Climate-related impacts

The global transition to a low-carbon economy and potential physical climate-related impacts present both challenges and opportunities. Our approach is to continue developing strategies that build our business portfolio's resilience to climate-related impacts while capturing opportunities.

ABSOLUTE GHG EMISSIONS SCOPE 1 AND 2[1]

2.4m

tonnes CO_2-e

↓7%

in FY2019

↓32%

since FY2012

GHG EMISSIONS INTENSITY SCOPE 1 AND 2

348

tonnes CO_2-e/A$m revenue

↓7%

in FY2019

↓48%

since FY2012

Boral recognises that climate-related physical risks and a global transition to a low-carbon future are expected to impact our operations, customers and suppliers.

We support the Paris Agreement and mechanisms to achieve its objective of limiting future average global temperature rises to well below 2°C, as well as Australia's 2030 target of a 26–28% reduction in carbon emissions below 2005 levels.

Looking at how Boral's carbon emissions are tracking relative to 2005 levels, in Australia we have reduced emissions by around 40% since FY2005. We achieved about half of this decrease largely by realigning our portfolio away from emissions-intensive businesses. The remainder of the decrease is due to reducing clinker manufacturing in Australia in favour of importing it from more efficient and larger scale operations in Asia.[2] Including Boral North America, our Scope 1 and 2 emissions decreased by 43% since FY2005.

We continue to progressively adopt the recommendations of the TCFD. In FY2019, we enhanced our climate-related governance and risk management, completed scenario analysis of Boral Cement's business and continued to strengthen our resilience to a 2°C scenario. We also broadened our reporting of physical climate-related risks and Scope 3 emissions.[1]

We completed a Group-wide review of our climate-related risks and opportunities using the TCFD framework. This review informed a two-year roadmap to undertake further scenario analysis of key climate-related business risks.

We transparently and constructively engaged with Climate Action 100+ investor representatives and other stakeholders during the year, sharing our progress in aligning our efforts with the TCFD recommendations and building greater resilience to climate-related impacts.

Fly ash reclaim operation at Montour, Pennsylvania

Strategy

Our strategy is to strengthen our resilience to climate-related impacts by further reducing our operational emissions intensity; creating innovative solutions and products that support a lower carbon future; and mitigating our climate-related risks. Through our Boral North America Fly Ash business, we also aim to increase our contribution to reducing carbon emissions in the production of ready mix concrete, by making more fly ash available as a cement substitute.

In FY2018, Boral set three climate-related goals that reflect our strategic ambitions. Our performance against these goals and targets is outlined on pages 38–39.

As a global manufacturer of construction materials and building products, we are a large emitter of greenhouse gas (GHG), particularly through our clinker manufacturing operations in Australia. Our Cement business accounted for nearly 60% of our total 2.4 million tonnes of GHG emissions in FY2019. Our brick businesses in Western Australia and the USA together accounted for a further 9% of our GHG emissions.

Since FY2012, we have reduced our Scope 1 and 2 emissions from our operations by 32% and our emissions intensity by 48%, including a 7% reduction in emissions intensity in FY2019.

We achieved this by realigning our portfolio towards lighter weight products and less carbon-intensive businesses, reducing clinker manufacturing in Australia in favour of importing clinker, and investing in energy efficiency and low-carbon fuels programs.

Repositioning the business has reduced our risks associated with transitioning to a lower carbon economy and cut our exposure to energy costs. In FY2019, Boral's energy and fuel costs totalled $353 million, accounting for 6% of our cost base.

We are confident we will continue to reduce our emissions intensity going forward. We do not intend to invest in new cement or brick kilns, and these manufacturing operations are unlikely to be in Boral's portfolio in the long term. In fact, in August 2019, we announced that we are divesting our Western Australia Midland Brick business, which will help bring down our GHG emissions by around 60,000 tonnes per year. We cannot put targeted dates on the life of remaining kiln-based operations, as this will be determined by economic drivers.

Clinker manufacturing is highly emissions-intensive, so we continue to develop ways to reduce carbon emissions from our Cement business and bolster its resilience to climate-related transition risks.

We completed scenario analysis to get a better understanding of the potential transition risks and opportunities facing our clinker manufacturing operations, which we had begun in FY2018. The scenario analysis methodology, key assumptions, levers and implications for the business are detailed on pages 40–41.

Boral Cement's climate-related strategic priorities, including our roadmap to reduce Scope 1 and 2 emissions by around 20%, are detailed on pages 41–42.

More broadly across the Group, we continue to focus on energy efficiency improvements, and using recycled materials to reduce our carbon emissions.

We continue to grow the revenue contribution of our lower carbon and high-recycled-content businesses and products.[3] These include our Boral North America Fly Ash and TruExterior® Siding & Trim businesses, and in Boral Australia, our Recycling business and lower carbon concretes such as ENVISIA®, Envirocrete® and Aspire®.

USG Boral is also continuing to progress plant trials and product development of USG-developed Sheetrock® EcoSmart Panels to suit the Australian market. EcoSmart Panels are produced using less water than other boards. This means less energy is used to dry the product, reducing carbon emissions by 20% during manufacturing.

Berrima Cement Works, NSW

CEMENT CARBON EMISSIONS

Clinker is the main ingredient in cement, which is used to make concrete.

Manufacturing clinker requires the decomposition of limestone, which typically accounts for about two-thirds of the total carbon emissions generated in cement production.[4]

Most of the remaining carbon emissions are generated by heating the clinker kiln using standard fuels such as coal and electricity for the raw feed milling and kiln operation, and to a lesser extent, diesel for on-site plant and equipment.

Grinding of clinker and other mineral additives typically only accounts for around 5% of GHG emissions in cement manufacturing.

1 See page 53 for definitions of Scope 1, 2 and 3 emissions.

2 Following the closure of Boral's clinker manufacturing plant at Waurn Ponds, Victoria in 2013, we have imported clinker from Asia. The emissions intensity of our Waurn Ponds clinker manufacturing operations in FY2013 was 0.98 tonnes CO_2-e per tonne of production. The emissions intensity of our imported clinker, included as Scope 3 emissions, is 0.95 tonnes CO_2-e per tonne of production, including shipping to the Port of Geelong (a 3% reduction in emissions).

3 Defined as having a minimum of 40% recycled content.

4 *Technology Roadmap* report by IEA and World Business Council on Sustainable Development Cement Sustainability Initiative, March 2018.

Climate-related impacts
(continued)

Climate-related risks and opportunities review

As part of our planning and risk management efforts during the year, we undertook a targeted review of our climate-related risks and opportunities across the Group, using the recommended framework set out by the TCFD. The work updated and revised the climate-related review we completed previously in FY2017.

Group HSE managed and coordinated the review, with assistance from Group Risk and an external consultant. The review incorporated input from functional managers and senior representatives of Boral's three divisions, obtained through a series of workshops and one-on-one interviews.

The review assessed and prioritised potentially significant physical and transition climate-related risks and opportunities, based on high-level climate scenarios. A summary of these is included on pages 35–37.

TCFD-based scenario analysis roadmap

Based on the outcomes of our climate-related risks and opportunities review, we established a two-year roadmap to further assess our most significant risks using comprehensive TCFD-based scenario analysis.

The planned scenario analysis will enable us to test the potentially significant business risks identified under different climate-related and regulatory scenarios. The findings from this work will inform our business strategies and actions, and be incorporated into Group-level climate-related financial risk modelling.

Work done	✓ **Clinker** manufacturing transition risks	Findings integrated into strategic plans and Group level climate-related financial risk modelling
FY2020–21 work plan	• **Physical climate-related risks** in key geographies • **Carbon pricing risks** across Boral's supply chain • Availability and supply of **synthetic FGD[1] gypsum** in USG Boral[2] • Supply chain impacts on **Boral North America Fly Ash** from potential decline in coal-fired electricity generation	

Boral North America, sourcing fly ash from a utility, Georgia

LEVERAGING OUR FLY ASH BUSINESS TO REDUCE CARBON EMISSIONS

Fly ash is a residue generated by coal-fired power stations. As a substitute cementitious material used in manufacturing concrete, fly ash has multiple benefits. It enhances the impermeability, durability and workability of concrete, is typically cheaper than cement, and mitigates carbon emissions associated with cement production.

In FY2019, we sold 7 million tons (6.3 million tonnes) of fly ash. The replacement factor of Portland cement with fly ash in ready mix concrete generally varies between 1:1 and 2:3, depending on the properties of the ash and the desired performance of the concrete.

On the basis that 1 tonne of cement produced results in about 1 tonne of carbon emissions, for every 1 million tonnes of fly ash we can bring to market, replacing Portland cement with fly ash would avoid 0.67–1 million tonnes of CO_2-e being emitted.

Fly ash substitution of Portland cement in concrete is currently around 16% in the USA, but up to about 50% in European markets. This means there is considerable opportunity for higher substitution rates if we can increase fly ash supply.

Our strategy is to increase the amount of fly ash we bring to market by reducing the amount of ash that would otherwise go to landfill and by reclaiming ash that is currently in landfill across the USA – an amount estimated to exceed 1 billion tons[3].

Initiatives underway to increase our supply of fly ash include optimising our distribution network; increasing use of beneficiation technologies and new ash storage facilities to reduce ash going to landfill; reclaiming landfilled ash; expanding into pozzolans and importing excess fly ash from countries where it is abundant. We are aiming to increase available fly ash for sale by 1.5–2 million tons per year by FY2022.

1. Flue gas desulfurisation.
2. FGD scenario analysis is subject to outcomes of strategic ownership changes of USG Boral.
3. Sources: American Coal Ash Association estimates around 1 billion tons of fly ash is currently in landfill. The United States Environmental Protection Agency estimates that around 1.5 billion tons of total coal ash has been landfilled or impounded.

Governance

Our approach to sustainability governance, including climate-related impacts, is outlined on page 21.

This year, we established a Group Environmental Sustainability Governance Steering Group that will be responsible for coordinating and reviewing climate-related risks, strategy and reporting. The group, chaired by Boral's Group President Operations, comprises senior functional leaders including from Group HSE, Group Risk and Investor Relations.

The group will oversee the implementation of Boral's climate-related scenario analysis roadmap, and review and endorse assurance activities, including recommendations to Boral's Executive Committee and the Board.

The group reviews the climate-related information in this Sustainability Report, including performance against our targets and goals, as do the CEO & Managing Director, the Board HSE Committee and the full Board. The Board also reviews performance against divisional strategic objectives and business plans. These include initiatives to develop and drive market expansion of lower carbon products, and to reduce costs and operational emissions through energy efficiency and low-carbon fuels programs.

We have had our performance against quantitative climate-related goals and targets – and our reported energy and carbon emissions data – independently assured. For more details, see EY's limited assurance statement on page 52.

Risk management

Climate-related risks are incorporated into Boral's enterprise risk management (ERM) framework and processes, which identify, assess, monitor and report on our organisation's risks.

Managed by Group Risk, these processes include business-specific, bottom-up risk assessments, as well as top-down reviews. The Group Risk team works with business leaders and functional managers to ensure risks are adequately considered through Boral's ERM process.

Group Risk reports to the Board Audit & Risk Committee at least annually on Boral's organisation-wide risks.

High-recycled-content TruExterior® Siding & Trim

Based on our existing categorisation of climate-related risks, we determine their relative significance using the same established methodology as for other risks. We review and revise these categorisations regularly, based on emerging issues. Climate-related risks are now also incorporated as a standalone category of risk in our ERM framework.

Boral's risk-scoring methodology assesses risks based on consequence and likelihood of occurrence, to identify the severity of the risk. The consequence is rated according to a number of factors including potential financial impact.

Divisional chief executives are responsible for managing identified risks and implementing mitigation action plans, and may delegate this responsibility to line managers.

A summary of our key risks and responses, including climate-related risks, is included on pages 16–17.

Risks and opportunities

PHYSICAL RISKS

Boral's key businesses and regions most at risk of potential climate-related acute physical risks include:

- our key quarries across eastern and southern Australia, and our Cement business operations
- Boral North America's southern USA region, from which the division derives nearly 50% of its revenue, and
- low lying coastal areas or river deltas in our USG Boral Asia operations.

Across our global operations, we consider flood and storm deluge risk to be a key physical risk. Over the last several years, we have reviewed stormwater infrastructure at potentially high risk sites and commenced investing in upgrading stormwater infrastructure at sites considered most at risk. Although this work is ongoing, outputs from this process have included:

- installing additional pumping equipment at quarries to improve our recovery response to high rainfall events
- installing backup power generators in case storms interrupt power supplies, and
- developing tailored emergency response plans.

In FY2019, we assessed the risks associated with extreme weather, including rainfall deluge, at sites that have some form of impoundment wall, such as a constructed dam wall. See page 45 for details.

From a Group perspective, our geographically diverse operating footprint is a key mitigating factor against the risk to earnings posed by climate-related weather events, as these typically tend to be geographically concentrated.

Climate-related impacts
(continued)

PHYSICAL RISKS – MEDIUM AND LONG TERM

Acute and chronic physical risks will be considered in our planned scenario analysis.

Potentially significant risk	Key mitigation measures
Acute risks – increased severity and frequency of extreme weather such as cyclones, severe precipitation causing floods or deluge, and bushfire events	
Property damage to key Boral operations, key suppliers and/or key customers may result in business interruption and repairs to Boral operations. Property damage to key suppliers may result in temporary supply interruption for key raw materials and/or significant cost increases	• Impact of physical damage to our buildings, plant, equipment and stock, and resulting lost profit, is mitigated through Boral's risk management which includes working with our group insurers – this involves considering and implementing improvements such as business contingency plans • Raw material supply continuity plans in place at key sites
Environmental damage may result in fines, penalties and/or damage to Boral property and/or community, including waterways	• Environmental management system helps to identify and mitigate site-specific environmental risks via internal self-assessments and audits • Investment in stormwater infrastructure
Disruption to logistics or supply chain across our network may impact our ability to supply our customers and have raw materials delivered from impacted regions	• Geographically diverse operating network delivers flexibility across a number of our businesses • Group Procurement considers supply risk and identifies alternative supply options for key raw materials
Chronic risks – shifts in climate, including precipitation patterns, unseasonal weather variability, rising mean temperatures and rising sea levels	
Constrained water supply due to prolonged drought may result in increased water costs and potential decline in product demand from customers due to higher prices	• Increased use of recycled water and on-site water storage over past decade • Establishing Group-wide water efficiency and re-use targets in geographies with potential water stress • USG Boral Sheetrock® EcoSmart Panels, currently being developed to suit Australian market, require 25% less water in manufacturing than other boards
An increase in the number of rain-impacted days may significantly affect our customers' operations and in turn demand in Boral Australia's Concrete and Asphalt businesses, and our Fly Ash business in the USA, in particular increasing costs through operational inefficiencies **An increased number of hot days** could lead to decreased productivity and higher energy costs, and possible reductions in revenue	• Project underway to develop strategies that increase business resilience in event of adverse weather

Given that the typical expected life of our operations extends more than 20 years, we define short-, medium- and long-term climate-related risks as follows.

Short-term risks	**0–10 years**
Medium-term risks	**10–20 years**
Long-term risks	**20+ years**

TRANSITION RISKS – SHORT TERM AND ONGOING

The following transition risks will be considered in our planned scenario analysis and/or have been considered in Boral Cement's clinker transition risk scenario analysis completed in FY2019.

Potentially significant risk	Key mitigation measures
Carbon policy changes and potential introduction of regulatory pricing mechanisms and/or trading systems may impact cost of non-renewable energy	
Boral Cement – there may be lower demand for clinker at a higher cost due to exposure to a potential carbon price	• See pages 40–41
Boral North America – there may be decreased supply and/or a higher cost of fly ash due to decline in coal-fired power generation	• Comprehensive growth plans to expand supply – see page 34
USG Boral – there may be decreased supply of synthetic gypsum and/or a higher cost due to decline in coal-fired power generation in Asia	• Investing in network flexibility and strengthening contracts with suppliers, and identifying network of alternative suppliers of raw materials, including natural gypsum
Energy policy changes may increase costs due to changes in supplied energy mix (such as more renewables), resulting in higher cost of raw materials, either domestic or imported	• Investing in lower carbon fuels and energy efficiency initiatives • Actively monitoring policy and regulatory developments
Disruptive technology may affect our competitiveness, either through reduced demand or supply-side cost impacts	• Continue to invest in developing innovative lower carbon building products and construction materials – see pages 33 and 42
Building and construction industry standards changes may result in decreased demand for higher carbon products	• Risk considered as part of clinker scenario analysis – see page 40 • Continue to invest in innovative lower carbon building products and construction materials

OPPORTUNITIES

Increased building and construction rectification and remediation work

- More frequent extreme events may result in higher demand for rectification and remediation work. For example, Boral North America Roofing business benefited from increased re-roof activity in Florida following Hurricane Irma in September 2017

Increasing demand for more resilient infrastructure and buildings

- In Australia, Boral's advanced lower carbon concrete range provides long-term strength and durability benefits that outperform conventional concrete
- In Boral North America, our concrete and clay tile roofing products offer greater resistance to extreme weather conditions than many other roofing materials

Capturing growth from changes in construction industry standards

- Building our capacity to develop and market more sustainable building products and construction materials
- Queensland Department of Transport and Main Roads recently approved our high durability, lower carbon ENVISIA® concrete for use in any Queensland infrastructure project
- Our US Fly Ash business is well positioned to benefit from increasing substitution of cement in concrete production

Reduced energy costs from improved energy efficiency

- Investment in low-carbon solid waste-derived fuels facility at Berrima is decreasing our energy costs and carbon footprint
- Continuing to explore opportunities to improve energy efficiency of operations, including investigating further low-carbon fuels programs in our Cement business
- Boral Timber is progressing development of a project to convert timber sawmill residues into renewable diesel and bitumen – see page 39

Climate-related impacts
(continued)

OUR GOALS AND TARGETS	FY2019
Further reduce **emissions intensity** by **10–20% on FY2018 by FY2023**[1,2]	↓7%
Deliver annual growth in share of revenue from lower carbon and high-recycled-content products from **9%**[3]	↑ to 10%
Reduce **1.1–1.5 million tonnes CO_2-e in supply chain** on FY2018 through increased fly ash supply by FY2022	↑0.1 million tonnes CO_2-e

GHG EMISSIONS
tonnes CO_2-e

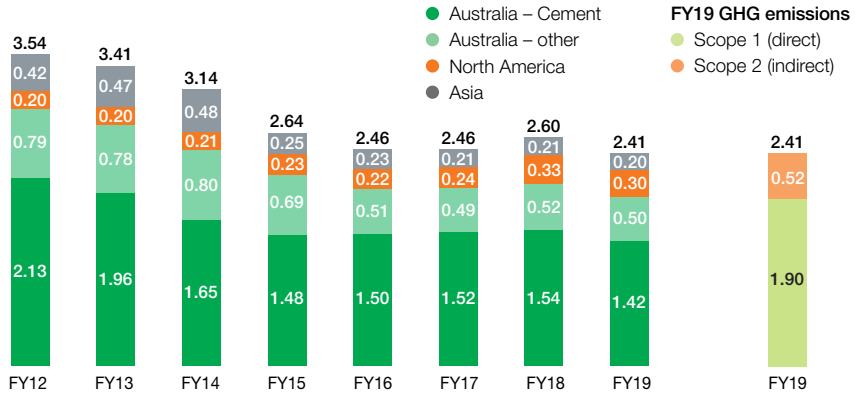
↓7% to 2.4m
Scope 1 and 2

3.0m
Scope 3

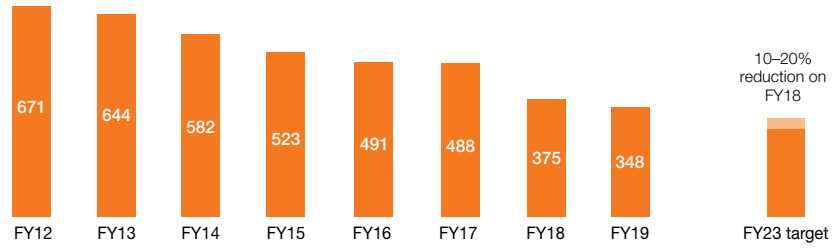
Metrics and targets

Our FY2023 emissions-intensity reduction target of 10–20% on FY2018 does not capture the potential exit of non-core brick operations, or other possible divestments or acquisitions. It reflects higher expected growth in our less energy- and emissions-intensive businesses, and the benefit of our low-carbon fuels program at Berrima.

During FY2019, we sold our Denver Construction Materials and Block businesses in the USA. In August 2019, we announced the sale of our remaining Australian brick business, Midland Brick, and an agreement to acquire Knauf's 50% stake in USG Boral Australia and New Zealand, and form an expanded USG Boral Asia joint venture with Knauf. These business portfolio changes are expected to impact our reported emissions intensity from FY2020, so we intend to review our emissions-intensity reduction target in FY2020.



GHG EMISSIONS FROM OPERATIONS[1,4] (million tonnes CO_2-e)



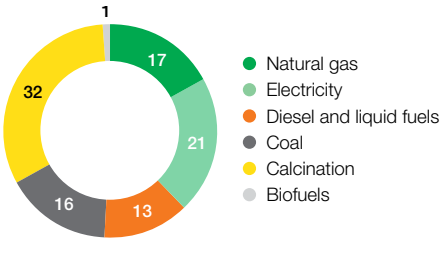
GHG EMISSIONS INTENSITY FROM OPERATIONS[1,2] (tonnes CO_2-e per A$m revenue)

Greenhouse gas emissions from operations

Our Scope 1 and 2 emissions decreased by 7% to 2.4 million tonnes compared to the prior year.[1] The decline largely reflected lower clinker production, the benefit of the low-carbon fuels program at Berrima, and the divestment of the Denver Construction Materials and Block businesses in the USA.

Boral's GHG emissions intensity decreased by 7% to 348 tonnes of CO_2-e per A$ million of revenue, down from 375 tonnes in FY2018, reflecting lower absolute emissions and steady underlying Group revenue.[1,2] Excluding the divestment of our businesses in the USA in FY2019, our emissions intensity decreased by 9% compared to the prior year.[5]

Our lower carbon and high-recycled-content products and businesses accounted for 10% of Group revenue in FY2019, up from 9% in FY2018. See page 33 for a description of these.



GHG EMISSIONS BY FUEL SOURCE[1] (%)

Scope 3 emissions

This year, we expanded data collection and reporting for our Scope 3 emissions. We considered each of the 15 categories of Scope 3 emissions as defined in the GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard. With the aim of identifying and reporting on more than 95% of Boral's indirect emissions, each of our three divisions reviewed potential sources of Scope 3 emissions likely to account for more than 50,000 tonnes of CO_2-e of emissions per year across these categories.

On this basis, we identified 3.0 million tonnes of Scope 3 emissions in FY2019. Of these emissions, 90% related to purchased raw materials, and the remaining 10% related to the upstream emissions associated with our energy and fuel purchases, and downstream emissions associated with contractor haulage. Boral Australia's clinker imports and domestic cement purchased, together with Boral North America's cement purchased for use in the Stone and Roofing businesses accounted for 55% of our Scope 3 emissions.

Going forward, we will continue to refine and improve our Scope 3 reporting and methodologies.

Avoided emissions

GHG emissions avoided through the sale of fly ash in the USA were modestly lower at 5.1 million tonnes[6], down from 5.2 million tonnes in FY2018. We are targeting a reduction of 1.1–1.5 million tonnes carbon emissions in the supply chain on FY2018 by FY2022 through increasing annual supply of fly ash by 1.5–2.0 million tons.

Further data on Boral's GHG emissions, including Scope 3 emissions by division, energy consumption and other emissions is available on our website.

1. GHG emissions and energy consumption data excludes some joint ventures, which in aggregate are not deemed to have material emissions.
2. Group-reported revenue adjusted to include a 50% share of underlying revenue from the USG Boral and Meridian Brick joint ventures, which are equity accounted.
3. Based on Group-reported revenue – this excludes underlying revenue from joint ventures which are equity accounted.
4. Data may not add due to rounding.
5. Assumes FY2018 emissions and revenue for businesses divested in FY2019.
6. We have used a conservative conversion factor to estimate CO_2-e emissions displaced as a result of fly ash substitution for cement in ready mix concrete, assuming that for every tonne of fly ash approximately 0.8 tonne of CO_2-e is displaced. This conversion rate accounts for varying qualities of fly ash, and so assumes a substitution rate of 1.25 tonnes of fly ash per tonne of cement in ready mix concrete, and assumes 1 tonne of cement produced results in 1 tonne of carbon emissions. We will review our methodology for calculating avoided emissions in FY2020.

ENERGY CONSUMPTION AND COSTS FY2019

↓4% to 20.6 PJ
A$353m

Boral Group

12.1 PJ	4.4 PJ	4.1 PJ
A$226m	US$41m	US$50m
Boral Australia	**Boral North America**	**USG Boral**

ENERGY

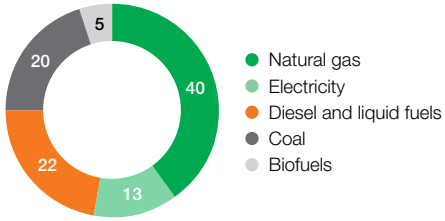
We aim to implement strategies to reduce our energy costs as well as our carbon footprint. This means we are investing in opportunities that improve our energy efficiency or decrease our energy costs while abating carbon emissions, where it makes economic sense to do so.

For example, the new low-carbon solid waste-derived fuels program at Berrima reduced our consumption of coal by 16,000 tonnes in FY2019, and we expect to replace more than 40,000 tonnes of coal in FY2020. Our Boral Timber business is also progressing the development of a project to convert sawmill residues into renewable diesel and bitumen.

In FY2019, our operations consumed 20.6 petajoules (PJ) of energy, down 4% on the prior year. This decline largely reflects lower clinker production at Berrima and the sale of the Denver Construction Materials and Block businesses in the USA.

The low-carbon fuels program at Berrima increased the contribution of biofuels in our energy mix to 5%, up from 2% last year.

Expenditure on energy was A$353 million in FY2019, down 7% compared to FY2018.



ENERGY BY FUEL SOURCE[1] (%)

TIMBER RESIDUE BY-PRODUCTS AS BIOFUEL

Boral Timber recently completed a feasibility study investigating the conversion of up to 50,000 tonnes per annum of sawmill residues from our Herons Creek mill into renewable diesel and bitumen. The study found that the project, which could supply up to 15% of Boral's annual diesel and bitumen needs, was technically and financially viable.

The $1.2 million study, co-funded by the Australian Renewable Energy Agency (ARENA), included pilot plant trials using world-first technology developed by a Spanish company, Global Ecofuel Solutions S.L. The proof of concept identified the renewable diesel had less than 25% of the carbon emissions intensity of fossil-derived diesel.

Climate-related impacts
(continued)

Boral Cement scenario analysis

In FY2019, we completed the climate-related scenario analysis we commenced in FY2018, assessing the implications for Boral's Cement business of transitioning to a lower carbon economy.

We initially focused on our Cement business as it is our most emissions-intensive, and more likely to be impacted by domestic and global policy changes. Boral Cement also underpins a significant proportion of our revenues – Boral Cement and downstream businesses account for around one-quarter of Boral's revenue.

Our scenario analysis work tested the resilience of our clinker operations by modelling three different future climate transition scenarios out to 2030.

The three scenarios we considered were a Reference Case (a 3–4ºC economy), which incorporates a modest future policy transition, a Globally Aligned scenario, and a Regionally Differentiated scenario. The Globally Aligned and Regionally Differentiated scenarios aligned with the Paris Agreement 2ºC climate goal, and leveraged existing projections from the International Energy Agency (IEA).

The scenario analysis work provided a formalised approach to assess the impact of different policy and carbon pricing levers on:

- the demand and supply profiles for clinker and substitute cementitious materials (SCMs) out to 2030
- the cost to manufacture and import clinker, and implications for configuring the proportion of clinker manufactured and imported, and
- potential future capital investment requirements.

The carbon prices used in the scenarios were based on the Climate Change Authority's 2013 *Climate Change Mitigation Report*. The low and high price ranges used in the scenarios align with the medium level of global action and ambitious global action scenarios in that report.

The scenarios drew on historical relationship assumptions and future expectations focused around four key influencing levers.

KEY LEVERS

Carbon policy

- Carbon price and level of local assistance to emissions-intensive sectors in Australia and regionally
- Emissions abatement technology

Energy policy and energy efficiency

- Energy price in Australia and regionally
- Use of low-carbon fuels
- Energy efficiency of kilns

Construction policy and industry standards on construction materials efficiency

- Market demand for concrete
- Clinker-to-cement ratio
- Availability of SCMs

Environmental policies

- Kiln closures in Australia and regionally

The key assumptions and outcomes under each scenario are outlined below.

	Reference Case (3–4ºC economy)	**Globally Aligned** (2ºC economy)	**Regionally Differentiated** (2ºC economy)
Assumptions			
Description	Minor future policy transition	Ambitious policy action to achieve climate target both in Australia and regionally	Policy divergence with strong regional policy action and more gradual action in Australia
2030 carbon price (A$/tonne CO_2-e)	$60	~$150	$60 in Australia ~$150 regionally
Coal-fired plants decommissioned	By 2050	By 2035	By 2050
Lower carbon construction materials and design			
Industry standards	Unclear pathway	Strong advancements	Modest market acceptance despite changes in standards
Uptake of high blend and alternative cement	Limited	Significant increase	Modest increase
Timber as a concrete alternative	Limited	Modest increase	Modest increase
More concrete-efficient building design	No developments	Significant developments	Limited developments

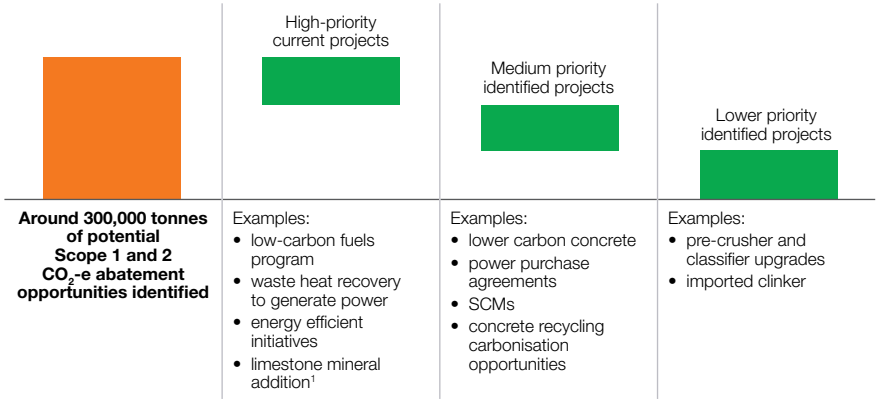
	Reference Case (3–4°C economy)	Globally Aligned (2°C economy)	Regionally Differentiated (2°C economy)
Outcomes			
Clinker demand	Continued growth to 2030	Marked decline by 2030	Gradual and moderate decline by 2030
Demand and supply profiles for SCMs	Slight increase in demand	Significant increase in demand and potential supply constraints	Moderate increase in demand
Cost to manufacture and import clinker	While this information is commercially sensitive, the different scenarios have implications for configuring the proportion of clinker manufactured and imported		
Capital investment	Considerations include capital investment for storage of fly ash and slag, and highly substituted blended cements		

The scenario analysis outcomes have provided greater insight into decision triggers and potential challenges and opportunities for the Cement business. This has informed strategic decision making and increased our efforts to leverage future opportunities and build our resilience in a potentially rapidly decarbonising economy, including a potential marked replacement of clinker with SCMs.

BORAL CEMENT STRATEGIC PRIORITIES

Our climate-related strategic priorities for Boral Cement are focused on reducing our operational emissions and optimising operational flexibility.

Boral Cement's revised 2019 carbon abatement plan identifies potential projects and opportunities to reduce Scope 1 and 2 emissions by about 20%, equivalent to about 300,000 tonnes CO_2-e.



Some of these opportunities depend on carbon pricing, capital investment and future lower cost alternatives. We are currently investing in projects assessed as high priority based on our initial assessment of their feasibility at a nil carbon price.

Low-carbon fuels program

Our new low-carbon solid waste–derived fuels (SWDFs) facility at Berrima, commissioned in FY2018, reduced our coal-related carbon emissions by about 30,000 tonnes in FY2019.

Over the coming year, we are aiming to progressively increase our use of SWDFs, which should decrease our coal-related carbon emissions by a further 50,000 tonnes per year.

SWDFs used include wood residues – such as untreated sawdust, pallets, bark chips and mill off-cuts – and refuse-derived fuels sourced from commercial waste such as paper, cardboard and packaging.

We are investigating further low-carbon fuels programs in our Cement business.

Waste heat recovery

The recovery of waste heat at Berrima is another high priority project we are investigating.

When clinker is produced, the calcination process consumes a significant amount of heat energy. A large amount of this heat is wasted when it is released rather than used. Waste heat recovery transfers this heat to a 'working fluid' – for example, water or an organic liquid – which drives a turbine to produce power.

Energy efficiency initiatives

Boral Cement has implemented a number of energy efficiency opportunities, including compressor optimisation, LED lighting initiatives and process optimisation. Further opportunities we are investigating include improvements to process dust collector efficiencies and optimising cement grinding.

1. Realisation contingent on change to cement standard.

Climate-related impacts
(continued)

Limestone mineral addition

Boral is working towards maximising limestone mineral addition in cements without detrimental effects to cement or concrete performance. Inter-grinding limestone and clinker reduces the clinker content of cement, saves energy and produces cement with lower embodied GHG emissions.

Lower carbon concrete

As a leader in developing innovative concrete solutions in the Australian market, we are working with design engineers and our customers to increase the adoption of our innovative lower carbon concrete products.

Our high durability, lower carbon ENVISIA® concrete achieves a Portland cement reduction of up to 65% using the Green Star MAT-4 method, without the traditional trade-offs in concrete performance. And our newly developed Aspire® concrete, specifically developed to maximise floorplans in commercial and high-rise buildings, has a cement replacement rate exceeding 40%.

To ensure we continue to create value for our customers through innovative product solutions, we are working to develop further material innovations. This includes supporting and partnering with third parties such as universities. See page 48 for more information about our lower carbon concretes.

Supplementary cementitious materials

We are investigating opportunities to further reduce the clinker-to-cement ratio in our operations, by replacing clinker with a greater proportion of SCMs.

We are working to access and secure higher volumes of usable fly ash and slag as a cementitious substitute material in Australia.

The suitability of fly ash as a replacement for cement in Australia depends on its quality and technical attributes, as well as our ability to economically acquire it.

Low-carbon solid-waste derived fuels facility at Berrima, NSW

Optimising operational flexibility

Being operationally flexible is an increasingly important consideration in our long-term planning and capital investment decisions. For example, our Boral Cement Geelong storage and grinding facility, currently under construction, allows for the use of a broader range of SCMs such as slag.

We are also:

- considering carbon pricing in our long-term supply chain network optimisation plans and in significant capital investment decisions, particularly where energy costs are material, and
- building our competency in monitoring regional carbon and energy policy settings, and understanding the implications for our Cement business.

Boral Cement's key climate-related strategic initiatives are consistent with the International Energy Agency's (IEA's) recommendations for the cement industry, as outlined in its *Tracking Clean Energy Progress* report. Published in May 2019, the report outlines key strategies to align with IEA's Sustainable Development Scenario to achieve the Paris Agreement's well below 2°C climate goal. These strategies include:

- improving energy efficiency
- switching to lower carbon fuels, such as waste and biomass
- reducing the clinker-to-cement ratio, and
- advancing process and technology innovations.