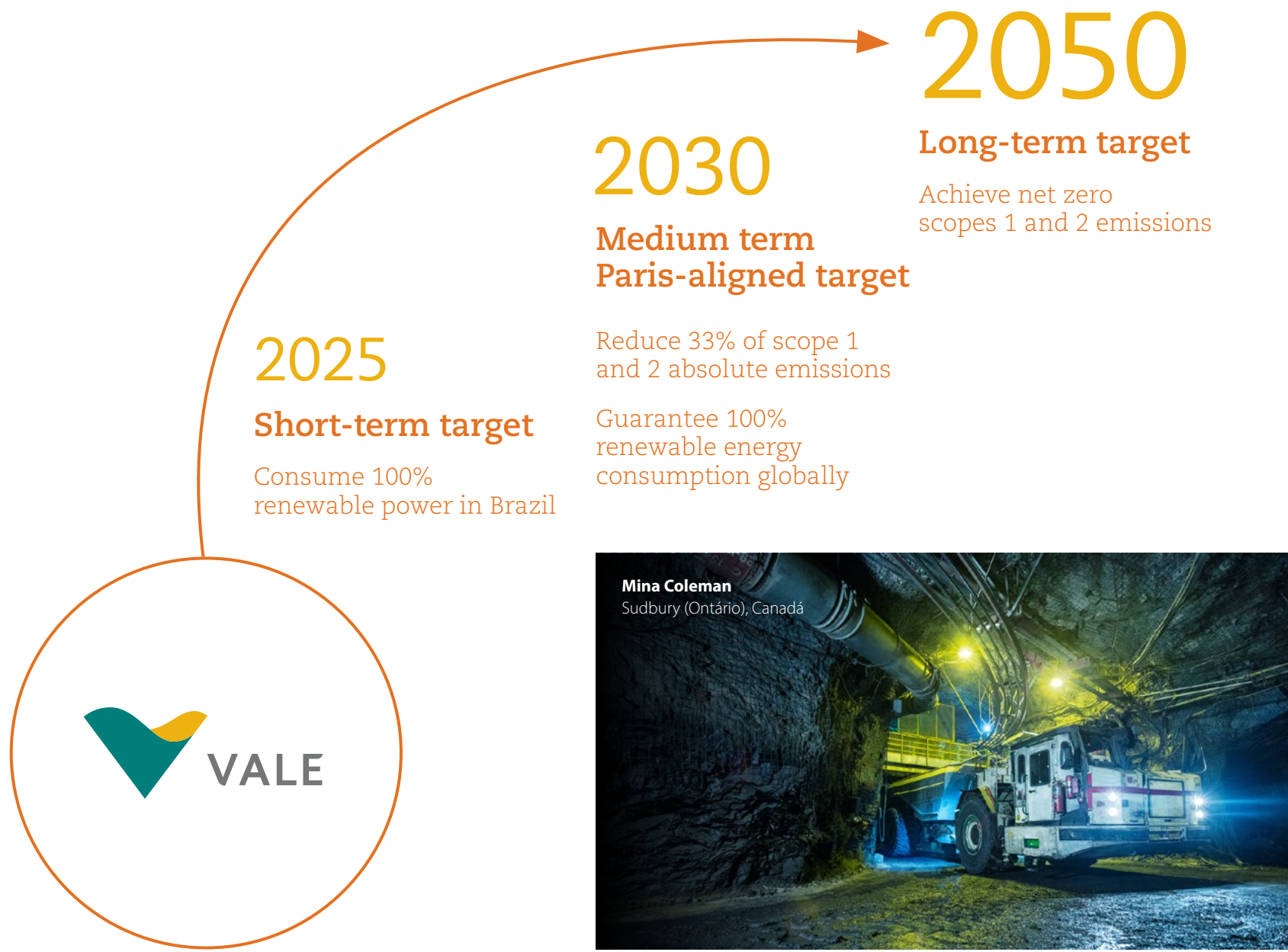
In the quest for leadership in low-carbon mining, we are committed to consume 100% renewable electricity in Brazil by 2025 and 100% globally by 2030.

As an important contribution to this goal, Vale announced the **Sol do Cerrado Solar Power Generation Project** in the municipality of Jaíba (Minas Gerais state) in Brazil in December 2020. With an installed capacity of 766 peak megawatts and scheduled to come on stream in the fourth quarter of 2022, the project will produce approximately 193 average megawatts (MWmed) of energy per year for Vale's operations. The solar project will be one of the largest ones in Latin America.

Vale also has an option to purchase 60% or 100% of the shares of the Folha Larga Sul wind project in Campo Formoso (Bahia State). It has an installed capacity of 151.2 MW and is already in operation, with 60% of its production destined for Vale or its subsidiaries by 2023.

Other examples include:

- **Generation of solar energy with storage based on lithium-ion batteries**
In 2020, at the Ilha Guaíba Port Terminal (in Mangaratiba, Rio de Janeiro state), Vale installed the largest energy-storage system with lithium-ion batteries in the country to supply its electrical demand. In addition to strengthening energy supply management and reducing costs, this initiative is part of our strategy to replace fossil fuels.
- **Energy Efficiency Program**
Vale's Energy-Efficiency Program aims to include the topic of energy efficiency in a structured way into operational routines, making employees think systematically about initiatives that promote energy efficiency in their processes. This work is being developed globally through multidisciplinary groups in each operation and supported by SmartEnergy, the platform responsible for managing electricity consumption throughout the company, providing automated energy-efficiency indicators. In 2022, with centralized governance and energy-efficiency indicators in the management routine, the goal is to obtain certification in ISO 50,001, the main international reference in energy management.



The PowerShift Program and the role of partnerships

Vale has created an internal innovation program called PowerShift to support its climate change goals, focusing on the transition to a lower-carbon energy mix. The program aims to make the Company's energy matrix clean by focusing on the use of renewable energy and alternative fuels, greater efficiency of operations using new technologies, and forest promotion. The Program assesses, pilots, scales up and implements lower carbon technologies and processes to help the company deliver on its goals, based on the Marginal Abatement Cost (MAC) curve.

In order to upscale its impact and results, the PowerShift program relies on partnerships, including with technology experts, research centers, suppliers and peers. The Charge On Innovation Challenge is an example of partnership promoted by senior leaders from Vale, BHP and Rio Tinto that encourage innovative technology development to support the mining industry's decarbonization efforts. The objective of the initiative is to propose solutions to enable the use of electric powered trucks in surface mining operations, in a way that the best solutions can be used by all companies in the sector, mining companies and suppliers, creating a safe loading pattern that can be adopted quickly, while contributing significantly to our greenhouse gas reduction goals

The road towards **net zero emissions by 2050**

Vale has a long-term commitment towards net zero by 2050, aligned with the Paris Agreement goal. We will get there based on three pillars:

How will Vale reach net zero (scopes 1 and 2) by 2050?



Prioritization of operational emission reductions

- Continuously reduce scopes 1 and 2 emissions through innovative processes, technologies and partnerships



Nature-based solutions with socioenvironmental co-benefits

- Vale differentials – Fundo Vale impact investing strategy, leveraging local opportunities
- NBS and removals as additional lever for climate change mitigation



High-integrity carbon markets for residual emissions

- Guarantee of additionality and permanence
- Positive socioenvironmental impact, contributing to SDGs
- Careful accountability based on international best practices
- Transparency on credits used and projects supported

It starts with our number one priority which is to continuously reduce our operational emissions, through innovation and technology. That is why we are working hard towards our absolute emission reduction goal of 33% reduction by 2030. And we will move forward.

Science recognizes that, as a hard-to-abate sector, we may also rely to a limited extent on carbon offsets and removals. We will leverage on our expertise and know-how to address sound nature-based solutions. And we will also count on high-quality and credible carbon markets, aligned with international best practices.



Nova Lima, Minas Gerais (MG)

The role of carbon markets

Vale believes that pricing externalities related to GHG emissions enable a faster and more efficient transition to a low-carbon economy. At the same time, a carbon market is crucial to enable the net zero transition of hard-to-abate sectors, mainly through offsets and negative emission credits.

That is why Vale is part of the Taskforce on Scaling Voluntary Carbon Markets, led by Mark Carney, that works to significantly scale up voluntary carbon markets and ensure they are transparent, verifiable, and robust, drawing up a blueprint and roadmap to build the market infrastructure needed for a fully functional voluntary carbon market that works with high environmental integrity. Vale is one of the signatories of the endorsement letter of the TSVCM recommendations and is also part of the Credit-level Integrity Working Group.

In this scenario, the definition of a sound and robust framework for Article 6 is very important to Vale. Vale will not use any type of credits that can jeopardize the climate fight and, therefore, we need predictable rules to ensure this and to avoid reputational risks.

Vale's forest vocation and the relevance of nature-based solutions

Globally, Vale supports the conservation of approximately 1 million hectares of forests, that currently store up to 600 million tons of CO₂e. **We have been operating in the Amazon for more than 30 years helping to protect approximately 800 thousand hectares of rainforest. The area is five times the size of São Paulo's capital city and stores approximately 490 million tons of carbon equivalent.** Over 60% of our iron ore is produced within the Amazon region, proving that mining activities and sustainable development are compatible. We generate income and thousands of jobs and engage an entire chain of local suppliers.

As stated in our September 2020's Amazon Manifesto, we are committed to (i) respect and promote the rights and the culture of indigenous peoples and traditional communities; (ii) support the fight against illegal mining and logging, in addition to promote spatial planning and land regularization in consolidated areas; (iii) promote the inclusion of forests in the carbon

markets through REDD, nature-based solutions and other mechanisms; (iv) encourage environmental protection and restoration initiatives, highlighting the value of the rainforest, increasing carbon sequestration and stocking, and ensuring that we continue to offer environmental stewardship services.

In 2019, Vale set a target of protecting and reforesting 500 thousand hectares of native forests up to 2030, beyond its borders. We believe that Vale can be a catalyst for "impact carbon" projects that generate carbon sequestration or storage with significant socioenvironmental benefits.

In 2020 only, Vale has recovered more than 1 thousand hectare and conserved an additional 52 thousand hectares of vegetation. This was done based on agrosilvopastoral and agroforestry system, that also generate income to local communities, in a partnership between Vale Fund, Vale Natural Reserve and Vale Technology Institute.

Reserva Natural Vale
Linhares, Espírito Santo (ES)



Decarbonizing our value chain

Scope 3

We recognize that we can only lead the mining industry towards a low carbon economy if we induce our value chain on the same direction. Vale's scope 3 emissions, annually calculated and verified by independent third parties, represent 98% of our total emissions as of 2020, but they are not under our direct control.

About 97% of these Scope 3 emissions are downstream in our value chain, in other words, they were due to the processing, transport and use of products sold by Vale in 2020.

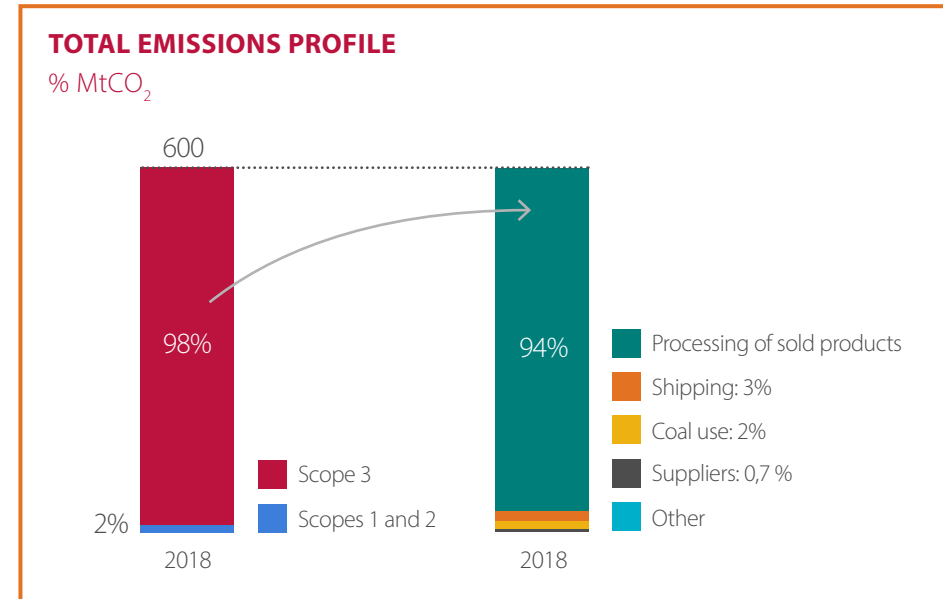
In late 2020, Vale set the first quantitative scope 3 target among our peers. We will reduce net scope 3 emissions in 15% by 2035, based on development of new products, nature-based solutions, partnership and engagement with clients and suppliers. This mean a reduction from 586 MtCO₂e in 2018 to 496 MtCO₂e in 2035. Vale will review its scope 3 target by 2025 and

every five years, given the uncertainties regarding low carbon technologies and climate policies.

Vale's scope 3 target was set based on the Science Based Target Initiative (SBTi) Target Setting Tool as of December 2020, given that a scope 3 SBT target needed to encompass at least 2/3 of total scope 3

emissions, and these should be reduced by 21% as of 2035 in order to be aligned with a 2°C scenario. Considering that the other 1/3 of emissions could remain flat, total scope 3 emissions would reduce by 14-15% by 2035, versus 2018 levels.

We will achieve this target through two main pillars: (i) through our own initiatives; (ii) through Partnership with clients and suppliers.



Scope 3 emissions, those associated to Vale's value chain, account for 98% of total emissions

94% of scope 3 emissions concentrated in processing of sold products, mainly in **steel production**

Shipping emissions around 19 Mt CO₂ respond for **3% of scope 3** emissions

Coal use in power generation accounts for only 2% of scope 3 emissions (13 MtCO₂)

Our high-quality portfolio

Our own initiatives may respond to between 15-25% of the emission reduction by 2035 and rely mostly on our world-class portfolio that will lead to reduced emissions in steelmaking.

Energy efficient agglomerates for direct reduction can promote higher energy efficiency in steelmaking and substitute high-emitting processes such as sintering. Our higher-quality iron products and agglomerates favor the migration to the lower emitting Electric-Arc Furnace (EAF) route. An example of the advances in our products is the “green briquette”, an iron ore briquette that will be able to reduce by up to 10% greenhouse gases emissions (GHG) during production processes used by its steelmaking clients. The product also reduces emissions of particulates and gases such as sulphur dioxide (SOx) and nitrogen oxide (NOx), as well as eliminates the use of water in its production.

Finally, steel emission reductions will be reached based on natural gas-based HBI production and biomass-based pig iron production (through Vale’s proprietary Tecnoled technology).

The steel industry decarbonization shall value high-quality, lower-emission iron ore products and solutions. **Vale’s current Strategic Plan already considers a portfolio with a 90% share of high-quality products by 2024.** The framework below summarizes how Vale’s portfolio is well positioned to support steel decarbonization:

Vale is naturally well positioned for a market that values high quality and low CO₂ emission products

Iron ore quality premia will be pushed higher by:



Higher fuel costs per ton in ironmaking



Demand for high productivity, resulting from bottlenecks in low CO₂ iron production capacity

Vale will benefit from the decarbonization trend by:



Developing **low to zero CO₂ iron ore agglomeration products for the blast furnaces** at an accelerated pace.



Using proprietary technology to offer more of **the top-end premium products (>68% Fe)** necessary to the EAF production route.



Establishing with partnerships for the use of leading technologies to help accelerate the transition away from BFs to lower CO₂ ironmaking routes.

Partnership and engagement with clients and suppliers



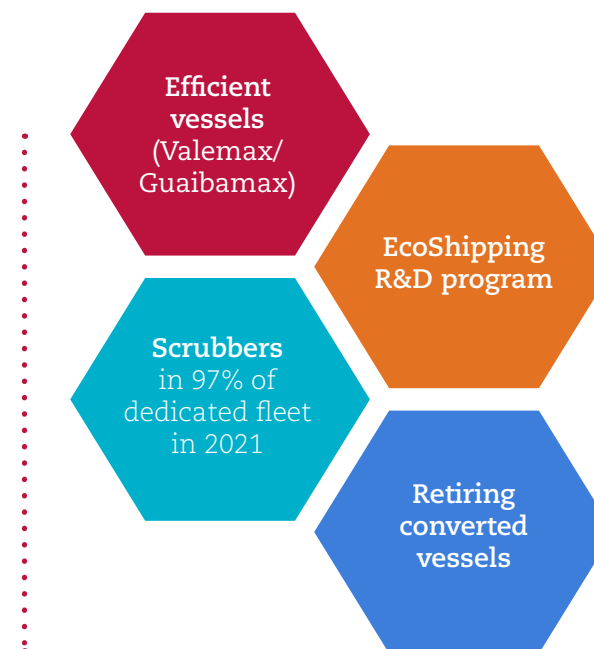
For the remaining 85-75% of scope 3 emissions reductions, we will lead through partnership.

We are already engaging with the most relevant steel clients to foster technological development and lower carbon iron solutions.

In this scenario, in early 2021 Vale completed an investment of USD 6 million in Boston Electrometallurgical Company to acquire a minority

stake and promote the development of a technology focused on steel decarbonization by using electricity.

In order to provide low carbon solutions to the steel industry, Vale has signed a Memorandum of Understanding (MoU) with Ternium S.A. in which both agreed to pursue opportunities to develop steelmaking solutions focused on reducing CO₂ emissions. Both companies intend to develop economic feasibility studies of potential investment in (i) an iron ore



briquetting plant (green briquette) located at Ternium Brasil facility; and (ii) plants to produce metallic products with low carbon footprint, using Tecnored, HYL and other technologies for iron reduction.

And we are supporting the shipping industry decarbonization through our EcoShipping program.

Vale supports the IMO ambition to reduce emissions from international shipping. They include:

- Reduction of CO₂ intensity, as an average across international shipping, by at least 40% by 2030, pursuing efforts towards 70% by 2050 (versus 2008);
- Reduction of the total annual GHG emissions from international shipping by at least 50% by 2050 (versus 2008).

The very large ore carriers used by Vale are already the most efficient in the world.

Vale's contracted shipping fleet has higher standards of energy efficiency, including green vessel initiatives such as Valemaxes, which are the most efficient vessels of the world in emissions of greenhouse gases (GHG) in operation. The 2nd-generation Valemaxes emits 41% less CO₂ than a 180,000-ton Capesize, built in 2011, which served as a comparative basis for the 1G Valemax.

In addition to 2G Valemax, of 400,000 tons, Vale negotiated contracts for vessels of 325,000 tons, the so-called Guaibamax. As well as 2G Valemaxes, the Guaibamaxes have incorporated the state-of-the-art in terms of energy efficiency, emitting 38% less carbon dioxide than the reference 2011 Capezise ships.

The two Valemaxes generations and Guaibamaxes have already brought the reduction of -16% in CO₂ equivalent emissions fleet intensity reduction on a self-assessment compared to 2011.



Navio Vale Brasil
Malásia

Valemax 1G
-35% CO₂e



Ponta da Madeira Terminal - North Port
São Luis, Maranhão(MA), Brasil

Valemax 2G
-41% CO₂e



Navio Vale Rio de Janeiro
Vitória, Espírito Santo (ES), Brasil

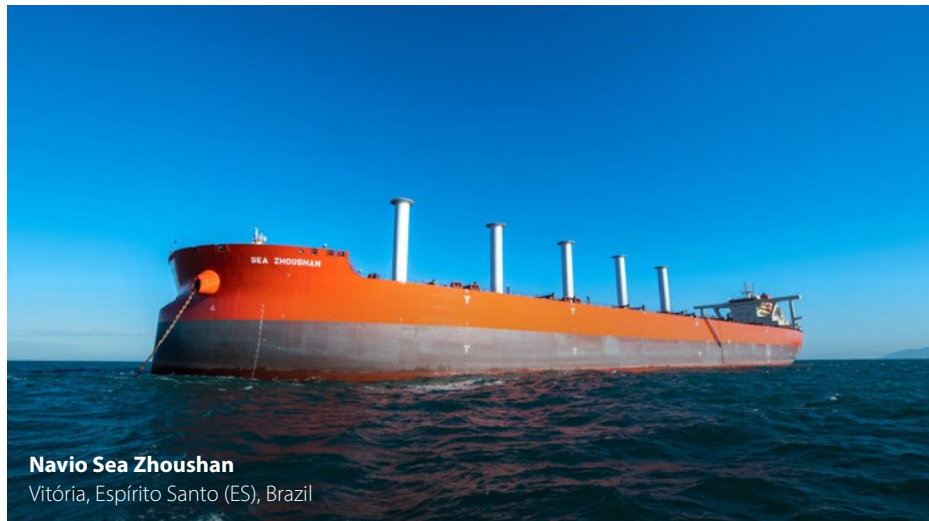
Guaibamax
-38% CO₂e

Through our Ecoshipping program, Vale is also investing in many R&D initiatives alongside external research institutions to map and test new technologies on emission reduction from maritime transport. It has a roadmap of pilots being implemented in 2021 that include innovative technologies to reduce emissions intensity such as rotor sails, air lubrication and hull cleaning with robots.

**-16% in CO₂e emissions
intensity reduction¹**

LNG Ready can reduce
emissions by 23% after
retrofitting LNG fuel system

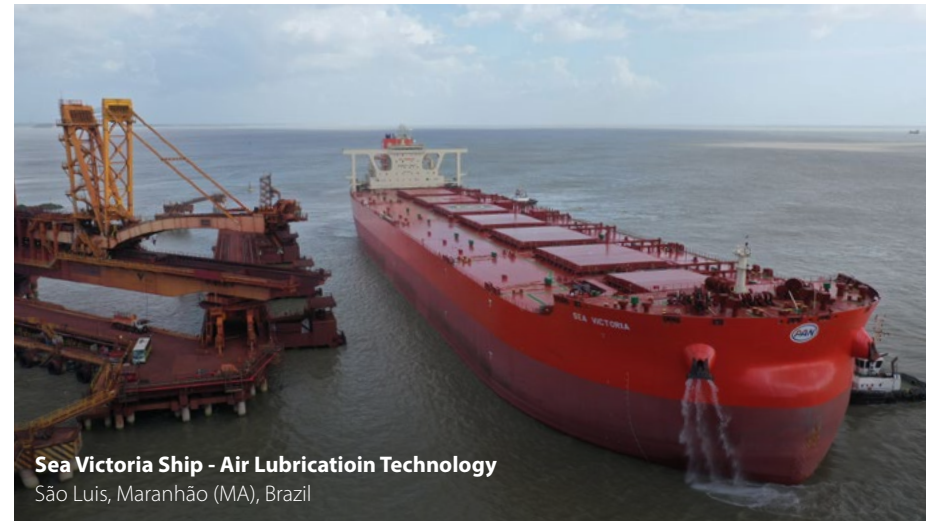
New technologies being tested at ships that transport our iron ore



Navio Sea Zhoushan
Vitória, Espírito Santo (ES), Brazil

Rotor sails

This technology uses the wind to generate thrust and propel the ship resulting in fuel savings. The increased efficiency between 5% and 8% can generate up to 3.5 mil tons of CO₂ per ship per year.



Sea Victoria Ship - Air Lubrication Technology
São Luis, Maranhão (MA), Brazil

Air Lubrication

This technology injects air bubbles under the vessel to reduce the frictional resistance and save fuel. The increased efficiency between 4% and 8% can generate up to 5.6 mil tons of CO₂ per ship per year.

In the medium and long term, Vale is developing solutions for other alternative fuels, like methanol and ammonia, where preliminary assessment indicated emissions reductions could be between 40% and 80% on the same vessels. The project is developing a multi-fuel tank ready vessel to be adapted for the most suitable fuel once the future uncertainties are cleared. In this scenario, Vale signed in June 2021 an MoU with different mining, shipping, O&G companies, and port terminals to test the usage of ammonia in ships, including safety standards, procedures for fueling and GHG emissions.

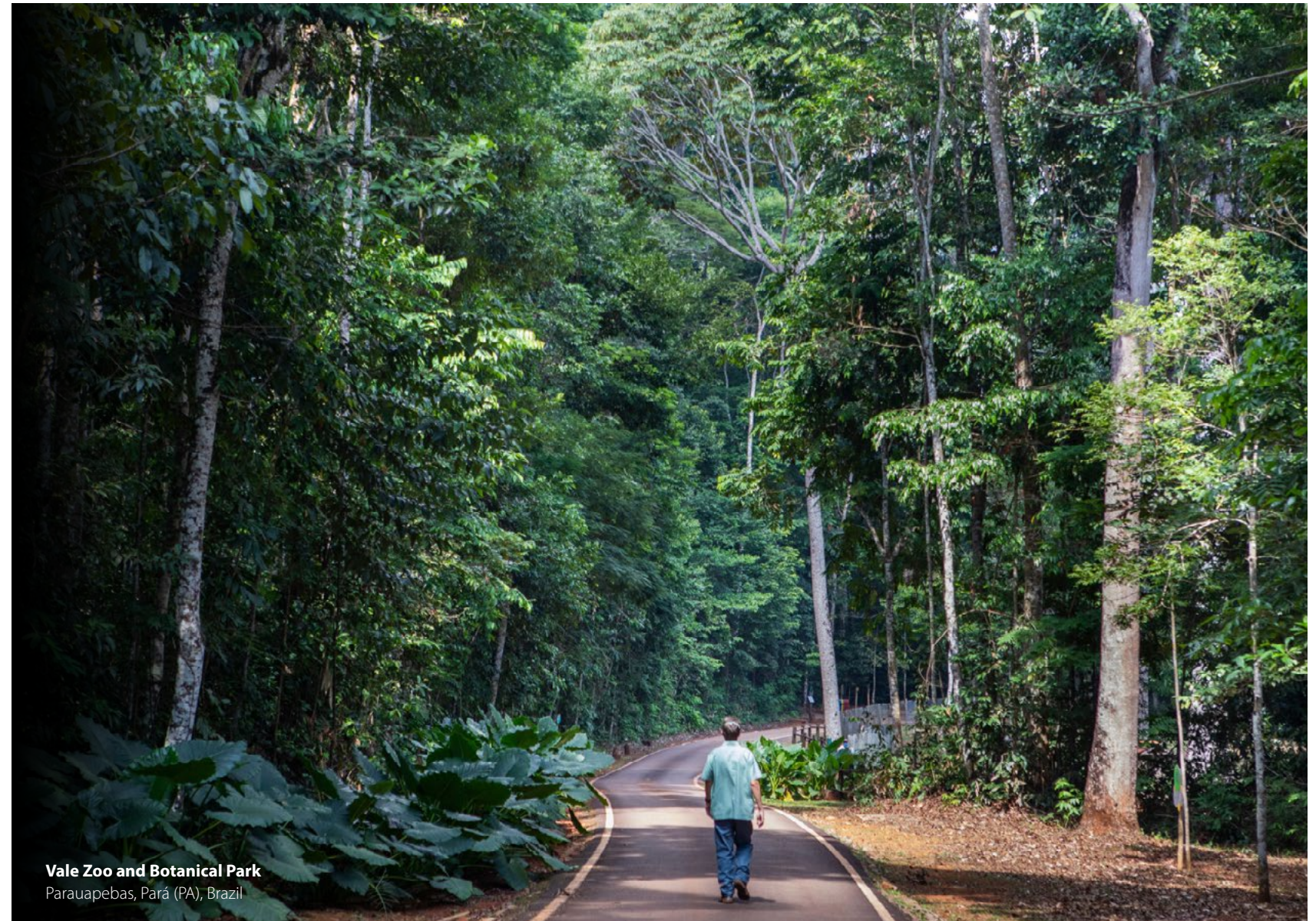
In the pathway for low carbon shipping, Vale is also developing an Emission and Cost Optimizer for Shipping (ECOS) aiming at optimizing shipping transportation taking into consideration GHG emissions as a restriction and allowing the decision-making process to consider the emission reduction objectives.

Finally, Vale is committed to raising the awareness of its supply chain regarding climate change and engage with them to improve their emission management. Our most relevant global suppliers, in terms of supply chain emissions, have been invited by Vale to join the CDP Supply Chain.

Limited use of high-integrity carbon credits

Since shipping and steel are hard-to-abate sectors, science recognizes that these sectors may use carbon credits to compensate for residual emissions. In this scenario, Vale can use carbon credits to deliver up to 20% of its scope 3 absolute emission reduction to 2035, the equivalent of 90 MtCO₂e.

As with its net zero by 2050 (page 22), Vale intends to leverage on its expertise and know-how to address sound nature-based solutions and assess high-quality and credible carbon markets, always aligned with international best practices.



Vale Zoo and Botanical Park
Parauapebas, Pará (PA), Brazil

A robust climate governance

To guide the implementation of our Net Zero Strategy, our **Executive Board** provides us with full support and strategic oversight. It is supported by a **Sustainability Committee**, comprised of Board members and an external independent advisor, in charge of overseeing Vale's actions. The Sustainability Committee advises the Board on sustainability-related issues, including climate change.

The Sustainability Executive Vice President

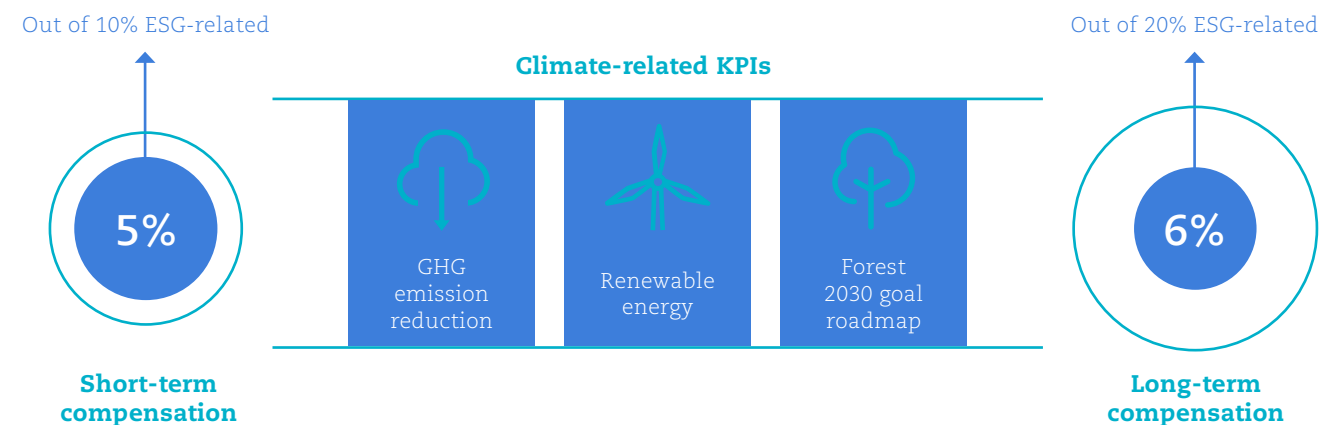
is the highest-level in management position responsible for climate change. It is responsible for proposing climate change policies, plans, projects and targets to the approval of the Executive Board, as well as for implementing the general policies and guidelines set forth by the Executive Board. The Chief Sustainability is also responsible for evaluating, monitoring and reporting Vale's performance, risks and opportunities regarding climate change to the Executive Board.

Also at the C-level, the company created the **Low-Carbon Forum**, a group led by the CEO and composed of vice presidents and their technical teams. The initiative reflects top leadership's engagement on the topic, helps to monitor performance in upholding our commitments, and drives constant advances in Vale's climate agenda. The meetings are held monthly with the participation of the broad leadership and technical teams that deal with the topic on a day-to-day basis.

As of 2021, goals related to the climate agenda represent 5% of short-term (out of 10% related to Sustainability) and 6% of long-term compensation (out of 20% ESG-related) of all employees, including our CEO and executive vice presidents. A goal composed of indicators of greenhouse gas emissions, forest recovery and protection, and renewable energy was also linked to leadership's long-term remuneration.

How to guarantee we will walk the talk?

Our climate agenda is linked to executive compensation



Corporate areas that work on climate change and operational areas that implement the decarbonization strategy also have specific additional variable compensation targets for project implementation, emissions management and/or risk management associated with climate change.

For more detailed information on our climate governance check **our CDP Report**.

Climate risks and opportunities

Vale supports the TCFD since its launch, as has been working on fully implementing its recommendations for climate change risks and opportunities management since then.

To better understand, track and estimate the potential exposure to climate change risks, the TCFD established climate-related metrics for transition and physical risks. Vale's results of these metrics are indicated below:

- **4% of Vale's assets³ are currently highly exposed to transition risks.** The assets considered highly exposed are Vale's coal assets.
- **67% of Vale's assets⁴ has been assessed under climate change physical risks exposure.**
- **68% of Vale's assets³ are currently highly exposed to climate opportunities.** The assets considered highly exposed are the North Corridor assets, which represents around 54% of Vale's iron ore assets, and Vale's pellets, copper, and nickel assets.

³ For proportion of assets exposed to transition risk and climate-related opportunities, Vale considers the value of assets exposed relative to the total value of Vale's assets.

⁴ For proportion of assets materially exposed to physical risk, Vale considers the assets exposed relative to the total number of Vale's assets.

TRANSITION RISKS



Regulatory changes to restrict emissions, including carbon pricing



Climate litigation
Reputational impacts



Changes in demand, with increased focus on lower carbon products



Product substitution due to new technologies and processes

CLIMATE-RELATED OPPORTUNITIES



Use of lower-emission sources of energy, potentially reducing costs

PHYSICAL RISKS



Chronic risks, such as average temperature increase, sea level rise and new rain patterns



Acute risks, including extreme weather and maritime conditions



Products and services diversification into higher-quality and lower carbon

Parauapebas, Pará, (PA), Brazil



Vale's climate risk management framework

Identifying and assessing

Vale's climate change risks identification and assessment is integrated to the company's corporate risk management process. Vale has adopted TCFD's guidelines managing impacts of transition risks to a low carbon economy and physical impacts.

The Executive Risk Committee – Sustainability, Institutional Relations and Reputation continuously monitors climate change risks and reports them at the Sustainability Committee. This Committee acts as the second line of defense, continuously evaluating the process of management of climate change risks and opportunities.

The main tools Vale uses to identify climate change risks and opportunities are:

- **Climate change scenario analysis and Vale Climate Forecast** with robust methodologies to evaluate our exposure to climate risks and opportunities.

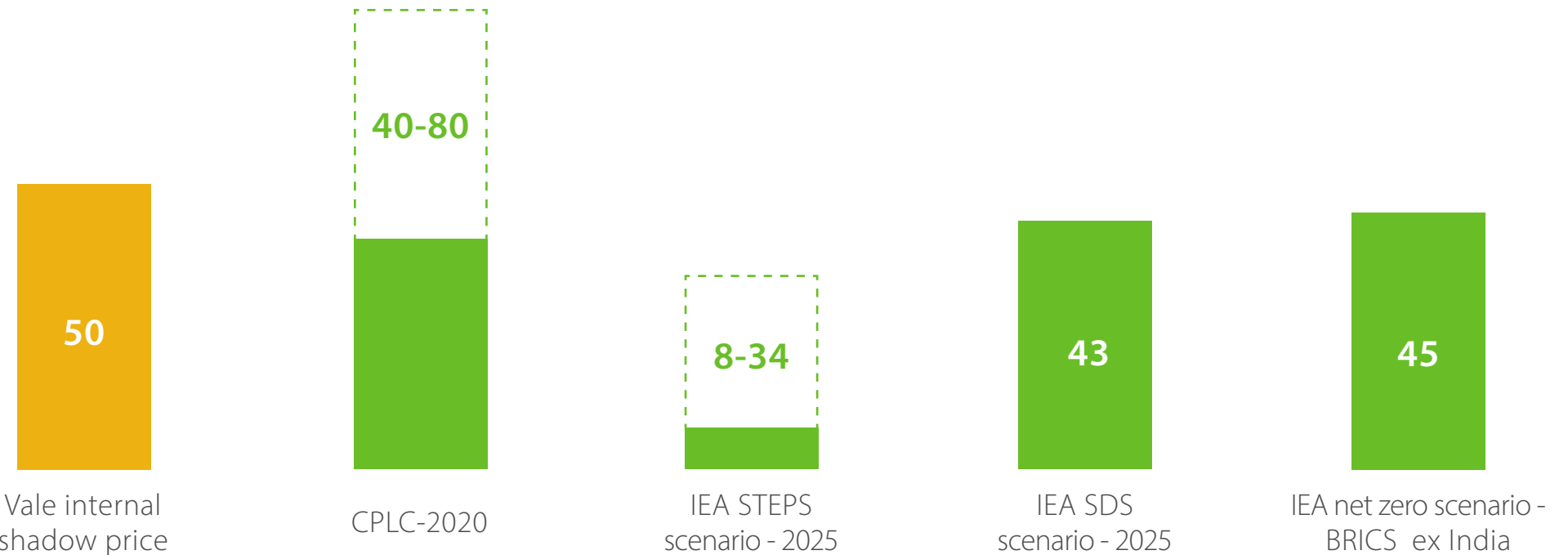
- **External environment monitoring**, including new regulations, emerging technologies, market developments and public policies – the company monthly has an internal Climate Intelligence Bulletin that maps the most relevant news for the climate agenda.
- **Stakeholder engagement** in the most relevant industry forums, in order to monitor new positioning, emerging trends and regulation.

Management and integration into overall corporate risk management process

Once climate change risks are identified, they are **included in Vale's risk management process and are assessed based on their severity and probability of occurrence.**

Internal carbon pricing is one of the tools to manage transition risks. The use of the shadow price of USD 50/tCO₂e, established in accordance with the Carbon Pricing Leadership Coalition (CPLC)⁵, is integrated to the decision-making process to guide our capital allocation enabling a faster and more effective transition to a zero-carbon economy.

Comparison of Vale's internal shadow carbon price with IEA's scenarios USD/tCO₂e



⁵ CPLC+Leadership+Report+2018-19.pdf (squarespace.com)

The resilience of our portfolio to the transition towards a zero-carbon economy

In 2020, Vale conducted a **climate change scenario analysis of its portfolio based on the International Energy Agency (IEA) scenarios**, which are recognized industry-wide and have ample international support. While the Current Policies Scenario (CPS) and the Stated Policies Scenario (STEPS) illustrate the consequences of ongoing policies and stated commitments, respectively, the Sustainable Development Scenario (SDS) identifies the policies and assumptions needed to achieve the UN Sustainable Development Goals related to energy i.e., (i) ensure universal access to electricity, (ii) reduce severe health impacts caused by air pollution, and (iii) address climate change. A more detailed description of each scenario and resulting primary energy demand is depicted below, while the supply and demand implications for Vale's various commodities are presented on the following pages.

THE INTERNATIONAL ENERGY AGENCY SCENARIOS

Current Policies Scenario (CPS)

Describes the energy sector trajectory assuming there are no additional changes in policies related to climate change⁶.

According in the IEA, the effort required for de CPS would result in greater consumption of the fuels and technologies, leading to a continuous raise of emissions and increasing tensions involving different aspects of energy security.

Stated Policies Scenario (STEPS)⁸

It considers intensions and specific policies that have already been announced and foresees an average annual growth of 1% in primary energy demand until 2040.

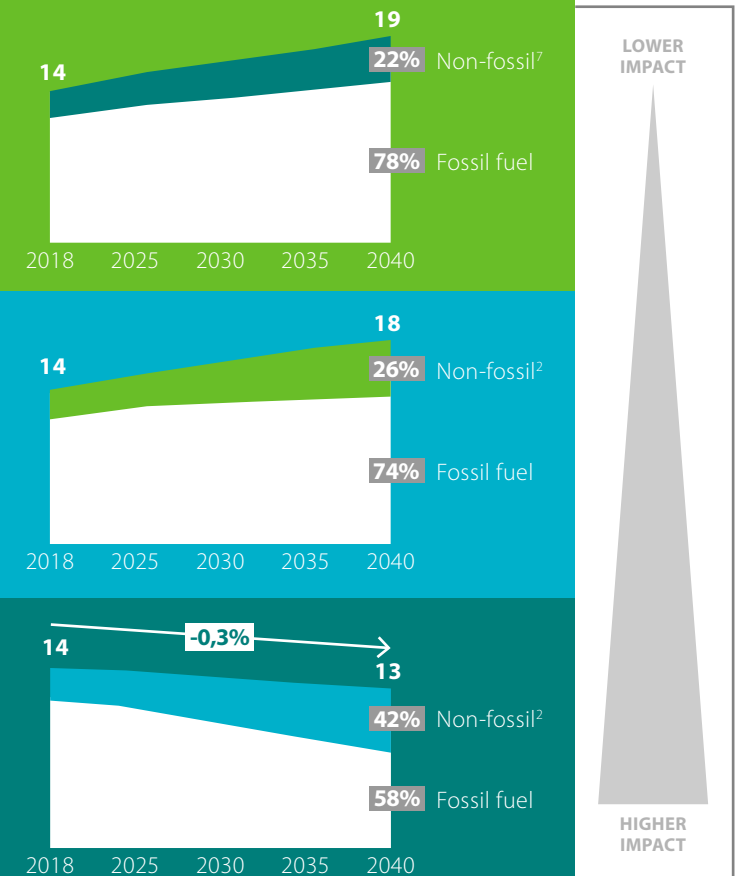
Sharp deceleration in demand for oil after 2025 until its stabilization during the 2030s. The use of fossil fuels for transportation reaches its peak in the late 2020s, even with 70% more cars on the roads between 2018 and 2040.

Sustainable Development Scenario (SDS)

It proposes a narrative that adheres to the ambitions of the Paris Agreement, and addresses the battle for clean air and universal access to energy.

The global economy growth projected all scenarios is achieved here without any increase in primary energy demand, given the significant development in energy efficiency and the expansion of the circular economy concept.

Primary Energy Demand Btoe



⁶ Considers the November/2019 update from the "World Energy Outlook".





⁷ Includes nuclear energy, hidroelectric and bioenergy production systems and other renewable sources.

⁸ The November/2019 scenario does not include the recent carbon neutrality announcements from China, South Korea and Japan.

In this challenging context of decarbonization, **our key commodities will be at the forefront of the challenges and opportunities posed by the climate crisis.** Copper and nickel will fully support the energy transition, representing key materials for building up the necessary renewable infrastructure and supporting the transport electrification through the electric vehicles (EV). Steel, produced from iron ore and metallurgical coal, will continue to be the material of choice for wind turbines, transmissions lines, and the necessary infrastructure to grant universal access to electricity and alleviate extreme poverty. Thermal coal, among other fossil fuels, will have to be gradually displaced by alternative energy sources while retaining share under special circumstances especially when combined with, and supported by Carbon Capture, Usage and Storage (CCUS) mechanisms.

More details on the results of our Climate Scenario Analysis can be found **here**.

Impact of climate scenarios on selected commodity markets

	Demand impact	Drivers	Industry challenges
NICKEL 	⬆️	EV sales	Meeting demand growth sustainably Need to recycle & reuse Ni in batteries Lack of commercial Ni mine projects/ deposits Reducing Ni mining emissions Discover and commercialize new deposits
	⬆️	Energy storage batteries	
	⬇️	EV battery recycling and scrap	
	⬆️	Stainless steel demand	
COPPER 	⬆️	EV sales	Meeting demand growth sustainably Need to increase scrap usage limit waste Environment challenges in many copper countries Discover and commercialize new deposits
	⬆️	Wind and solar power gen	
	⬆️	Transmission lines for power access	
	⬇️	Improved scrap recycling	
IRON 	⬆️	Energy transition focused infrastructure	Reduce steelmaking emissions Implement new BF technologies and efficiencies Support shift towards cleaner iron ore feedstock Promote recyclability of steel vs.other metals Iron ore use increasingly replaced by scrap
	⬇️	Declining car stock (mobility change)	
	⬇️	Construction efficiencies	
	⬇️	Scrap recycling and re-use	
COAL 	⬇️	Changing power mix to renewables	Develop cleaner coal end-uses Develop critical or ultra-critical coal power plants Carbon capture initiatives to reduce CO ₂ emitted Replace met coal by cleaner fuels when possible
	⬇️	Announced exits from coalpower gen	
	⬇️	Construction efficiencies for steel	
	⬇️	Steel recycling	

Sources: IEA, Woodmac

Impacts in our portfolio

The different behaviors of supply and demand under IEA's three scenarios result in changing competitive dynamics that impact the long-term price of our key commodities and our strategy by extension.

For Vale, the Current Policies Scenario partially impacts our capacity to generate value. In addition to greater exposure to physical risks, CPS does not consider the opportunity for growth in renewables, transport electrification and the need to decarbonize the steel industry, which are today fundamental parts of our strategy.

The SDS, in turn, creates an ecosystem that encourages our growth options and amplifies the relevance of our strategic pillars i.e., Base Metals Transformation and the Maximization of flight to quality in Iron Ore.

We want to be the preferred supplier of high quality, zero carbon products

All scenarios analyzed showed that the steel industry decarbonization will put a high value in high-quality, lower-emission products. Vale's current strategy already considers a portfolio with a 90% share of these products by 2024.

To reinforce our position and offer additional solutions to the steel industry, we are focused on

increasing the supply of our high-quality sinter feed from the North System, offering higher grade products using New Steel technology, leading the world production of pellets and other direct-charge products, and finally, promoting Metallics, which through partnerships and in an asset light platform provides low-carbon solutions.

We are leaders in providing nickel for a sustainable energy transition

Our Class 1 nickel assets already place us in a unique position with competitive operations in the North Atlantic. The base metals transformation follows a net zero agenda geared towards recycling electric vehicle batteries, using biofuel and biomass, decarbonizing rotary kilns and electrification from renewables.

In addition, as part of Vale's Nickel strategy, investment opportunities in Indonesia through JVs in the Bahodopi and Pomalaa projects, production stabilization in the South Atlantic and other projects ensure options capable of sustaining a significant EBITDA increase in 2040 in SDS.

We have organic growth potential in copper, taking advantage of the robust market fundamentals

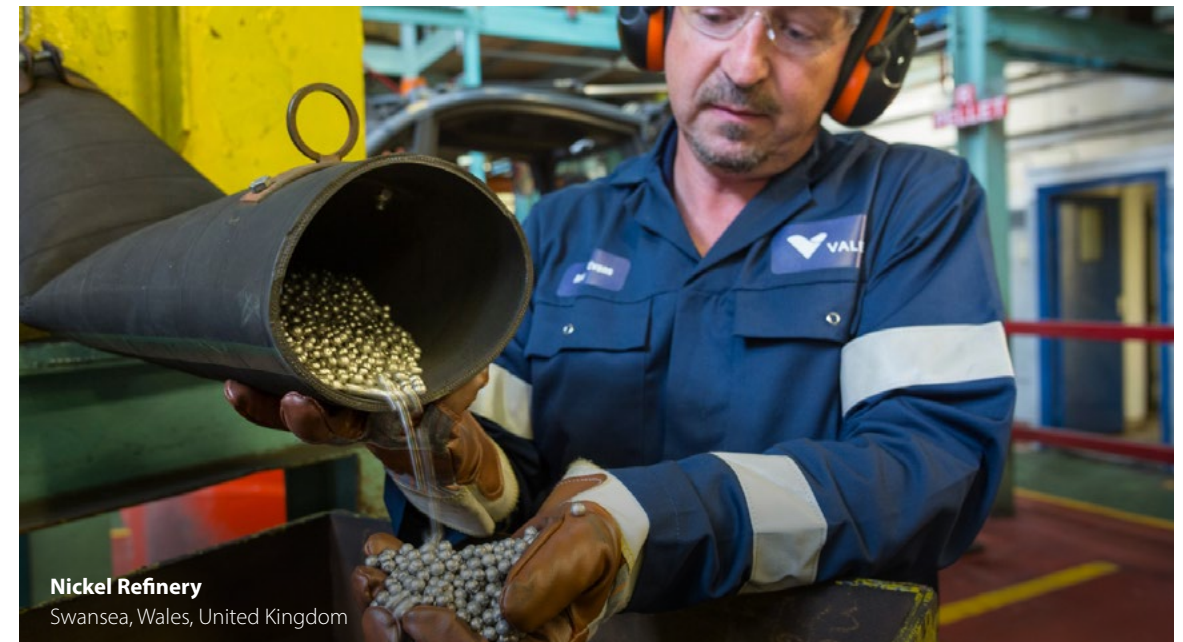
With the high penetration of EV in transport, the expansion of renewables infrastructure and transmission lines, the bottleneck will be the sustainable supply of this ore.

In view of this, recent studies on the Hu'u project, which indicate great potential in Indonesia, join the existing portfolio of projects in the Carajás basin which will support our growth in the future while preserving rainforests.

Finally, it is important to highlight that our coal assets will be negatively impacted by STEPS and SDS. However its impact will not be severe as coal represents a tiny fraction of our portfolio. In our path towards carbon neutrality, we are reevaluating our assets' portfolio that may not fit into this greener future. In

January 2021, Vale signed a Heads of Agreement (HoA) with Mitsui as the first step to exit the coal business.

In summary, under several climate change scenarios, Vale's EBITDA performs in a range of 90% to 140% in relation to base case. Such resilience is the result of a flexible portfolio; capable of adapting to different market conditions and well aligned with energy transition trends.



Nickel Refinery
Swansea, Wales, United Kingdom

Vale's EBITDA in 2040

Base Case⁹ = 100



- This analysis was performed based on the production volume considered in the Strategic Plan in 2040;
- The simulations considered, in addition to the volume, other implications from each scenario, such as commodity prices and cost impacts;
- The STEPS and SDS scenarios embrace the maximization of high-quality ferrous products and opportunities for additional volumes in nickel and copper.

⁹ Base case – Strategic plan volume in 2040, considering Wood Mackenzie price in September.

Driving physical climate resilience in our operations through Vale Climate Forecast

At Vale, nearly 67% of Vale's assets were evaluated for climate change physical risks exposure.

In partnership with the Vale Institute of Technology, we downscaled the global warming models referenced by the Intergovernmental Panel on Climate Change (IPCC) to the Brazilian reality. This allowed Vale to identify changes in rainfall patterns and volumes, and temperature variation for all operations in Brazil. The RCP 4.5 and 8.5 models were regionalized. This methodology to identify physical impacts of climate change in Vale is called The Vale Climate Forecast, which enables:

Short-term analysis and seasonal forecasts for physical risks associated with climate change, with the main focus on impacts on our operations and product shipment. The analysis of short-term climate risks enables the inclusion of climate variables in the decision-making processes of Vale's operations systematically. It also generates a higher control against the impacts of climate change-

impacts which are already being witnessed in/around our operations as they are elsewhere worldwide—helping to mitigate the causes of risks and their potential negative consequences for the business.

We downscaled the global warming models referenced by IPCC to the Brazilian reality

Vale Climate Forecast pilot in Ponta da Madeira Port

In Port of Ponta da Madeira, site for the pilot for implementation of the Vale Climate Forecast, an application with daily rain forecasts was developed making it feasible to disseminate the data to all operators at the Port.


This helps decision-making in the operations of shipments and distribution of iron ore and other products. With these forecasts in hand, the operators optimize the product shipment plans and minimize the risk of non-shipment due to excessive humidity content in the ore.

Vale considers an average operational loss of 0.5% in the production due to abnormal precipitation conditions in Ponta da Madeira Port. Considering 2020's iron ore net operating revenues of USD 27.28 billion, it would have accrued a loss of about USD 138 million per year. Moreover, damages suffered by Vale's logistics complex in the Northern region of Brazil can affect the entire operation, because all product from Carajás mine is transported by rail to the port.

Long-term analysis for physical risks associated with climate change, with a focus on identifying necessary investments in facilities to adapt to and/or mitigate impacts due to climate change.

A summary of its most recent results is provided:


Causes

 **Atmospheric discharge**
Strong winds
Temperature increase

- Itabira
- North Corridor
- Railroads (EFC and EFVM)
- Mariana
- Tubarão Port
- Tubarão Pelletizing
- Oman and Malasya
- Canada

 **Heavy rains**
(above expected volumes)

- Itabira
- Brucutu
- Vargem Grande
- Serra Sul Ferrous
- EFC and EFVM
- North Corridor Plant
- Minas Pelletizing
- Oman and Malasya
- Canada

 **Water restriction**

- Mozambique



Pilot for quantifying physical risks and adaptation plans in Canada

Vale Climate Forecast also enables long term physical risks identification, such as future exposure to flood, heat, wind, and precipitation. We have run a pilot for Vale’s Canadian operations, including Long Harbour, Voisey’s Bay, Sudbury, Port Colborne and Thompson.

To identify potential physical impacts, we used the climate scenario SSP5-8¹⁰ and the thirty-year timeframe.

Vale’s Canadian assets characteristics and the results of the analysis are presented below. Results show most of our sites are not exposed to material changes to climate conditions.

Long Harbour: Located in Newfoundland and Labrador, it is a processing site for nickel and associated copper and cobalt products. Long Harbour has presented vulnerability for wind and precipitation and flood exposure.

Voisey’s Bay: Located in Newfoundland and Labrador, it is a fly in/fly out mining site that produces nickel-cobalt-copper concentrate. Overall, the site is classified

as “low” risk of experiencing damaging winds, while it might face risk of precipitation pattern changes.

Sudbury: Located in Ontario, Sudbury is one of the largest mining complexes in the world. It produces nickel, copper, cobalt, platinum group metals, gold and silver. Sudbury ranks relatively lower across most peril exposures. Sudbury emerges as a relatively heat-prone location compared with Vale’s other Canadian Operations.

Port Colborne: Located in Ontario, Port Colborne is a refinery on the shores of Lake Eerie as well as a shipping center for Vale. Port Colborne faces medium exposure to thunderstorm formation. There might be some precipitation risk.

Thompson: Located in Manitoba, Thompson is a major nickel-producing site. It faces relatively medium exposure to flood, heat and wildfire.

The pilot for quantifying physical risks and adaptation plans in Canada showed interesting and relevant results for Vale to mitigate climate change risks and to establish action plans to deal with potential physical impacts.

Physical impact of climate change – potential risks in Vale’s Canada Operations



¹⁰ Climate change scenarios are defined using the paired Shared Socioeconomic Pathway — Representative Concentration Pathway framework. SSP2-4.5 corresponds to RCP 4.5 and end-of-century warming of 2-3 °C. SSP5-8.5 corresponds to the high emissions RCP8.5 scenario and warming in excess of 4 °C. The complete data set also includes SSP1-2.6, which corresponds to the Paris-aligned RCP2.6 scenario with warming held below 2 °C.

Overview of Vale's climate-related risks and opportunities

Below is a summary of our main climate-related risks and opportunities. Their full description can be found in our CDP report available [here](#).

Transition risks

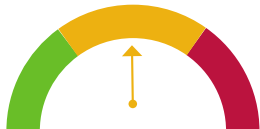

RISK	Regulatory						
DESCRIPTION	<p>Changes in policies to restrict emissions or adapt to the effects of climate change, imposing costs on issuers. Examples:</p> <ul style="list-style-type: none"> • More stringent emission regulations and carbon pricing, e.g., carbon border taxes; • Country-specific carbon pricing policies will affect margins for carbon intensive businesses 						
TYPE	Transition						
TIMEFRAME	Medium term						
EXPOSURE AND LIKELIHOOD	<div style="display: flex; align-items: center;"> <div style="margin-right: 20px;"> <p>LOW EXPOSURE</p> </div> <div style="margin-right: 20px;"> <p>INCREASING TREND</p> </div> <div style="border-left: 1px dashed gray; padding-left: 10px;"> <p>Potential financial impacts</p> <p>Estimated negative impact on Vale EBITDA 2030, related to a potential carbon pricing on Scope 1 & 2 emissions (considering today's emissions) as described in IEA scenarios:</p> <p>1. USD 50/t (STEPS); 2. USD 75/t or USD 140/t depending on the site location (SDS)</p> <table border="1"> <thead> <tr> <th>Scenario</th> <th>Impact</th> </tr> </thead> <tbody> <tr> <td>STEPS</td> <td>-2%</td> </tr> <tr> <td>SDS</td> <td>-3%</td> </tr> </tbody> </table> </div> </div>	Scenario	Impact	STEPS	-2%	SDS	-3%
Scenario	Impact						
STEPS	-2%						
SDS	-3%						
MANAGEMENT RESPONSE	<ul style="list-style-type: none"> • Established emission reduction target of 33% for scopes 1 and 2 until 2030 and net zero in 2050 • Addition of specific carbon emission reduction target on executives' variable remuneration • Roadmap established to achieve target in 2030 continuously aiming positive economic returns • Carbon commitments integrated with Vale's strategic and financial planning • Climate scenario analysis • Internal carbon price of USD 50/tCO₂e for decision making 						

Transition risks

RISK	Market									
DESCRIPTION	Reduction in demand for thermal coal due to the energy transition and consequential substitution of the fossil fuel by renewables, also changing the met coal market dynamics due to the necessity of low-carbon products for steel industry decarbonization									
TYPE	Transition	Potential financial impacts Decrease in net operating revenues of coal sales in vs Current Policies Scenario ¹¹ <table border="1"> <thead> <tr> <th>Scenario</th> <th>Impact (%)</th> </tr> </thead> <tbody> <tr> <td>IEA starting point scenario (CPS)</td> <td>0%</td> </tr> <tr> <td>STEPS</td> <td>-34%</td> </tr> <tr> <td>SDS</td> <td>-75%</td> </tr> </tbody> </table>	Scenario	Impact (%)	IEA starting point scenario (CPS)	0%	STEPS	-34%	SDS	-75%
Scenario	Impact (%)									
IEA starting point scenario (CPS)	0%									
STEPS	-34%									
SDS	-75%									
TIMEFRAME	Medium term									
EXPOSURE AND LIKELIHOOD	<p>HIGH EXPOSURE INCREASING TREND</p>									
MANAGEMENT RESPONSE	<ul style="list-style-type: none"> • This risk represents a great opportunity to adjust our portfolio of projects in order to provide low-carbon solutions to our customers for the value chain decarbonization, also adapting to potential market shift demands • In early 2021, Vale announced the beginning of the process to sell of its coal assets in a responsible manner, while engaging with local communities and governments 									

¹¹ It considers an assumption of reduction in Vale's sales in the same proportion as the coal market decrease in each scenario
Source: Group Strategy, Coal team and Woodmac.

Physical climate risks

RISK	Chronic and Acute	
DESCRIPTION	<p>Long-term shifts in climate patterns (e.g., sustained higher temperatures). Examples:</p> <ul style="list-style-type: none"> • Changes in precipitation patterns and extreme variability leading to increased operating costs; • Sea-level rise impacting production and distribution of the ore, leading to losses. <p>Event-driven, including increased severity of extreme weather events, such as cyclones, hurricanes, or floods.</p>	
TYPE	Physical	Potential financial impacts
TIMEFRAME	Long term	Loss of 0.5% in shipment/production of iron ore and coal due to abnormal rain patterns - USD 138.8 million/year
EXPOSURE AND LIKELIHOOD	 <p>MEDIUM EXPOSURE</p>  <p>INCREASING TREND</p>	
MANAGEMENT RESPONSE	<ul style="list-style-type: none"> • The “Vale Climate Forecast” enabled Vale to update the diagnosis of risks and impacts caused by the Climate Change in the North, South and Southeast Corridors. • To assist the physical impact map identify operational risks related to climate change, Vale bought a radar that was installed in Carajás urban area. The radar had an investment approximately USD 1.6 million (BRL 8 million). • Vale has an operational risk area which conducts periodic risk analysis for all Vale businesses and operations, including those related to climate change. • Mitigation actions at Vale’s Guaíba Island (TIG) terminal in Mangaratiba, Rio de Janeiro, that are underway: drainage solutions, containment of overflow water from the patio and emergency/permanent treatment stations. 	

Climate-related opportunities

OPPORTUNITY

Avoided costs of scope 2 emissions pricing

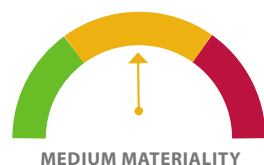
DESCRIPTION

Use of renewable sources of energy leading to positive returns on investment in low-emission technology due to energy cost reductions and local incentives. The delay in the transition of the company's energy matrix may have impacts on reputation, customer relations, resistance to our products, among other.

TIMEFRAME

Long term

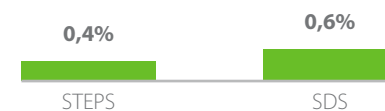
EXPOSURE AND LIKELIHOOD



Potential financial impacts

Estimated EBITDA avoided decrease due to zero scope 2 (electricity) emissions in 2030, considering Vale's target and carbon pricing from IEA scenarios:

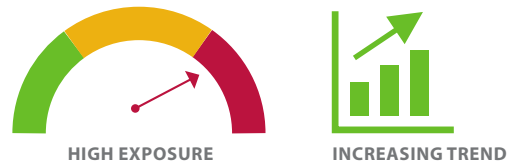
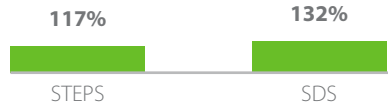
1. USD 50/t (STEPS); 2. USD 70/t or USD 140/t depending on the site location (SDS)



STRATEGY TO REALIZE OPPORTUNITY

- Vale has set targets for 100% renewable electricity in Brazil to 2025 and globally to 2030.
- To achieve this goal, the company has structured a roadmap of initiatives, which involves restructuring the current generation portfolio and partnerships to insert wind and solar energy.
- Most of the renewable energy products also help Vale to reduce energy costs
- Also, Vale is working on the development of the Powershift program, with pilots to substitute fossil fuels with renewable sources and/or electrify operations, based on our MACC Curve

Climate-related opportunities

OPPORTUNITY	Products and services opportunities	
DESCRIPTION	Ability to diversify business activities. Our goal is to expand our copper production - a fundamental commodity for the energy transition.	
TIMEFRAME	Long term	
EXPOSURE AND LIKELIHOOD		Potential financial impacts A potential gain in copper EBITDA due to increased production to approximately 1Mtpa and prices considering the IEA scenarios in 2030 ¹² : 
STRATEGY TO REALIZE OPPORTUNITY	<ul style="list-style-type: none"> • Definition of internat targets for business expansion • Acceleration of organic portfolio of Copper projects and dedication of R&D exploration expenses for the expansion agenda • Established strategic capital guidelines to support the business expansion 	

¹² Price differential to CPS scenario
Source: IEA, Woodmac, Group Strategy.

TCFD Summary Table Showing Vale’s Improvement since TCFD’s Endorsement

The TCFD summary table is updated annually in Vale’s Integrated Report

TCFD Recommendation	Year	Vale reported
1. GOVERNANCE – transparency regarding the governance of risks and opportunities related to climate change		
1.1. Description of the supervision of the Executive Board	2019	Sustainability Committee and Executive Board responsible for validation and low-carbon monitoring of guidelines Chapter “Governance” or “Sustainability Governance” of the Sustainability Report 2019. CDP question C1.1
	2020	Sustainability Committee and Executive Board responsible for validation and low-carbon monitoring of guidelines. Compliance and Risk Committee incorporates climate in its analyses. Chapter “Governance” of the Integrated Report 2020. CDP question C1.1
1.2. Role of executives in mapping and managing the agenda	2019	Low Carbon Forum, with monthly meetings to assess the deployment and implementation of the Vale Net zero strategy. This forum is coordinated by the Sustainability Executive Vice President, with the support of the Executive Officers for Coal, Strategy and Mineral Exploration, Business Support, Ferrous and Base Metals, and with the participation of Vale’s CEO and CFO. The meetings involve top management and technical groups from the business and corporate areas. Chapter “Climate Change and Energy” of the Sustainability Report 2019. CDP question C1.2
	2020	Low Carbon Forum, with monthly meetings to guide the implementation and delivery of the commitments assumed through the Vale Net zero strategy. This forum consists of a group led by the CEO, and coordinated by the Sustainability Executive Vice President, with the participation of the Executive Vice Presidents and their technical teams. The meetings involve top leadership and technical groups from the business and corporate areas. In 2020, the targets related to the climate agenda represented 10% of the employees’ short-term variable remuneration, including CEO and Executive Board. A target composed of indicators for greenhouse gas emissions, recovery and protection of forest areas, and assurance of renewable energy was also tied to the long-term compensation of the leadership. Sounding Panel, an advisory board under the Executive Board consisting of global ESG experts. Chapter “Climate Change” and “Relationship with Stakeholders” of the Integrated Report 2020; CDP questions C1.1 and C1.2.

TCFD Recommendation	Year	Vale reported
2. STRATEGY – current and potential impacts on the company’s business, strategy and financial planning		
2.1. Transparency on risks and opportunities identified in the short, medium and long term	2019	Preliminary and qualitative assessment of potential transition and physical risks, as well as low carbon opportunities. The studies will be further developed over 2020 Chapter “Climate Change and Energy” of the Sustainability Report 2019. CDP questions C2.4, C2.5.
	2020	Transition climate risks: Regulatory and Legal (changes in policies to restrict emissions or adaptation requirements to the effects of climate change, imposing costs to emitters, litigation for non-compliance with policies to mitigate climate impacts); Technological (replacement of products and/or processes by more efficient and/or current technologies); Market (changes in supply and demand due to alternative products); Reputation (perception of consumers and investors on the company’s adherence to transition to a low carbon economy). Physical risks: Direct damage to assets and indirect impacts on the supply chain caused by floods, droughts, incidence of strong winds and higher incidence of atmospheric discharges.
2.2. Impact of identified themes on portfolio and strategy	2019	Adoption of ongoing internal carbon pricing (shadow price) of USD50/t CO ₂ and in line with what is required to limit temperature increase to 2°C, to be integrated into analyses of capital projects, current projects, budget cycle and strategic planning in 2020 Chapter “Climate Change and Energy”.CDP questions C2.4, C2.5.
	2020	Transition risks could lead to increased costs, reduced market share and profitability. Physical risks eventually negatively impacting the company through operational interruption, increased costs, and reduced revenues.

TCFD Recommendation	Year	Vale reported
2.3. Business Resilience to Climate Scenarios	2019	<p>Initial exercise prepared in 2018 in relation to EBITDA sensitivity to International Energy Agency scenarios, including 2°C scenario. Preliminary analysis of physical risks of temperature increase and rainfall regime prepared by Instituto Tecnológico Vale. Sensitivity analysis to climate scenarios in progress within the current Strategic Planning cycle, based on the scenarios of the International Energy Agency.</p> <p>Chapter “Climate Change and Energy” of the Sustainability Report 2019. CDP item C3.1</p>
	2020	<p>As the TCFD suggests, in 2020 Vale opted to use the International Energy Agency (IEA) scenarios, which are recognized by the industry and have international backing. The different supply and demand behaviors in the three IEA scenarios result in changing competitiveness dynamics that affect the long-term price of Vale’s main commodities and its strategy.</p> <p>For the company, the Current Policies Scenario impacts, in part, its ability to generate value. Besides the higher exposure to physical risks, the Current Policies Scenario (CPS) does not consider the opportunity for growth of renewables, electrification of transportation and the need to decarbonize steelmaking, all of which are key parts of Vale’s strategy today.</p> <p>The Sustainable Development Scenario (SDS), on the other hand, creates an ecosystem that encourages the company’s growth options and amplifies the relevance of its strategic pillars, which are base metals transformation and maximization of iron ore flight-to-quality.</p> <p>The coal asset is negatively impacted in the Stated Policies Scenario (STEPS) and SDS scenarios, but is not representative in the consolidated result. On the path to carbon neutrality, Vale has evaluated its portfolio of assets and announced in early 2021 the divestment of its coal business, a strategy that is in line with the company’s focus on prioritizing its core businesses and its ESG agenda.</p> <p>Under a variety of climate change scenarios, Vale’s EBITDA performs in a range of 90% to 140% relative to the base case used in our strategic planning. This resilience is a result of a flexible portfolio that is able to adapt to different market conditions and has a strategic positioning that is well aligned with the trends of transition to a low-carbon economy.</p>

TCFD Recommendation

Year

Vale reported

3. RISK MANAGEMENT – process of identification, evaluation and management of corporate risks

2019

The Vale Institute of Technology regionalized (downscaled) the global warming models referenced by the Intergovernmental Panel on Climate Change (IPCC) to the Brazilian reality. This allowed Vale to identify changes in rainfall patterns and volumes, and temperature variation for all operations in Brazil. The RCP 4.5 and 8.5 models were regionalized. From the changes in rainfall and temperature patterns, it was possible to identify the main vulnerable assets and potential changes in the intensity and frequency of operational risks previously identified by the company's risk management process.

Chapter "Climate Change and Energy" of the Sustainability Report 2019. CDP question 2.2

1) Continuous monitoring: The Sustainability Directory, through the Executive Management of Environmental Management, acting in the second line of defense, continuously monitors physical and transition risks, as well as climate change opportunities.

2) Identification of risks from the business: Based on Vale's strategic planning, risks and opportunities are identified, considering the risk management process itself and the monitoring of the regulatory framework on the subject.

2020

For example, the Vale Institute of Technology regionalized (downscaled) the global warming models referenced by the Intergovernmental Panel on Climate Change (IPCC) to the Brazilian reality. This allowed Vale to identify changes in rainfall patterns and volumes, and temperature variation for all operations in Brazil. The RCP 4.5 and 8.5 models were regionalized.

Based on the Intergovernmental Panel on Climate Change (IPCC) scenario studies, Vale, in partnership with the Vale Technology Institute, has developed the Vale Climate Forecast, a methodology for analyzing risks and opportunities related to climate change. The Vale Climate Forecast enables:

- Very short and short term analysis and seasonal forecasting for physical risks, with the main focus on preventing impacts on operations and product shipments;
- Assessment of physical risks and their impacts in the long term to identify necessary investments in the facilities – for adaptation and/or mitigation of climate change.

Chapter "Climate Change: Risks and Opportunities in Climate Change" of the Integrated Reporting 2020; ESG Portal – Climate Change; CDP question 2.2.

**3.1. Process for mapping
and assessment of
climatic risks**

TCFD Recommendation	Year	Vale reported
3.2. Climate risk management process	2019	<p>The main climatic risks are part of the company's risk management process. In addition, the monitoring of the main risks is also communicated in the framework of the Low Carbon Forum.</p> <p>Chapter "Climate Change and Energy" of the Sustainability Report 2019. CDP question 2.2</p>
	2020	<p>The main climate risks are inserted in the company's risk management process, through analysis by the Executive Risk Committee and reporting to the Executive Board. In addition, the monitoring of the main risks is also reported within the Low Carbon Forum.</p> <p>From changes in rainfall and temperature patterns, it was possible to identify the main vulnerable assets and potential changes in the intensity and frequency of operational risks previously identified by the company's risk management process.</p> <p>For the transition risks, analyses were prepared on the resilience of the strategy, on the financial impacts, in face of different Climate Change scenarios, in addition to the periodic regulatory monitoring.</p> <p>Carbon pricing is one of the internal tools for managing the transition risk. The use of the shadow price of USD 50/tCO₂e is in line with what is required to limit the temperature increase to less than 2°C and is integrated to the economic-financial feasibility analysis of capital projects and current projects (sustaining), within the budget and strategic planning cycles as of 2020.</p> <p>For physical risks, we have developed an application to standardize the information on short-term physical risks in operations (Vale Climate Forecast app).</p> <p>Chapter "Climate Change: Risks and Opportunities in Climate Change" of the Integrated Reporting 2020; ESG Portal - Climate Change; CDP question 2.2."</p>
3.3. Integration into the corporate risk management process	2019	<p>Climate risks mapped by the different areas within the scope of Corporate Risk Management (CRM), and included in the Operational and Business Risk matrices Regulatory and physical risks included in risk factors (20 F).</p> <p>Chapter "Risks Management" of the Sustainability Report 2019.</p>
	2020	<p>Climate risks mapped by the different areas in the ambit of Corporate Risk Management (GRC), and included in the matrices of Operational and Business Risks Regulatory and physical risks included in the risk factors (20F). Periodically, material risks and opportunities are presented to the Executive Risk Committee for analysis and quarterly reporting to the Executive Board. The main results are also presented at the Low Carbon Forum.</p> <p>Chapter "Climate Change: Risks and Opportunities in Climate Change" of the Integrated Reporting 2020.</p>

TCFD Recommendation	Year	Vale reported
4. METRICS AND GOALS		
4.1. Metrics Reporting used to monitor climate risks and opportunities	2019	<ul style="list-style-type: none"> • Absolute emissions and intensity; • Absolute emissions and intensity Energy consumption, intensity and matrix profile; • Water and land use. <p>Chapters “Climate Change and Energy”, “Biodiversity” and “Water Resources and Effluents” of the Sustainability Report 2019; ESG Portal; CDP questions C5., C6., C7. and C8.</p>
	2020	<ul style="list-style-type: none"> • Absolute emissions and intensity; • Absolute emissions and intensity Energy consumption, intensity and matrix profile; • Water and land use. <p>Chapters “Climate Change: Greenhouse Gas (GHG) Emissions”, “Climate Change: Energy and Energy Efficiency”, “Biodiversity” and “Eco-Efficiency: Water Resources” of the Integrated Reporting 2020; ESG Portal; CDP questions C5., C6., C7., C8 and C9.</p>
4.2. Transparency regarding scopes 1, 2 and 3 emissions	2019	<p>Emissions reporting scopes 1, 2 and 3 in the Sustainability Report, ESG Portal and CDP Questionnaire.</p> <p>Chapter “Climate Change and Energy”. Of the Sustainability Report 2019; ESG Portal – Climate Change. CDP questions C5, C6 and C7.</p>
	2020	<p>Emissions reporting scopes 1, 2 and 3 in the Integrated Reporting, ESG Portal, ESG Databook and CDP Questionnaire.</p> <p>Chapters “Climate Change: Greenhouse Gas (GHG) Emissions” of the Integrated Reporting 2020. ESG Portal – Climate Change. CDP questions C5, C6 and C7.</p>

TCFD Recommendation	Year	Vale reported
4.3. Setting goals clearly	2019	<p>In December 2019, Vale assumed more ambitious goals in its climate agenda, with 2017 as the base year. These are the goals:</p> <ul style="list-style-type: none"> • Become a net zero mining company (Scopes 1 and 2) by 2050. • Reduce absolute emissions of Scopes 1 and 2 by 33% by 2030, in relation to the base year of 2017, aligned with the Paris Agreement. This target was defined based on the Science Based Target Initiative (SBTI) calculation tool and is therefore compatible with a global temperature increase of less than 2° and considered a science-based target. For Scopes 1 and 2 no offsets of any kind are considered and the entire strategy is related to the reduction of internal emissions. This target is linked to the variable remuneration of all Vale employees; • Consume 100% of electricity from renewable sources by 2025 in Brazil and globally by 2030; • Establish ambition to reduce scope 3 emissions; • Recover and protect an additional 500,000 hectares by 2030, beyond Vale’s borders. <p>Chapters “Global Sustainability Goals” and “Climate Change and Energy” of the Sustainability Report 2019; ESG Portal – Climate Change; CDP question 4.1.</p>
	2020	<p>In addition to the targets announced in 2019, in 2020 Vale assumed the goal of reducing Scope 3 net emissions by 15% until 2035, compared to the base year of 2018. The reduction volume was defined based on the Science Based Target Initiative (SBTI) calculation tool, Absolute Contraction Approach method, so it is also considered a science-based target.</p> <p>Chapters “Progress on 2030 Commitments” and “Climate Change” of the 2020 Integrated Reporting; ESG Portal – Climate Change; CDP question 4.1.</p>

Credits

General Coordination

Sustainability Executive Vice President

Design

grupo report - rpt.sustentabilidade

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