



WWF

BUSINESS
CASE

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2018

Eco-blend cements for low-carbon construction

Emerging climate-smart business opportunities

Supported by:



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A snapshot of the opportunity

Cement production is instrumental to the government's infrastructure expansion plans and development goals. Given its significant carbon footprint, using conventional cement in the planned infrastructure build will make the achievement of South Africa's greenhouse gas (GHG) mitigation commitments more difficult. Substituting clinker with Supplementary Cementitious Materials (SCM) to create cements with lower environmental impact (eco-blends), is the simplest and most obvious option to reduce cement's carbon footprint.

PHOTO: SHUTTERSTOCK.COM



The case for investment

- **Potential market capture:** eco-blend cements have the potential to capture 90% of the cement market.
- **Reduce costs:** increased usage of SCM will lower the cost of cement production.
- **Productive use of waste and by-products:** a substantial amount of the 40 million tonnes of fly ash produced each year in South Africa could be used as an eco-binder for low-carbon cement production.
- **Carbon pricing legislation:** will drive the move in the cement industry towards increased usage of SCM.



The offtake market

- **Market size:** six major producers in the South African cement industry account for approximately 71% of market production capacity.
- **Growth market:** the South African cement market was valued at R48 billion in 2014. Cement sales data indicates a compound annual growth rate of 3.9% between 2012 and 2015.
- **Sizeable opportunity:** eco-blends can potentially capture some of the estimated R496 billion to be invested in construction activities between 2013 and 2023 in South Africa.



Socio-economic benefits

- **Increased well-being:** using industrial wastes and by-products for eco-blend cement production contributes to a lower-waste society and circular economy, with positive job opportunities, for example in collecting, sorting, processing and transporting of the waste.
- **Economic gains:** newer, smaller firms could enter the eco-blends market.



Climate change benefits

- **Reduce greenhouse gas (GHG) emissions:** the South African cement industry contributes approximately 1% towards the country's total GHG emissions. Assuming a cement sector emissions baseline of 11.97 MtCO₂e, increasing the average clinker substitution levels by 5%, to an average of 35%, will result in emissions saving of over 450 000 tCO₂e across the sector.



Greenhouse gas (GHG) mitigation in the cement sector

Cement, the primary ingredient in concrete, is one of the most consumed substances on Earth. It forms the foundations and structures of the buildings we live and work in and the roads and bridges we drive on. Both cement and concrete are indispensable for construction activity and development and are therefore closely linked to the global economy.¹



Cement production is a high energy and GHG emissions intensive activity because of the extreme heat involved in the processing of the primary components and the chemical reactions needed to give cement its structural qualities.

5%
global CO₂ emissions
from the global
cement sector

CO₂e

To enable us to compare the emissions of different greenhouse gases, they are converted to a common basis called carbon dioxide equivalent (written CO₂e) – expressed as 'carbon emissions' for short.

PHOTO: SHUTTERSTOCK.COM

Global greenhouse gas (GHG) emissions

The Paris Agreement commits countries to reduce GHG emissions and prevent average global temperatures from increasing by more than 2 °C above pre-industrial levels.

To meet this target, the global cement sector must reduce its GHG emissions to around 1.7 Gt by 2050 – a 0.4 Gt reduction from the 2010 emissions levels of 2.1 Gt.⁵

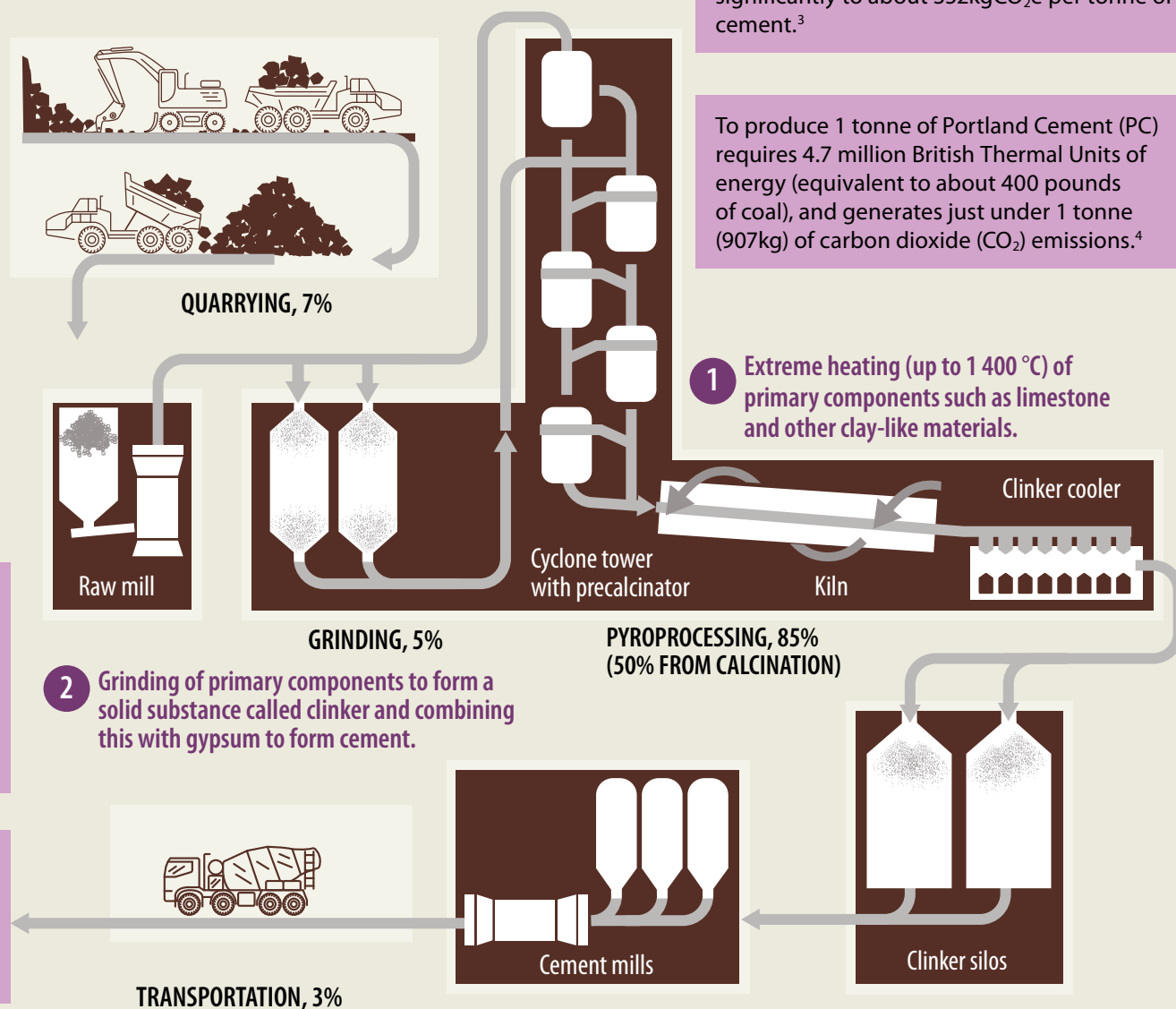
As countries look for ways to achieve their climate change mitigation commitments under the Paris Agreement, the cement sector can expect demands that it make significant efforts to reduce its emissions profile.

Without any mitigation effort emission levels from global cement production are projected to reach 4.3 Gigatonnes (Gt) CO₂e per year by 2050 – an increase of 260% over their 1990 levels.²

Because continued growth is expected in the sector, further significant efforts are required to reduce the emissions profile.

Cement production at a glance

Share of total CO₂ emissions across the Portland cement production process



Key mitigation options

Four key mitigation options to reduce emissions⁶

1. Adopt new technologies, such as Carbon Capture and Storage (CCS) and alternative binder technologies, such as geopolymers and LC³ cements.
2. Improve energy efficiency.
3. Use alternative fuels in cement kilns.
4. Increase clinker substitution and the use of Supplementary Cementitious Materials (SCMs) in traditional Portland cement mixes.

Carbon Capture and Storage (CCS) is the process of capturing waste CO₂ from large sources and transporting and depositing it where it will not enter the atmosphere, for example underground.

Supplementary Cementitious Materials (SCMs) are clinker substitutes, such as industrial by-products and waste, like fly ash from coal and blast-furnace slags from steel.

Eco-blends are cement products produced with high levels of clinker substitution, using various SCMs, to reduce the carbon footprint of those products.

The respective potentials (on a global scale) of each option are shown on the graphs below.

By combining the four mitigation measures, GHG emissions per tonne of cement can be reduced by 80%; and by approximately 50% without CCS (which does not yet offer the possibility for investment planning).⁷

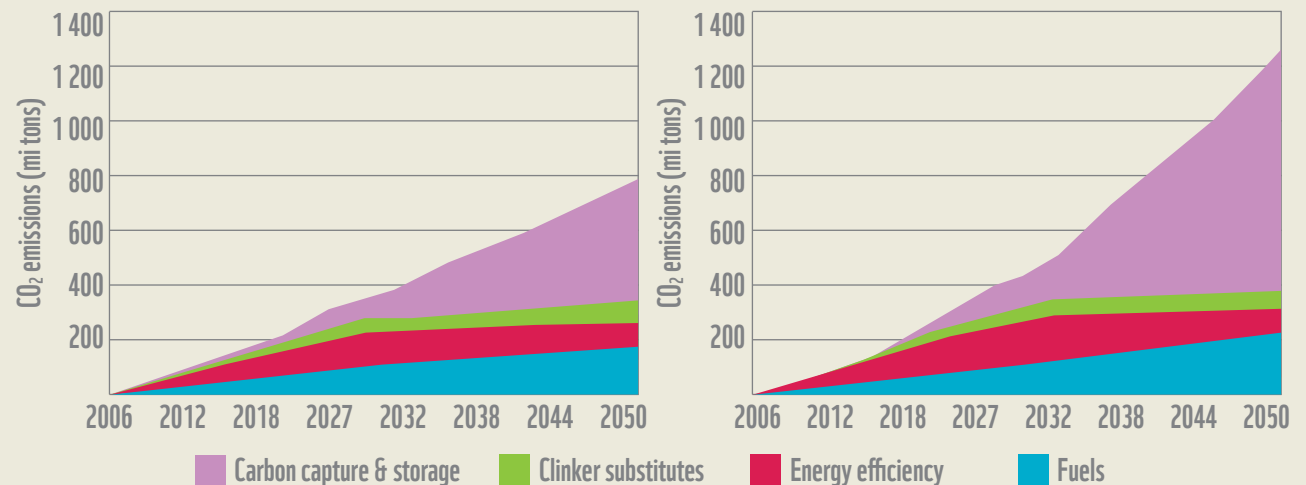
Fuel-related emissions (blue in the graphs) can be reduced through switching from fossil fuels to alternative fuel sources, such as municipal waste or tyres.


Traditional Portland cement consists of at least 90% lime-based clinker, which without any mitigation effort creates almost 1 tonne of CO₂e emissions for every 1 tonne of cement produced.⁸

This means that even if everything else remains the same:

- For every 10% clinker substitution with other SCMs, there is on average a 6% reduction in emissions.⁹
- To achieve a 30% reduction in emissions, requires a 50% clinker substitution; a 50% reduction requires a 70% clinker substitution.¹⁰
- Since 1990, global clinker content has steadily decreased to an average substitution level of 34% of the cement mix.¹¹
- To date, the increased use of SCMs has already produced a global saving of about 500 Mt of CO₂e. We can achieve further substantial emissions reductions with increased usage of SCMs to produce eco-blend cements.

CO₂ reductions compared to 2005 baseline from low (left) and high (right) scenarios for demand increase¹²





Viable alternative fuels from various types of waste

Cement emission characteristics and potential in South Africa

The cement industry in South Africa contributes approximately 1% towards the country's total GHG emissions.¹³

Over the last decade, South African cement producers have made a conscious effort to improve their energy efficiencies and use SCMs, and to reduce the clinker content in cement mixes, while maintaining its structural qualities.

However, there is still more to be done. According to the Department of Environmental Affairs:¹⁴

- Between 2000 and 2010, annual GHG emissions from cement production increased by 27% – from 3.3 Megatonnes (Mt)CO₂e to 4.2 MtCO₂e.
- By 2020, the annual *mitigation potential* will be 1.26 MtCO₂e, reducing emissions from the sector by 12%.
- By 2030, the *mitigation potential* is expected to increase to 3.65 MtCO₂e; and by 2050, to over 15 MtCO₂e.¹⁵

90%
the potential South African
cement market that eco-blend
cements can capture

PHOTO: SHUTTERSTOCK.COM



Efforts to reduce greenhouse gas (GHG) emissions to date

Since the 1990s, South African cement producers have steadily increased their mix of clinker substitutes to an average of between 30% and 40%.¹⁶ This has resulted in a reduction of emissions in the cement sector on a year-to-year basis.

A re-commitment by government to major public sector-led infrastructure development, paired with some signs that the economy is beginning to grow again, bode well for increased demand for cement. It is therefore imperative that solutions to further lowering the cement sector's CO₂ emissions are widely commercialised, so as to align with South Africa's GHG emissions commitments.

“Virtually all the cement producers in South Africa are extending their cements to different degrees, both to reduce their greenhouse gas emissions and to improve the quality of the concrete for a lot of applications. The extenders used include fly ash, ground granulated blast-furnace slag, ground granulated corex slag, which are secondary products from other industries, and limestone. The extent to which cement is extended at each factory is dependent on a number of factors including, availability of extenders, the distance from sources of extenders, the cost of such material and the demand for a particular cement for specific projects.”

Bryan Perrie, Managing Director:
The Concrete Institute (TCI), 2018

**21 million
tonnes**
the total integrated
capacity of all cement
producers per annum
estimated for 2014¹⁷

PHOTO: SHUTTERSTOCK.COM

Cement market analysis

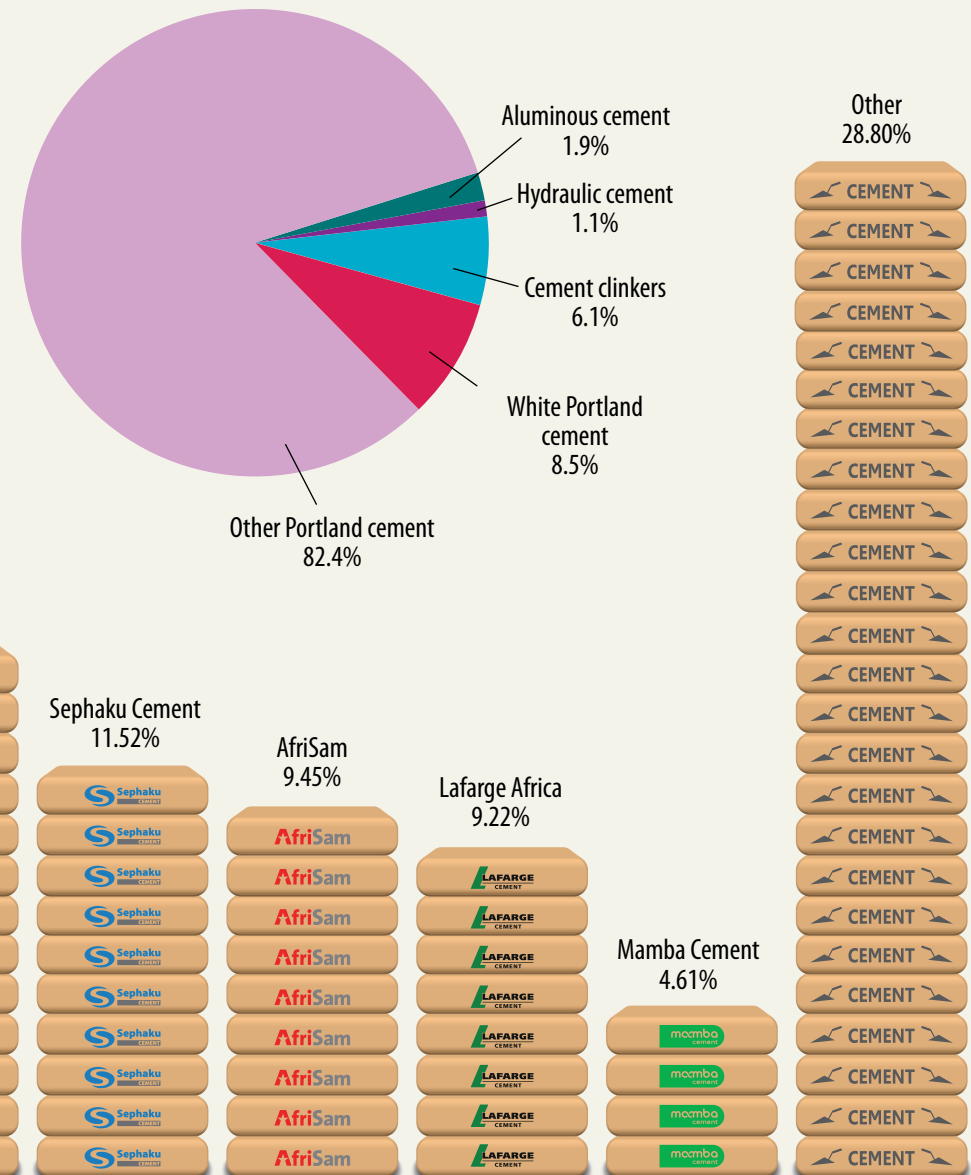
71% market production capacity of the six major South African cement producers

Market overview and outlook

The South African cement industry is the largest in Southern Africa and one of the largest on the continent:

- Although the data is somewhat contested, the cement market is estimated to have more than tripled in size from R15 billion in 2008 to R48 billion in 2014 and is expected to stabilise at R46 billion by 2019.¹⁸ However, cement industry stakeholders dispute these figures as overstatements.¹⁹
- Cement sales have been relatively resilient in recent years, increasing by a compound annual growth rate of 3.9% between 2012 and 2015.²⁰ However, cheap imports have adversely affected domestic production.²¹
- Retailers, instead of cement producers, now account for almost 70% of cement sales – an increase from 40% in 2011.²²
- Other customer segments include concrete product manufacturers, ready-mix concrete suppliers and construction companies.²³
- Increased competition has led to significant price reductions. Prices are currently at an average of R790/t, which is unsustainable because returns on capital are below the industry cost of capital.²⁴ This has prompted cement producers to go on a cost-optimisation drive.
- Historically, Portland cement is the most popular cement product, having dominated more than 50% of the market since 2008. It is expected to grow to 90% by 2019.²⁵

Market share by product type²⁶



Largest cement companies in South Africa by market share, as of 2014²⁷



Available low-carbon cement technologies

While SCMs are already in use in South Africa, the potential exists to increase their uptake in cement production. At present, other low-carbon cement technologies, such as geopolymers cement (GPC) and CCS remain less attractive to the cement sector.

Supplementary Cementitious Materials (SCMs)

Various studies suggest that utilising SCMs as clinker substitutes can reduce the carbon footprint of traditional Portland cement by between 6% and 50%.²⁸

There are a variety of SCMs available to create eco-blend cement:

- Industrial by-products and wastes, such as fly ash (combustion ashes from the coal industry) and blast-furnace slags (from the steel industry)²⁹
- Calcined clays present a viable clinker alternative internationally

PHOTO: RMB

- Hydraulic minerals are used to produce alternative Portland cement clinkers, such as calcium aluminate cements and calcium sulfoaluminate cements.

Industrial by-products and waste

While there are concerns regarding the global supply of fly ash and slags, they are relatively abundant in South Africa, given the country's sizeable coal and steel industries.³⁰ This presents an important opportunity for the local production of eco-blend cements using these raw materials as clinker substitutes.

South Africa produces approximately 40 million tonnes of ash every year.³¹ Sasol alone produces about 8 million tonnes of gasification ash, while Eskom produces 35 million tonnes of ash (10% bottom and 90% fly ash). Only 5% of this fly ash is used productively, with the rest being deposited in ash dams and landfills.³² This runs the risk of toxic elements seeping into the soil and groundwater. More of this ash could be used as SCMs in eco-blend cement production.

Using industrial by-products and wastes in cement production (either as SCMs or alternative fuels for cement kilns) will reduce carbon emissions, improve resource-use efficiency; reduce additional environmental impacts from disposing of these resources as wastes in landfills and dams; and contribute to the circular economy. However, industrial waste producers in South Africa will need to invest in waste management and handling to ensure the consistency and quality of the raw material.

INDUSTRY EXAMPLES

The use of cement with very high levels of clinker substitution (between 65% and 95% clinker substitution) has been used successfully in three construction projects in South Africa.³³

The 30-story **Portside building** in Cape Town, was built using ground granulated corex slag as a SCM with a 65% Portland cement clinker replacement. Some of the concrete had as much as 85% clinker replacement. Based on the original concrete specs of a maximum of 35% clinker replacement, there was a 50% reduction in carbon emissions and a cost saving of 4.7%.³⁴

Most of the concrete slabs in **Transnet's City Deep Container Terminal** in Johannesburg were based on a 70% clinker substitution with pulverised fuel ash. Some slabs had as much as 100% clinker substitution. Based on the original specs of 35% clinker replacement, there was a 35% reduction in carbon emissions and a cost saving of 8%.³⁵

The **Loeriesfontein Wind Farm** in the Northern Cape has 61 wind turbines on about 3 500ha of agricultural land. The maximum clinker replacement in this project was 95% ground granulated corex slag. Based on the original 35% clinker replacement, there was a 30% reduction in carbon emissions and a cost saving of 2%.³⁶



The construction team at the Loeriesfontein Wind Farm during the pouring of the foundation of one of the wind turbines.

PHOTO: LOERIESFONTEIN WIND FARM



Calcined clays

While common SCMs, such as fly ash and slags can reduce carbon emissions, their quality and supply on a global scale is of concern. For this reason, researchers are identifying alternative SCMs suitable for cement and concrete production and abundant enough to meet global demand. One of the most promising alternatives is clay. More specifically, calcined clays have excellent potential as natural pozzolans in low-carbon cements,³⁷ and have been used successfully in India and Brazil. The Jupia Dam in Brazil, for example was constructed in 1962 using calcined clays.³⁸

Using calcined clays alone can reduce the clinker content up to 30% of the total mix, but by adding an additional 15% limestone and 5% gypsum, the clinker content can be reduced to 50%. This mix is referred to as LC³ cement.³⁹ LC³ cement avoids the scarcity of fly ash and slags, and can be produced using existing cement plant equipment and at similar costs to traditional Portland cement. It also does not influence the concrete's mechanical performance.⁴⁰

“The South African cement sector has over the past years proactively addressed climate change by introducing energy efficiency measures as well as using alternative fuels and resources. A thrust to the use of alternate fuels is being up-scaled to further reduce dependency on coal as part of our climate change response which would simultaneously support the National Waste Management Strategy by reducing landfilling of calorific waste streams, as well as creating jobs in the waste sector.”

Dr Dhiraj Rama, Executive Director, The Association of Cementitious Material Producers (ACMP)

PHOTO: SHUTTERSTOCK.COM

Alternative Portland cement clinkers

Calcium aluminate cement

Originally invented to resist sulphate attack, calcium aluminate cement has several advantages over Portland cement:

- Rapid strength gain and improved resistance to abrasion⁴¹
- Significantly less GHG emissions are generated in its production.

Despite being produced for the past 100 years, calcium aluminate cement faces two major challenges that have prevented its wider usage:⁴²

Pozzolans are a broad class of siliceous or siliceous and aluminous materials which, if processed in a certain way, can form compounds possessing cementitious properties.



PHOTO: DR. VLADIMIR RONIN, CC BY-SA 3.0, [HTTPS://COMMONS.WIKIMEDIA.ORG](https://commons.wikimedia.org)

- ‘Conversion’: this is a process which leads to increased porosity and, as a result, a decrease in strength.
- Expense: it is about five times more expensive than traditional Portland cement because of the expertise and number of people required to support its production and the limited supply of bauxite – the main source of alumina in the cement.⁴³

Therefore, calcium aluminate cement is only justified for applications or circumstances where its advantageous properties warrant higher costs.

Calcium sulfoaluminate cement

First produced in the 1970s, calcium sulfoaluminate cement has several advantages:

- It is made from ye’elemite or Klein’s compound and was initially intended for use in the manufacture of self-stressed concrete pipes, to take advantage of its expansive properties.⁴⁴
- Processing ye’elemite releases less CO₂ than traditional Portland cement clinker. In addition, the temperature required for the production of calcium sulfoaluminate cement clinkers is between 1 200-1 300 °C – about 200 °C lower than required for Portland cement clinker production. Together, this results in approximately 50% less carbon emissions relative to Portland cement.⁴⁵

Despite being used in China for the last 30 years, calcium sulfoaluminate cement only constitutes about 0.1% of total concrete production due to several challenges:

- There is a large amount of diversity in the calcium sulfoaluminate cement mixtures, making it difficult to generalise as a product.

- It requires more significant support, leading to increased costs.
- High raw material costs make the cement less commercially viable compared to traditional Portland cement.

Therefore, neither calcium aluminate cement nor calcium sulfoaluminate cement can compete economically with eco-blend cement, as a viable alternative to traditional Portland cement in general construction.⁴⁶

“It is possible to produce 100% extended cement using Supplementary Cementitious Materials such as fly ash and blast-furnace slags, without a loss in strength and durability. In fact, in some cases, highly extended cements have outperformed traditional Portland cement. However, highly extended cements should initially be marketed for niche applications and environments to gain a track record and to encourage regulators to consider allowing for higher substitution levels in cement regulations.”

Cyril Attwell: Director Arc Innovations, 2018



Other emerging low-carbon cement technologies

Carbon Capture and Storage (CCS)

Although CCS has the potential to deliver an estimated 30% reduction in emissions, it is currently a highly speculative technology and is also extremely capital intensive,⁴⁷ increasing fuel and electricity usage by 38% and 51% respectively. Therefore, this cement technology does not yet offer the possibility for investment planning and it is unclear if and when this might change.

Geopolymer cement (GPC)

Relative to CCS, GPC is a much more likely candidate to help reduce the cement industry's emissions in the medium- to long-term. Government, for example predicts that by 2040, GPC will offset 2.5% of total cement production, and by 2050, will have the highest long-term emissions reduction potential of all cementitious materials.⁴⁸ Other stakeholders suggest a 50% uptake of GPC by 2030 is possible (and indeed required, in line with sectoral decarbonisation targets),⁴⁹ with 100% uptake by 2050.⁵⁰

However, advantages of GPC over traditional Portland cement are highly contested:

- Different studies put the emissions reduction potential of geopolymer cement between 59% and 90%, depending on the SCMs used in the GPC mix.⁵¹
- Typically, studies which advocate reductions of 80% or more do not take into account energy expenditure during mining, sourcing of raw materials, manufacturing of sodium silicate and sodium hydroxide (alkali-activators for GPC),

50%
the possible uptake
of GPC by 2030

PHOTO: SHUTTERSTOCK.COM

elevated temperature requirements for curing, and transport emissions.⁵²

- The cost of GPC falls into a rather broad range of 7% cheaper than Portland cement to almost 40% more expensive.⁵³

In summary, eco-blends present the most feasible near-term alternative to traditional Portland cement, in terms of emissions reduction benefits, costs and uptake readiness.

Comparison of alternative low-carbon cements

	Advantages	Disadvantages
Fly ash and slag eco-blend cement	<ul style="list-style-type: none"> • Fly ash and slag are relatively abundant • Saves costs • Reduces carbon emissions from cement production • Improves resource-use efficiency and contributes to the circular economy • Reduces additional environmental impacts from disposal as wastes in landfills and dams • Increases jobs in waste management and handling • Produced with same plant equipment as Portland cement • Similar costs as Portland cement • Same performance as Portland cement 	<ul style="list-style-type: none"> • Industrial waste producers need to invest in waste management and handling to ensure the consistency and quality of the raw material
Limestone calcinated clay cement (LC³)	<ul style="list-style-type: none"> • Abundant in most countries • Produced with same plant equipment as Portland cement • Similar costs as Portland cement • Same performance as Portland cement 	<ul style="list-style-type: none"> • Clays are not abundant enough in South Africa to be a viable alternative to Portland cement
Calcium aluminate cement and calcium sulfoaluminate cement	<ul style="list-style-type: none"> • Reduces carbon emissions from cement production • Rapid strength gain and improves resistance to abrasion • Advantageous expansive properties for specific applications 	<ul style="list-style-type: none"> • Risk of 'conversion', increased porosity and a decrease in strength • More expensive to produce than Portland cement • Requires more customer support • Too much diversity in the calcium sulfoaluminate cement mixtures
Geopolymer cements (GPC)	<ul style="list-style-type: none"> • Potential to reduce GHG emissions relative to traditional Portland cement – but this is contested 	<ul style="list-style-type: none"> • High alkalinity environment and use of sodium hydroxide in the production of GPC presents a significant health and safety risk • Does not provide significant emissions reductions throughout the full life cycle

PHOTO: SHUTTERSTOCK.COM



Size of opportunity

The potential emissions, cost savings, and market size for eco-blend cements is based on various assumptions about the South African cement sector:

- It operates at a maximum capacity of about 21 Mt of cement production per annum.⁵⁴
- In 2010, the average clinker substitute level was 30%⁵⁵ and the emissions intensity was approximately 0.57 tCO₂e per tonnes of cement produced.⁵⁶
- The cement sector emissions baseline is 11.97 MtCO₂e.⁵⁷
- In 2018, the cement market is valued at R47 billion.⁵⁸
- Traditional Portland cement accounts for 90% of the market and eco-blend products will replace all traditional Portland cement.

Based on these assumptions, the uptake of eco-blend cements up to the maximum allowed under current regulations can potentially achieve the following:

- **An additional emissions savings of over 20kgCO₂e per tonnes of cement, or over 450 000 tCO₂e across the sector**
- **A potential sales value of over R40 billion by replacing traditional Portland cement.**

PHOTO: SHUTTERSTOCK.COM



Socio-economic benefits

- Replacing clinker with industrial waste or by-products reduces the consumption of non-renewable raw materials⁵⁹ and prevents such waste ending up in landfills. This can contribute towards a circular economy and a lower-waste society with potential job creation opportunities and positive health implications.⁶⁰
- Fostering innovation and competitiveness, opens opportunities for new, smaller firms to enter the eco-blends market and benefit from initiatives by government to address both the market dominance of incumbent players, while affording emissions' 'space' to new firms.

Drivers for the uptake of eco-blend cements

Climate-friendly legislation

The introduction of a carbon tax should make switching production to eco-blend cements increasingly attractive to cement producers.

- Depending on the design of carbon budgets, producing eco-blend cement might afford producers tax-free allowances and opportunities to trade carbon credits and create another revenue stream. For example, in Australia, the use of 1 tonne of fly ash will earn a GPC producer 1 carbon credit, which can be sold within the carbon credit trading system (priced in 2014 at about R200/tCO₂e).⁶¹
- The proposed Climate Change Mitigation System being developed by government sets aside emissions space for new, low-carbon market entrants. This is an opportunity for new entrants to capture this emissions space to produce eco-blend cements while minimising their carbon tax liability.

Reduced costs and increased revenue

- Eco-blend cements are estimated to reduce production costs by 2%-8% for fly ash and slag-based blends⁶² and 15-25% for LC³.⁶³ In Cuba, for example, overall profitability for the cement sector is estimated to increase by between 8% and 10% by 2025 if LC³ is adopted.⁶⁴

Industrial policies, legislation and regulations

The government's Industrial Policy Action Plan⁶⁵ potentially supports the uptake of eco-blend cements:

- It identifies massive infrastructure investment programmes as powerful drivers of industrialisation. These programmes offer opportunities for a wide range of manufactured inputs for infrastructure development, especially in construction.
- It estimates an investment of about R496 billion in construction between 2013 and 2023. This provides a significant opportunity for eco-blend cements to capture some of this investment.
- Together with the Competition Commission, it tightens various conditionalities associated with state support of larger firms so as to establish a competitive market. New low-carbon market eco-entrants can benefit from such efforts to reduce market concentration.

A row of concrete test cylinders in a laboratory setting. The cylinders are arranged in a line, receding into the background. They are dark grey and have a porous, speckled texture. Some cylinders have handwritten markings on their ends. The background is blurred, showing more cylinders and a bright light source.

Barriers to the uptake of eco-blend cements

Standards

- Current structural standards for cements were developed when non-Portland cement binders and alternatives were uncommon and, therefore, present a significant barrier to their wider commercial uptake.
- While eco-blend cements must meet the same structural standards and specifications as Portland cement, it may be necessary to adapt current specifications and regulations from being recipe-based (specifying maximum percentages for the use of various SCMs in cement mixes) to being performance-based. This applies specifically to SANS 1197, which determines clinker content for A, B and C grade cements. For example, eco-blends allow for high substitution of clinker, with the associated emissions reduction benefits, but South African regulations limit clinker replacement to 35%.⁶⁶
- Successful eco-blend applications used in the Portside building in Cape Town, Transnet's City Deep container terminal in Johannesburg, and Loeriesfontein Wind Farm in the Northern Cape, demonstrate the potential to increase clinker replacement percentage to far more than 35% – as much as 80% or more without compromising on cement performance.

PHOTO: SHUTTERSTOCK.COM

Waste Management Act, 2008

- The Waste Management Act regulates the disposal of industrial waste and does not encourage the use of by-products or waste for economically productive activities, including eco-blend cement production.
- To motivate for amendments to the Act, it is necessary to prove that there is scope for some of these wastes to be reclassified as by-products so they can be used in eco-blends. Ideally, this reclassification would be designed in line with other quality control standards set on industrial waste products. How these amendments will influence the availability of industrial waste for eco-blend cement production creates regulatory uncertainty.

Limited data and demonstration track record

- The lack of long-term durability data, particularly in field performance for eco-blends with clinker substitution levels higher than 35%, may cause a lack of confidence in eco-blend cement, hindering its commercialisation.
- The absence of a sufficient local track record for the many different possible combinations of eco-blends is also a real hindrance to wider uptake. Civil engineering firms, for example, are resisting uptake due to fear of high litigation costs in case the new materials do not perform as planned.

Skills shortage

- In South Africa, as in the rest of the world, there is a shortage of skills required to design and develop suitable eco-blend admixtures, especially for chemists and chemical engineers.⁶⁷
- A remuneration policy, which focuses on performance and retention of key skills, career planning strategies, and training and development initiatives, is needed to increase both the availability of necessary skills as well as their retention rate.⁶⁸

Variability in supply

- Although recent investments in new coal-fired power stations will ensure sufficient availability of raw material in the 20-50-year timeframe, supply variability in source materials for SCMs is of greater concern, given that fly ash characteristics can vary between coal mines and power stations. This can be resolved with a relatively modest investment in waste collection and treatment systems by waste generators.

Macro-economic environment

Up until now, South Africa's macro-economic setting and low economic growth has limited government spending and is slowing down the planned investment in large construction and infrastructure projects, and has threatened cement and concrete

demand.⁶⁹ Recent debt status downgrades may result in higher costs of borrowing, thereby limiting firms' investments in research, development and implementation of alternative technologies. Continued exchange rate fluctuations threaten trade exposed businesses.⁷⁰ The outlook for 2018 has improved somewhat and may help mitigate certain of these broader economic and fiscal constraints.

Limited awareness

Lack of environmental consciousness and general resistance to change may prevent consumers from purchasing new products other than traditional Portland cement.



Action points

The case exists for increasing eco-blend cement production. This holds the most immediate potential for GHG reduction in the cement sector in South Africa. The most urgent requirement is therefore to review the existing regulations that place a cap of 35% on SMCs in eco-blends.

Investors and lenders

Development finance, climate finance institutions and other stakeholders can work together to support the development of demonstration projects, skills and data, to scale-up efforts to introduce increased use of SMCs as clinker substitutes in construction projects.

Cement producers

- Where they have not already done so, cement producers can identify sources of SMCs close to construction sites or support a shared service that details the sites, volumes and grades of these materials country-wide.
- They can invest in testing and developing a track record for eco-blends with higher levels of clinker replacement, which can be used as a basis for the adjustment of current standards to allow higher levels of clinker substitution.

Unions

Unions can work with government and industry to better understand the potential risks to employment of eco-blends, and where opportunities exist.

Policy-makers

- Standards must be adapted to allow for greater uptake of SCMs in cement mixes beyond the 35% regulated cap. Work being done in this area needs to be expedited.
- Changes are required to waste legislation to ensure that it supports the use of appropriate waste streams and manages their quality as materials for SCMS for eco-blend cement production.
- Clarity and finality is needed on climate mitigation legislation, and on an appropriate level of carbon budget and taxes to drive the increased use of eco-blend cements in the industry.

Research houses

Demonstration, data and skills could all support the application of eco-blend cements as viable alternatives to traditional Portland cement.

Insights from industry

In July 2017, WWF South Africa hosted a workshop with cement industry stakeholders. The purpose was to obtain expert insight into the possible commercialisation of geopolymers cement as a low-carbon alternative to traditional Portland cement.

The main points to emerge from the workshop:

1. Research to date has not accurately portrayed the benefits of geopolymers cement – especially in terms of emissions reduction – in relation to traditional Portland cement.
2. Wider use of low-carbon cement does not require significant investment on the side of cement manufacturers.
3. Current policy and regulations are major barriers to the uptake of eco-blend cements, because standards are based on Portland cement specifications.
4. Hybrid cements meet regulation standards, whilst offering a cheaper alternative to Portland cement and substantial emissions reductions.
5. There is a need to change the perception of regulatory authorities and engineers towards alternative cements, for example, through flagship projects.
6. Various industrial wastes which now need to be disposed of in landfills should and can be used as inputs into eco-blend cements.

Cement technology roadmap identifies levers to cut CO₂ emissions by 24% by 2050

The International Energy Agency (IEA) and Cement Sustainability Initiative (CSI) have launched a technology roadmap entitled, *Low-Carbon Transition in the Cement Industry*. It outlines three scenarios: a business-as-usual case; IEAs reference technology scenario; and a 2 °C scenario, which requires additional technology investments and policies.

With reference to eco-blends, the roadmap proposes that governments develop regulations and standards (including durability testing) to support the further uptake of cementitious constituents to lower the clinker content of cement.

Other key actions identified include:

- Creating a stable and effective international carbon pricing mechanism to address asymmetric pricing pressures in different regional markets
- Developing legislation to support the use of fuels (particularly from waste) that are less carbon intensive in cement kilns
- Regulating emissions' monitoring
- Raising awareness and enhancing industry training.

Sustained funding and risk-mitigating mechanisms are also recommended as well as public-private collaboration to promote new technologies and processes that offer the potential for CO₂ emissions reduction, with an immediate focus on oxy-fuel carbon capture.

Find out more at: <http://www.iea.org/publications/freepublications/publication/TechnologyRoadmapLowCarbonTransitionintheCementIndustry.pdf>



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The climate change mitigation debate in South Africa needs to move from improving efficiency within a projection of the existing economy, to innovation and options beyond the constraints of the current dispensation and structure of the economy. It may take step changes in the development path to achieve mitigation adequate to South Africa domestic and international commitments, and to maximise economic development and social wellbeing. Business models presently unconsidered may be waiting in the wings.

The 'Low-carbon development frameworks in South Africa' project seeks to deepen understanding of, and reveal opportunities for, transitions to a low-carbon economy. It facilitates and develops contributions at the intersection of climate change mitigation, economic development and socio-economic dimensions, across immediate, medium and long-term horizons.

Working variously with government, business and labour, the project reaches from providing input to emerging government mitigation policies and measures; through investigating the business and socio-economic case for selected mitigation initiatives which hold growth potential in energy, transport, industry, waste, and land use; to analysing potential future economic trajectories and the systemic opportunities offered by these.

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WWF's Policy and Futures Unit undertakes enquiry into the possibility of a new economy that advances a sustainable future. The unit convenes, investigates, demonstrates and articulates for policy-makers, industry and other players the importance of lateral and long term systemic thinking. The work of the unit is oriented towards solutions for the future of food, water, power and transport, against the backdrop of climate change, urbanisation and regional dynamics. The overarching aim is to promote and support a managed transition to a resilient future for South Africa's people and environment. The organisation also focuses on natural resources in the areas of marine, freshwater, land, species and agriculture.

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