mpa
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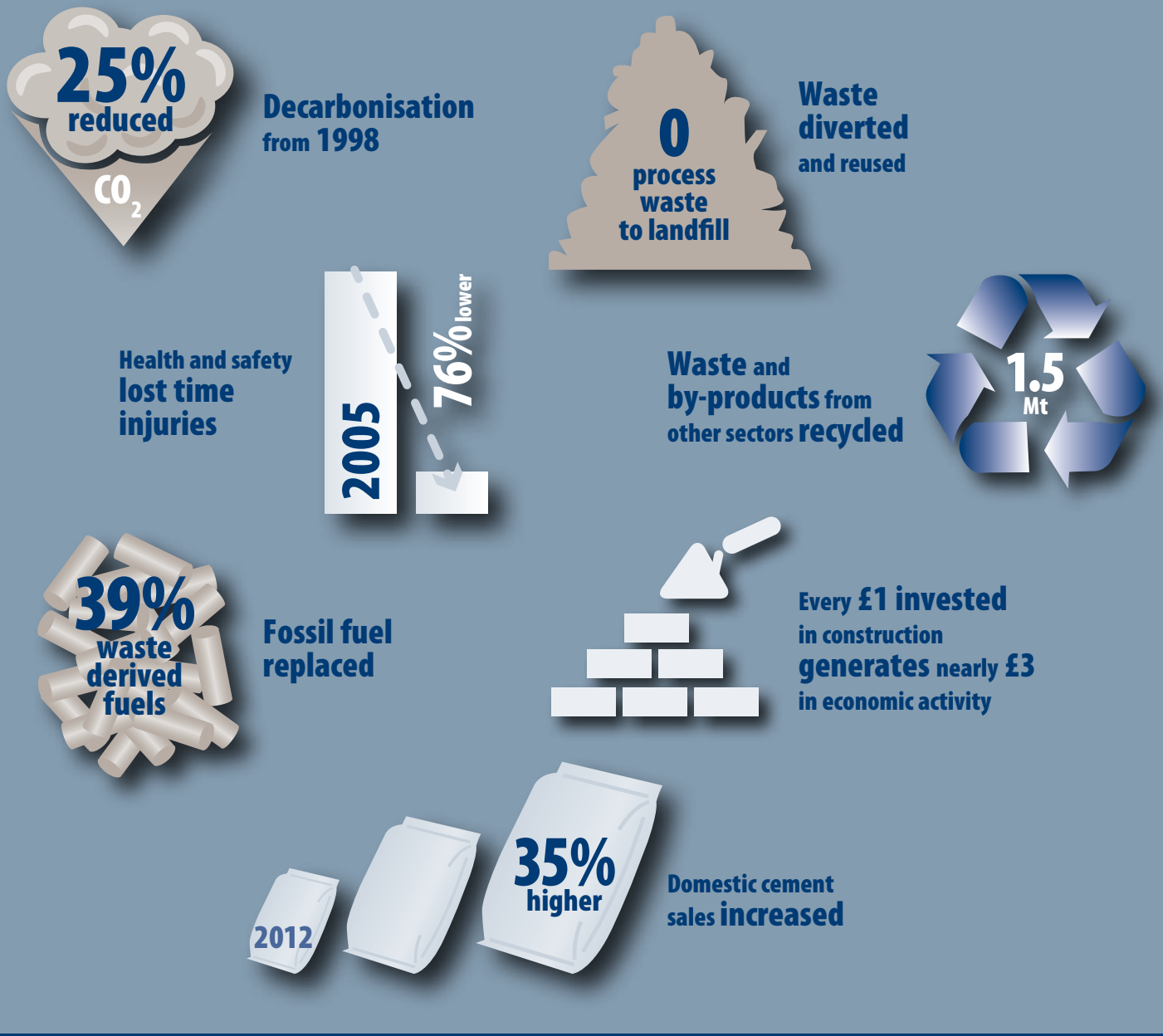


MPA Cement

Sustainable Development Report 2017

tackling air quality

Reflecting on 2016

There were no changes in ownership in 2016, so the five companies manufacturing cement in the UK remain Aggregate Industries (operating as Lafarge Cement), Breedon Cement (previously known as Hope Cement), CEMEX, Hanson, and Tarmac. Together these companies supplied 82% of the cement consumed in the UK.

Domestic production continued to grow, with output up to 9.8 million tonnes, a 5.9% increase on 2015. However, production is still considerably lower than pre-recession levels, as shown in figure 1.

MPA Cement has been reporting on the sustainability performance of the UK cement sector since 2003 and this report continues our commitment to transparency. MPA Cement members continue to minimise the impact of their operations on the environment, neighbours and employees.

UK cement production

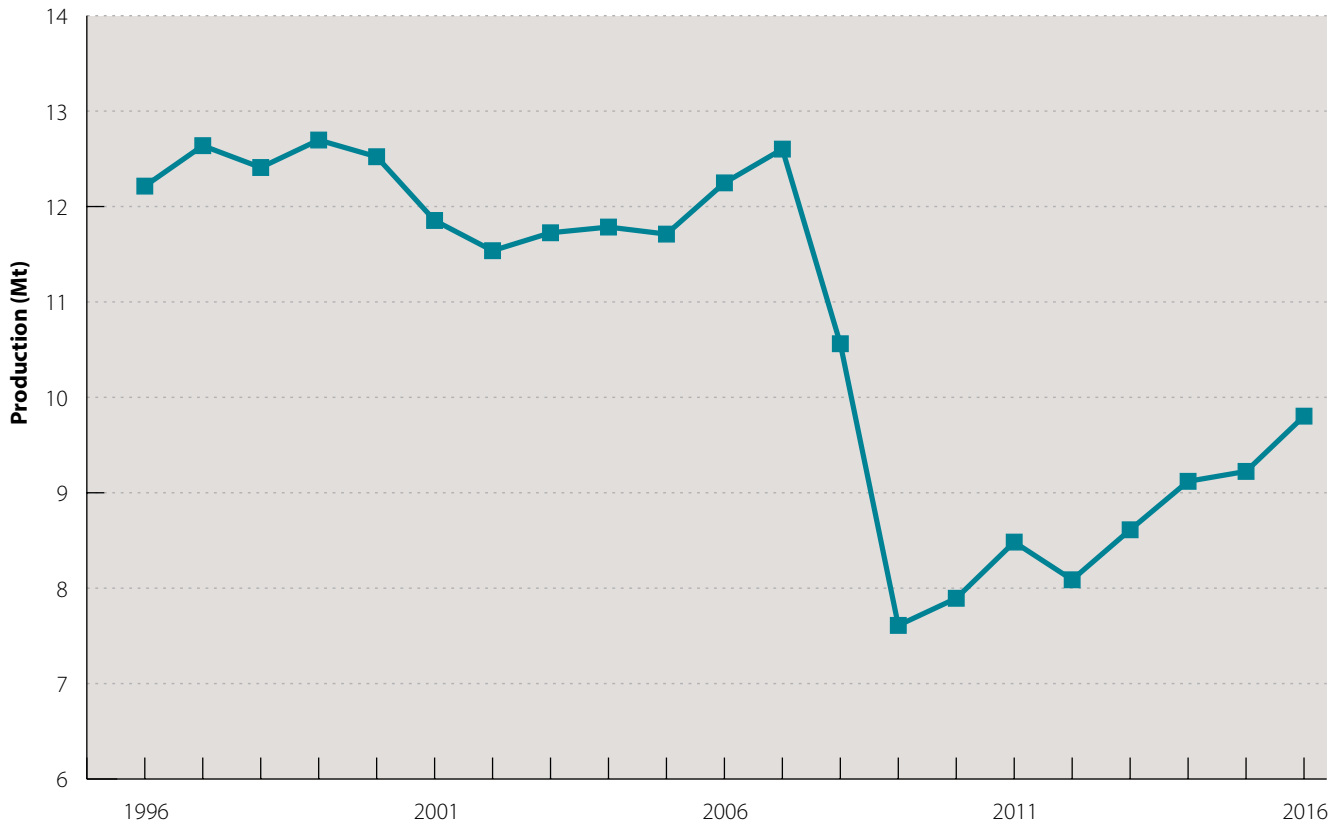


Figure 1: Domestic cement production over the last 20 years

Tackling air quality

Improving air quality is high on the Government priority list as the short and long-term impacts of nitrogen oxide (NOx), particulate matter (PM) and other emissions become more apparent.

MPA Cement members have invested heavily in reducing NOx, PM (dust) and sulphur dioxide (SO_2) emissions and considerable progress has been made since data gathering started in 1998 (figure 2). Emissions of NOx, PM and SO_2 from cement manufacture are now very low with only minor variations each year.

These emissions are heavily regulated under the Industrial Emissions Directive. This sets limits on the amount that can be emitted by cement plants across the UK and Europe.

Figure 7 (pages 8-9) shows the main release points of these air emissions in the cement manufacturing process and the abatement measures taken by MPA Cement members to tackle them.

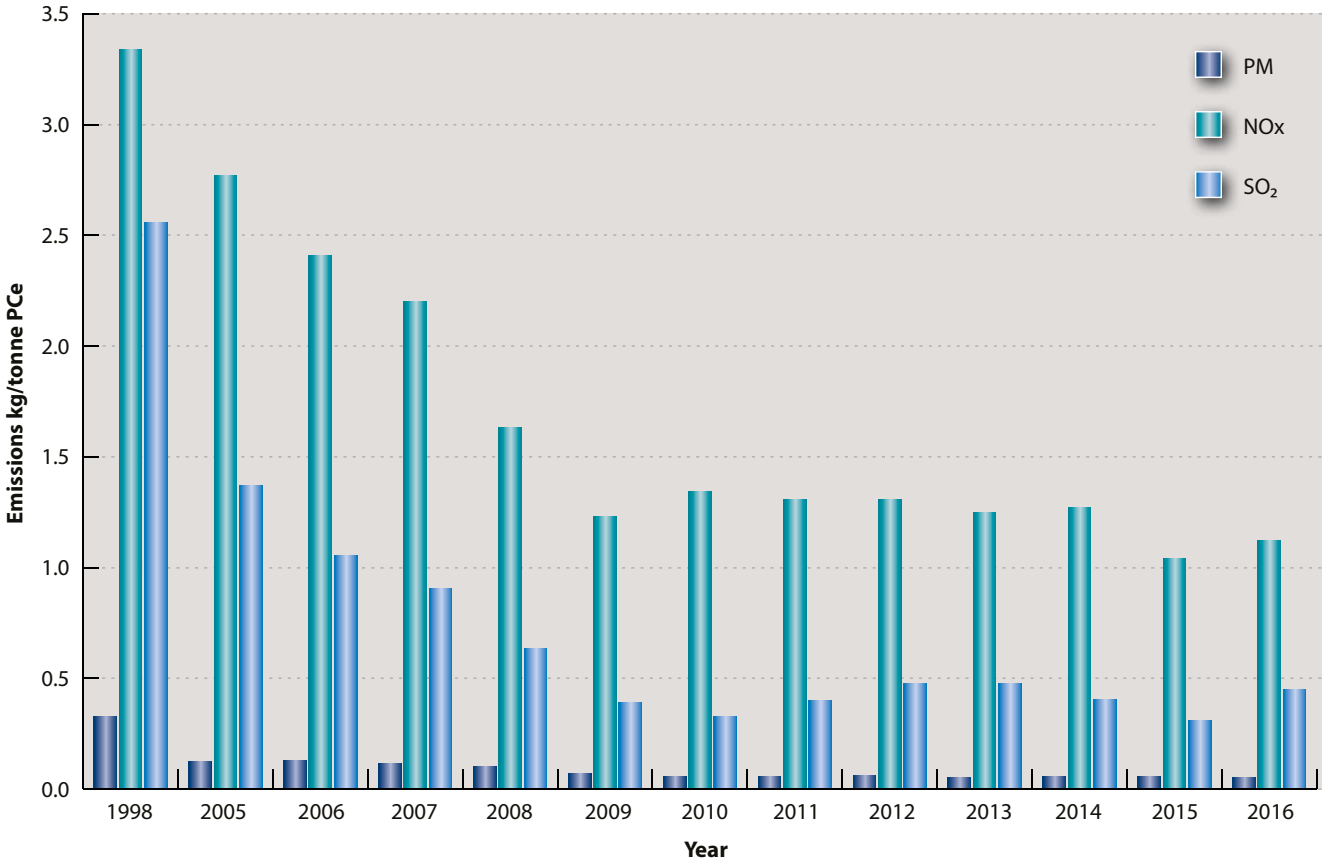


Figure 2: Emissions of NOx, PM and SO_2 in 1998 (base year) and from 2005 to 2016. Since 2008, emissions have been at a steady low rate with only very minor fluctuations since 2009

Tackling air quality

NITROGEN OXIDES (NOx)

NOx emissions are generated by the burning of fuels containing nitrogen compounds (fuel NOx) and the reaction of nitrogen in air at very high temperatures (thermal NOx). NOx emissions can be reduced through the use of waste derived fuels, which have lower fuel NOx compared to fossil fuels such as coal, and tend to have lower flame temperatures, which results in less thermal NOx.

One of the most common forms of NOx abatement is Selective Non-Catalytic Reduction (SNCR) using ammonia. SNCR installation on a cement plant typically costs between £500,000 and £800,000. However, this abatement technique may be associated with 'ammonia slip' (unreacted ammonia emitted from the SNCR). Thus, as regulation drives emissions of NOx downward, there may well be a corresponding increase in ammonia slip.

PARTICULATE MATTER – DUST

The manufacture of cement involves the management of fine powders at many stages of the process, including the crushing of raw materials, the grinding of clinker, the blending of clinker with other materials, and the handling of the final cement product, itself a fine grey powder.

In 2016, the UK cement sector crushed 12.9 Mt of raw materials, produced 8.0 Mt of clinker and blended this with 1.5 Mt of natural and alternative materials to produce 9.8 Mt of cement. Particulate matter (PM) emissions are actively managed by the UK cement industry so that in 2016, despite handling over 22 Mt of powder material, the total amount of dust emitted to air across all sites was just 501 tonnes – that is, 0.0023% of the powder material handled. To deliver such low emissions, cement manufacturers have invested around £21.5 million in dust management in the last seven years.

SULPHUR DIOXIDE (SO_2)

SO_2 emissions are generated from raw materials with a high content of pyrite (FeS_2).

MPA Cement members that require abatement to control SO_2 emissions have installed two wet scrubbers; and two kilns use absorbent additions.

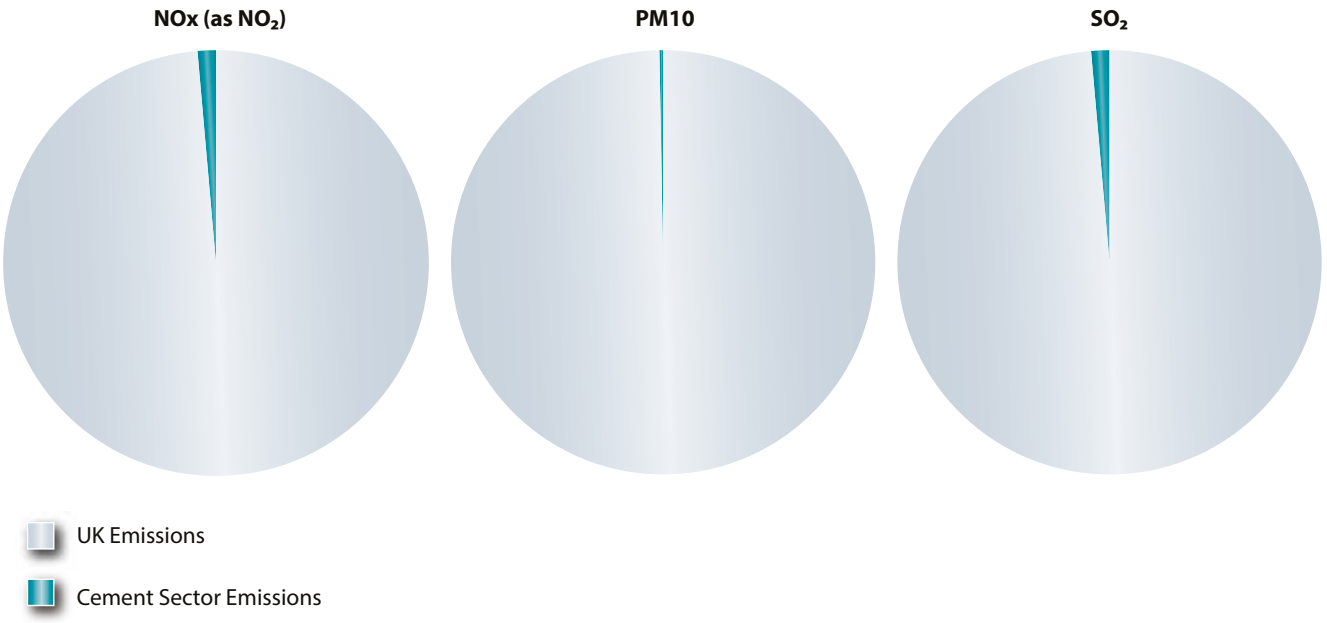


Figure 3: Proportion of UK emissions of NOx, PM10 (PM with particle size less than 10 micrometres) and SO_2 arising from cement manufacture [Source: National Air Emissions Inventory]

Tackling air quality

TRANSPORT

As well as investing in efficient road vehicles, MPA Cement members have spent millions of pounds in upgrading rail depots at plants so that more material can be transported by rail, lowering NOx, and CO_2 emissions from product transportation. While MPA Cement members aim to increase the use of rail transport, Government targets to increase passenger rail travel mean that freight must compete with passenger transport for very limited capacity on rail networks.

Currently 82% of cement is transported by road and 18% by rail and water.

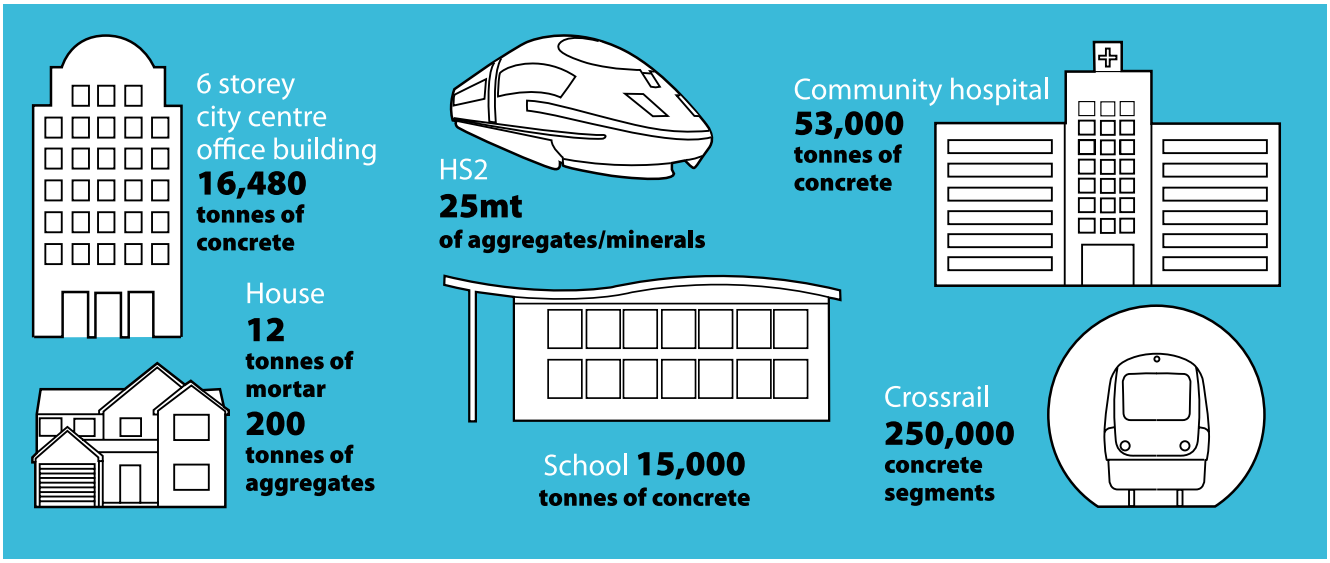


Figure 4: Quantities of mineral products required in different applications

Economic sustainability

ECONOMIC SUSTAINABILITY

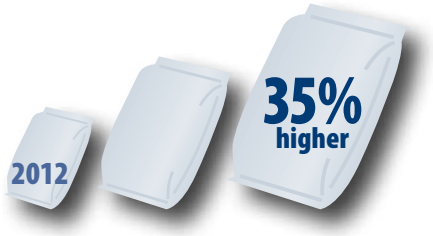
Cement is the key component in producing ready-mixed concrete, precast concrete and mortar. These materials are locally produced, with the majority of raw material inputs being sourced from within the UK. The cement and concrete supply chain is therefore a vital part of the UK economy (figure 4).

Domestic cement production is improving, with an increase of 5.9% in 2016 compared to 2015, but sales of cement remain 12% lower than in 2007. Some 18% of cement sales in the UK are from imports, which have steadily increased their share of sales over the last ten years.

The UK continues to be an expensive place for industry to operate, with high energy prices (a result of energy and climate change policy costs) and high network and wholesale costs.

MPA Cement members are still unable to access compensation from the indirect costs of the EU Emissions Trading System and UK Carbon Price Support passed on in electricity bills, unlike some other energy intensive sectors. Figure 5 illustrates the renewable and climate change policy cost impact on cement. The Government aim is for much higher CO_2 prices and more renewables in the energy mix. Over a short period of time this is likely to rapidly increase the policy cost impact.

Domestic cement sales improved 35% since 2012 but sales still 12% lower than 2007



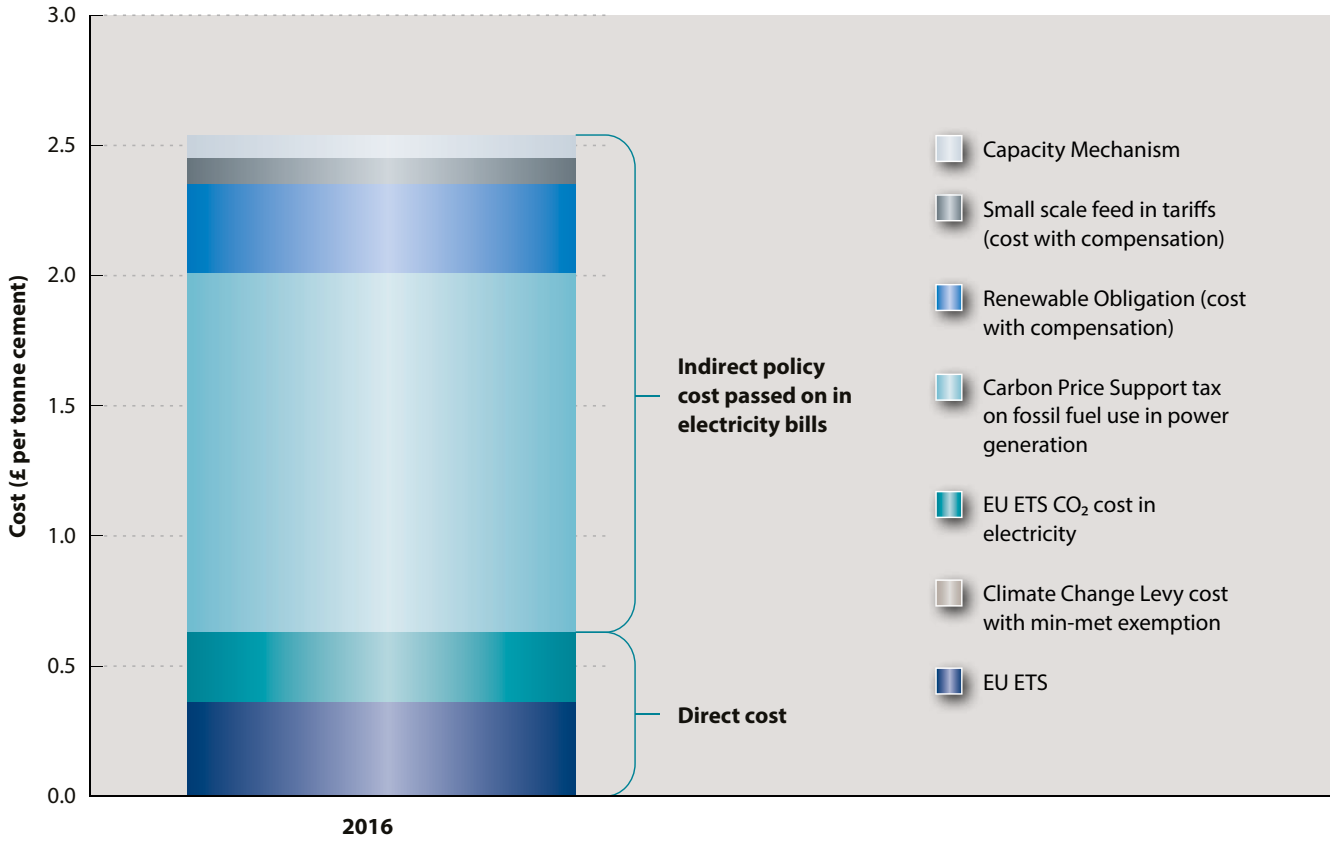


Figure 5: Cumulative direct and indirect climate change and renewable energy policy costs per t cement

Social sustainability

1. LOCAL COMMUNITIES

3,015
direct employees

2,352
visitors to cement sites
attending open days, tours and visits

27,301
employee training hours

£650k
charitable donations made
(including equivalent monetary value where staff have undertaken volunteer projects)

3,758
voluntary work hours by staff
during normal working hours

30
local liaison meetings

2. HEALTH & SAFETY

The number of Lost Time Incidents (LTI) increased during 2016 and three main causes were identified: slips, trips and falls; handling, lifting and carrying; and hitting an object. Consequently, a new health & safety strategy was drafted with an initial focus on plant shutdowns, communication, occupational health (dust) and improving root cause analysis of incidents.

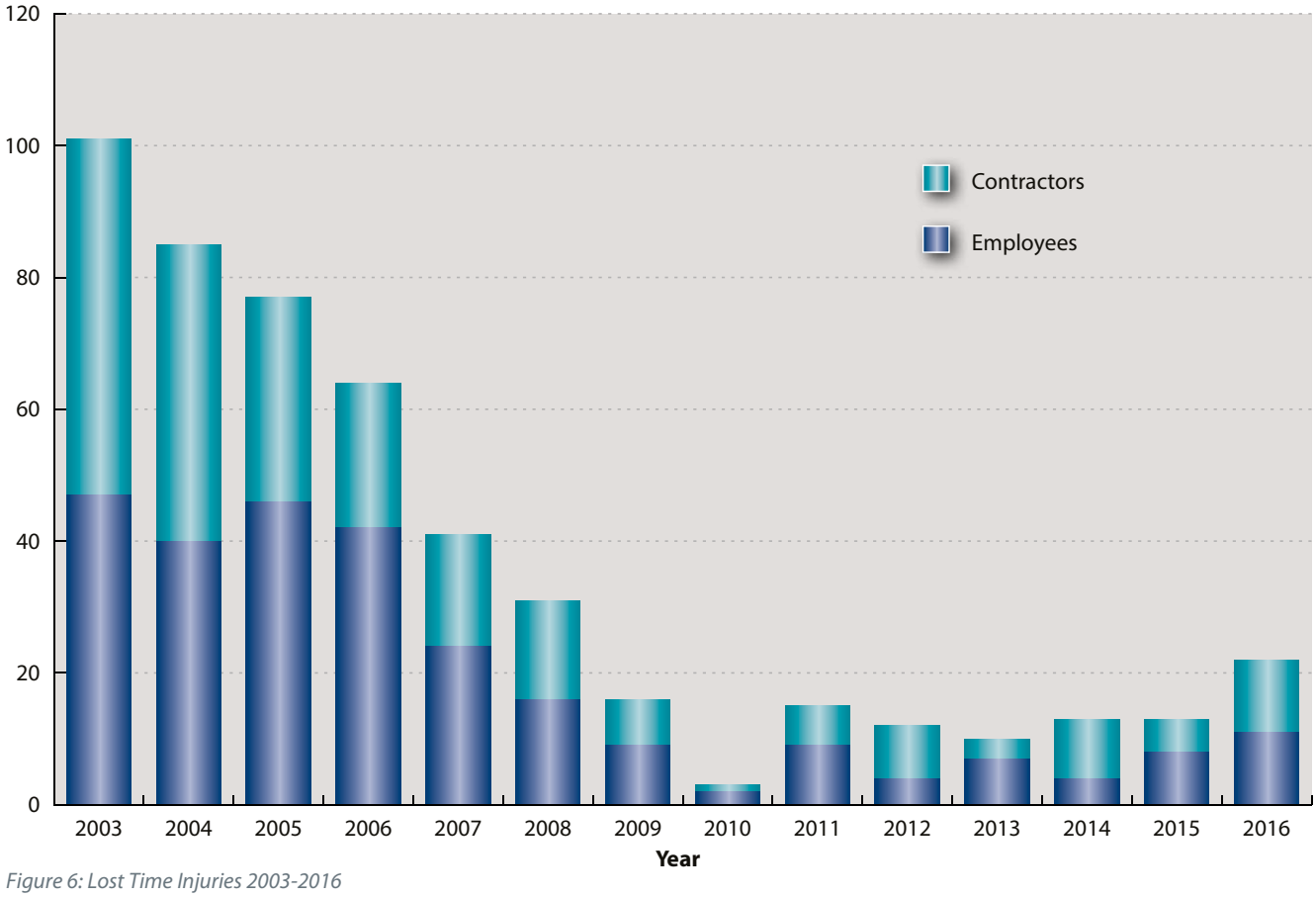


Figure 6: Lost Time Injuries 2003-2016

Guide to abatement measures

NOx

Primary abatement measures:

- Low NOx burners: Indirect firing with very early fuel ignition in an oxygen-deficient atmosphere, which tends to reduce the formation of NOx.

Secondary abatement measures:

- Selective Non-Catalytic Reduction (SNCR): Injecting ammonia water (up to 25% ammonia), ammonia precursor compounds, or urea solution into the gaseous emissions to reduce nitric oxide (NO) to harmless nitrogen gas (N_2).
- Selective Catalytic Reduction (SCR): Injecting ammonia into the gaseous emissions and then passing the gas over a catalyst reduces NO and nitrogen dioxide (NO_2) to harmless N_2.

PARTICULATE MATTER (PM)

- Fabric bag filters: Using a fabric membrane to collect PM. The filters are cleaned periodically to remove the PM for recycling/recovery.
- Electrostatic precipitators (ESP): Charging PM in an electrostatic field and attracting it to an oppositely charged collection plate. The PM is periodically dislodged from the collection plates for recycling/recovery.

SO_2

- Absorbent additions (dry scrubber): Reacting absorbents with SO_2 emissions produces substances that are then incorporated in the cement product. Absorbents added to gas emissions include quicklime (CaO), activated fly ash with a high calcium oxide content, sodium bicarbonate ($NaHCO_3$), and hydrated lime ($Ca(OH_2)$), which can also be added to the raw materials.
- Wet scrubber: Reacting SO_2 emissions with oxygen, water and calcium carbonate form calcium sulphate (gypsum), water and carbon dioxide.

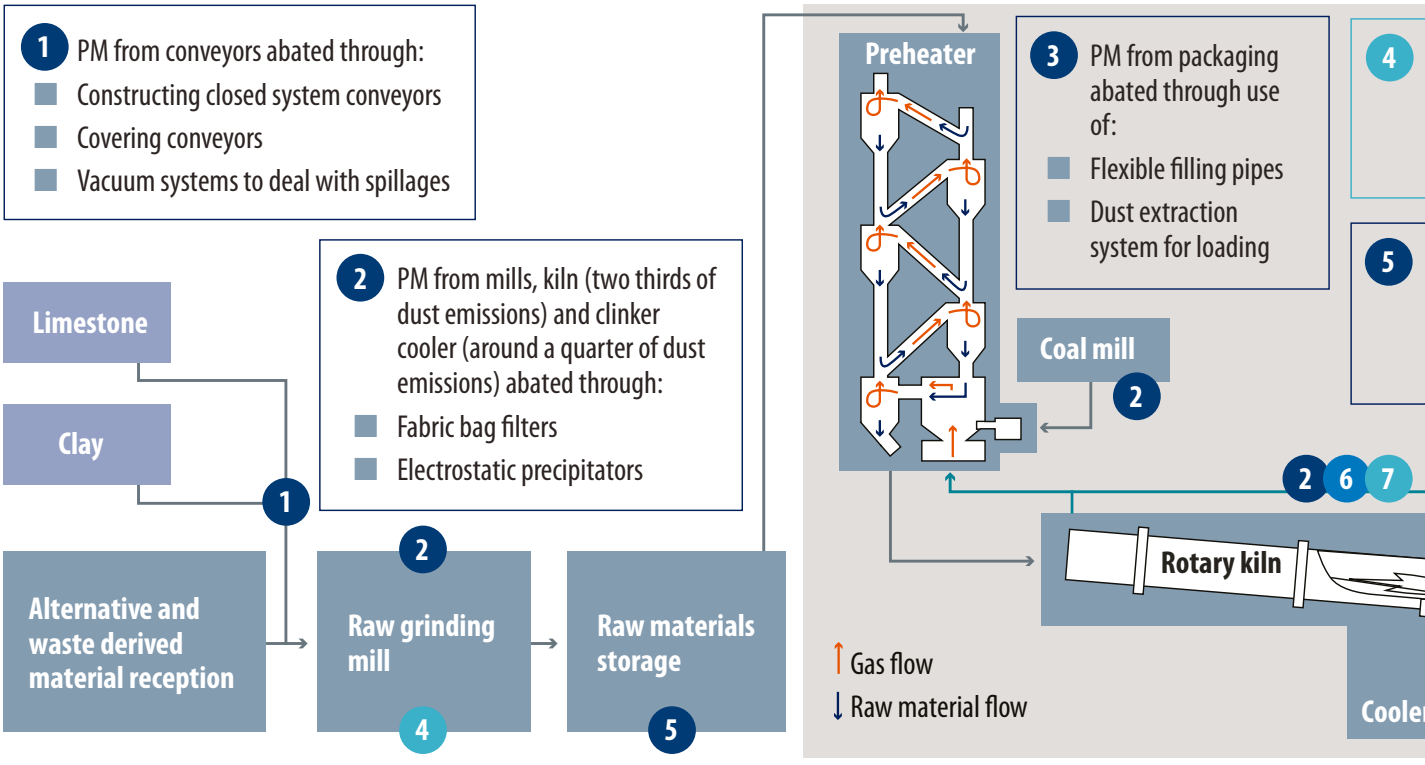


Figure 7: The cement manufacturing process and the emission of NOx, PM and SO_2 and their abatement

Use of an in-line raw mill allows SO_2 in kiln flue gas to react with limestone as it is ground

PM from storage abated through the use of closed and fully automated storage areas

Clinker

r (clinker cooler)

6 NOx abated through primary and secondary measures:
- Primary: low NOx burners
- Secondary: SNCR, SCR

7 SO_2 abated through:
- Absorbent additions
- Wet scrubber

8 PM from storage silos abated through use of silos with:
- Adequate capacity
- Level indicators and cut off switches to prevent over filling
- Filters to extract dust from air displaced during filling

Clinker silo

8

Pre-grinding system

Separator

Coarse powder

Fine powder

Blender

8

Cement silo

Portland cement

Blended cement

2 Cement grinding mill (finish mill)

3

Transport

Very low emissions to air in 2016: NOx = 1.12 kg/tPCe, PM = 0.05 kg/tPCe, SO_2 = 0.45 kg/tPCe

Environmental sustainability

1. PUBLICATION OF UPDATED ENVIRONMENTAL PRODUCT DECLARATION (EPD)

MPA has updated its UK Average Cement EPD with 2016 data. The EPD is based on a 'Life Cycle Assessment' and provides customers and stakeholders of the UK cement sector with the most up-to-date environmental information on UK-produced cement. The EPD is available to download from the MPA website http://www.cement.mineralproducts.org/sustainability/sustainable_production/environmental_product_declaration.php

2. RECYCLED CONTENT

In 2016, MPA members used 1.5 million tonnes of waste and by-products from other industries. Co-processing of waste fuels in cement manufacture also recovers mineral and metal content, thus co-processing is material recycling and energy recovery in one unique simultaneous process. Figure 8 illustrates the recycled content of the average UK produced cement.

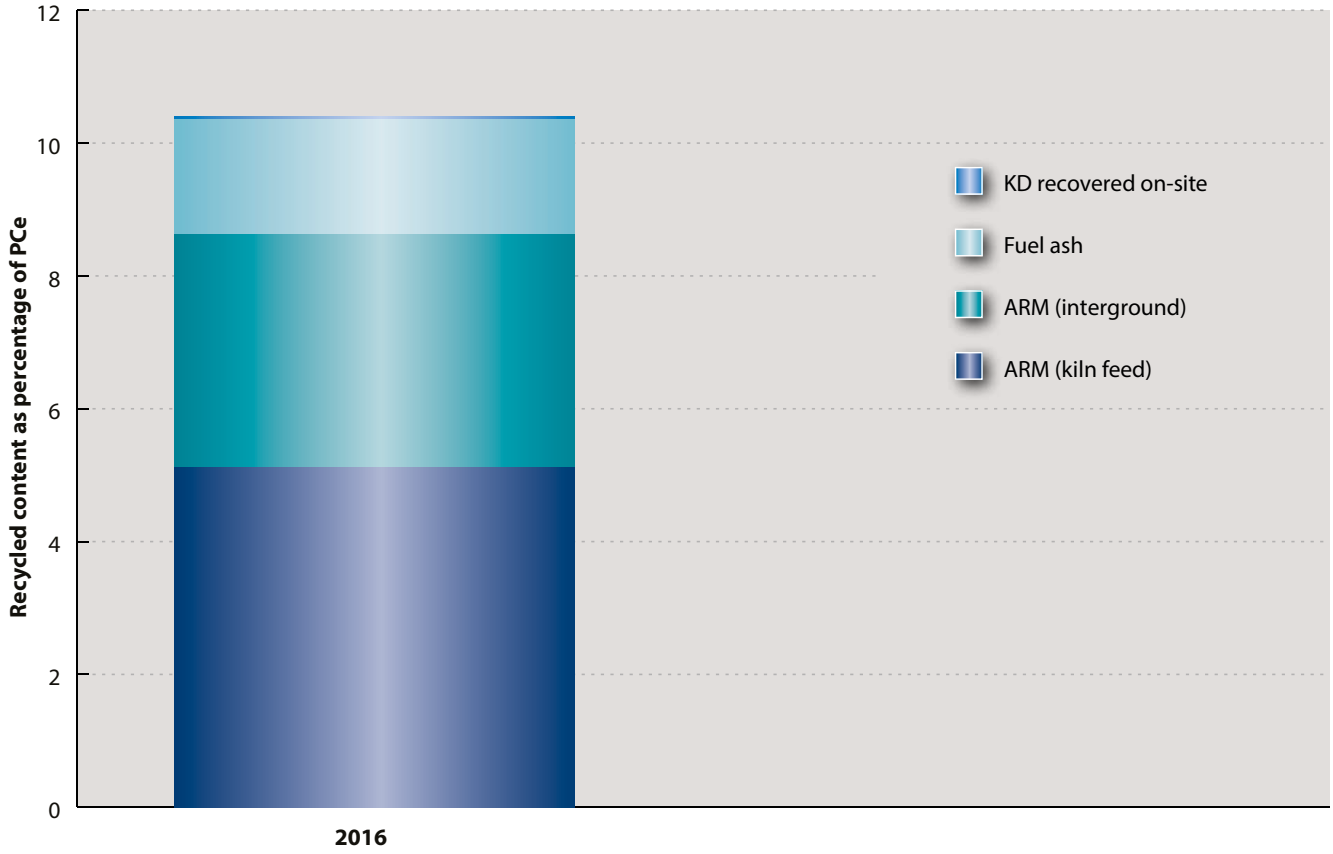


Figure 8: The total recycled content of UK produced cement from kiln dust (KD) recovered on site, fuel ash recycled as mineral content, alternative raw materials (ARM) interground with clinker to produce cement and ARM fed to the kiln (kiln feed)

3. PROPORTION OF FUEL COMPRISING WASTE MATERIAL

The proportion of thermal input from waste derived fuels declined for the third year in a row, from 44% in 2014 to 39% in 2016. The use of waste biomass and part biomass fuels reduced to only 16.7% of the thermal input, down from 19.9% (the highest recorded proportion) in 2014.

This worrying trend is attributed to competition for biomass fuels with other consumers who can receive Government incentives, such as the Renewable Heat Incentive, which cement manufacturers cannot access due to poorly formed policy. Due to the policy distortion, one MPA Cement member ceased using a 100% biomass fuel in 2017 and another is expecting to cease use during 2018.

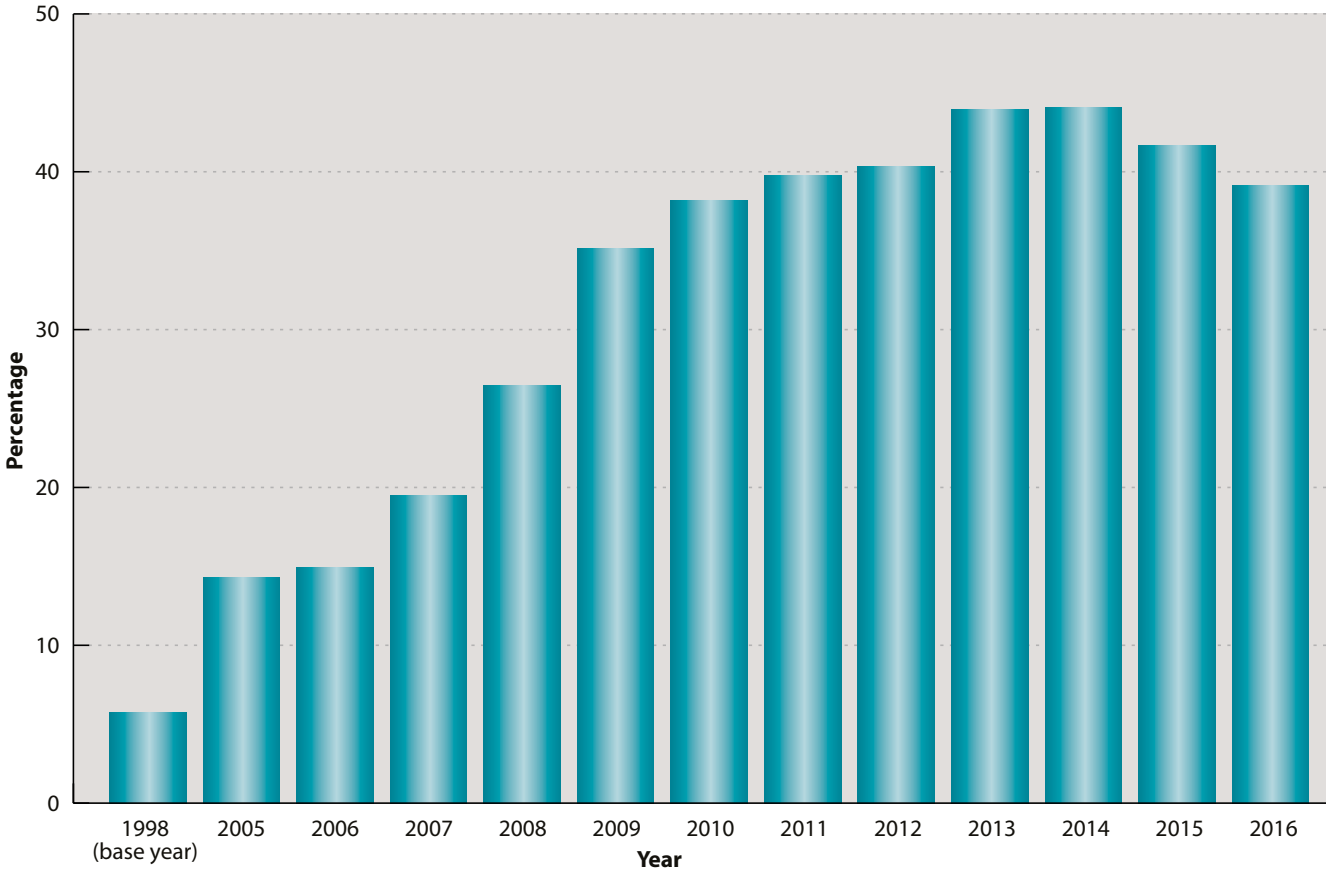


Figure 9: Waste derived fuel use in 1998 (base year) and from 2005-2016

Environmental sustainability

4. DECARBONISATION

During 2016, MPA Cement worked with Government to produce an action plan setting out the tasks required to decarbonise the cement sector. The action plan was published in October 2017. There are three key technologies for reducing greenhouse gas emissions in cement manufacture:

- Carbon capture and storage/use: vital for the long term decarbonisation of cement manufacture, which has a high proportion of unavoidable process emissions.
- Fuel switching to biomass: Considerable fuel switching has already taken place but market pressure means that the use of waste biomass fuels will continue reducing if no action is taken.
- Low carbon cements: MPA is working with Carbon Trust to access the Government Industrial Energy Efficiency Accelerator Fund to undertake a project that would enable the deployment of a range of new low-carbon cements in the UK.

Direct emissions of CO_2 from the UK cement sector in 2016 were 24.7% lower than in 1998 and 1.93% lower than in 2015. The reduction is attributed to an increase in the proportion of clinker substituted by materials such as limestone.

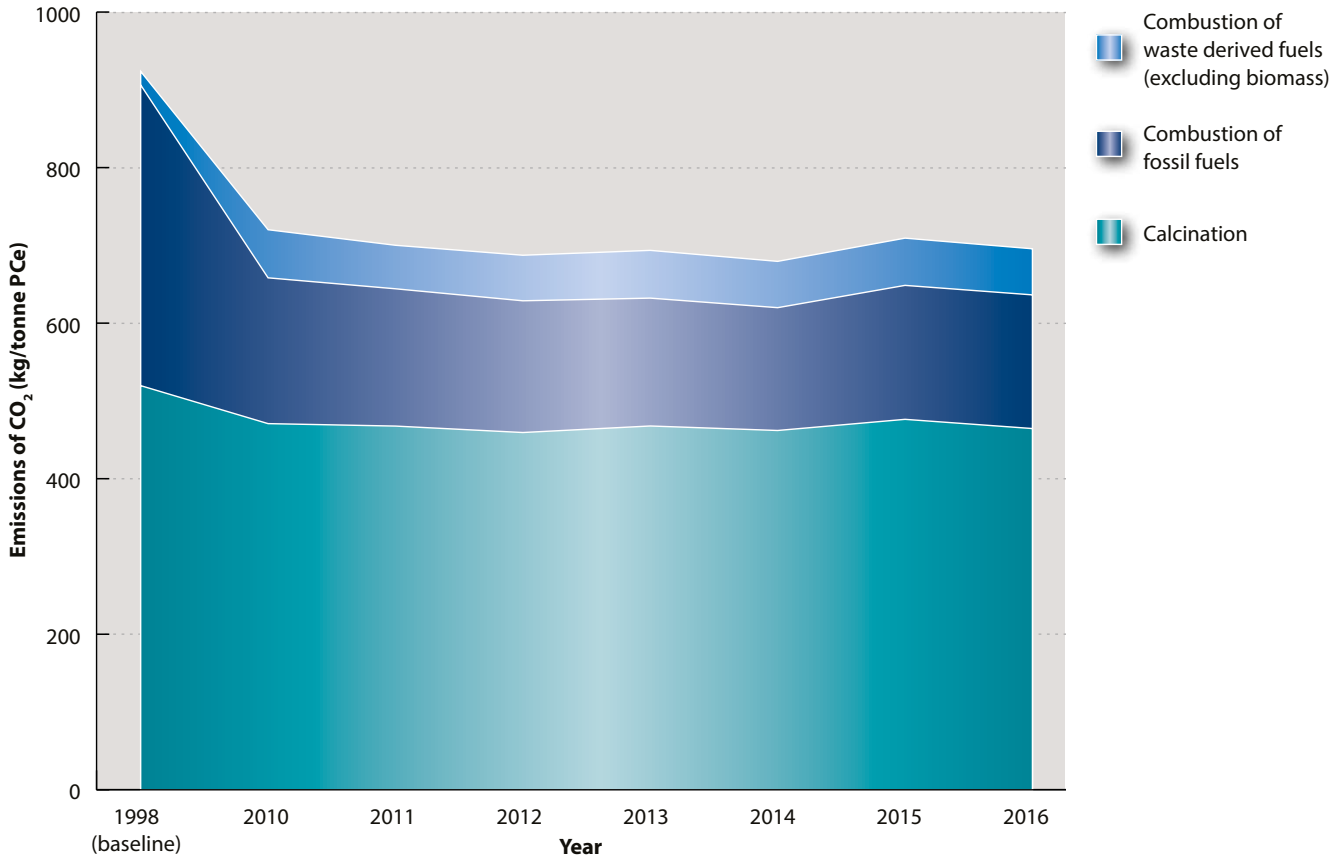


Figure 10: Reduction in direct emissions of CO_2 in 1998 (base year) and 2010-2016

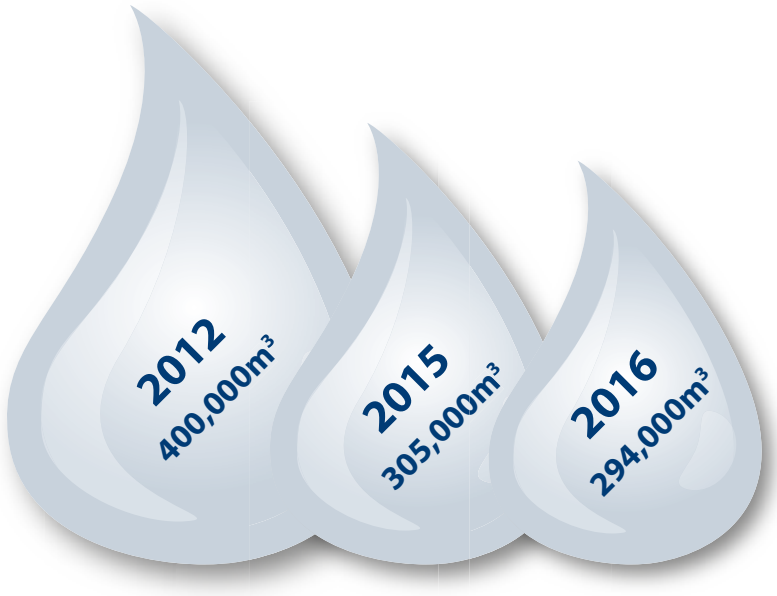
Environmental sustainability

5. RESPONSIBLE SOURCING

In 2016, the majority of cement produced in the UK was certified to very good or excellent level under the BES 6001 responsible sourcing scheme. Certification to BES 6001 requires companies to demonstrate (and verify through an independent third party) that organisational governance, supply chain management and environmental and social responsibilities have been responsibly managed.

6. WATER

MPA Cement members continue to monitor and reduce water consumption where possible. As a result, consumption of potable water decreased in 2016 by 26.5% on 2012, and 3.6% on 2015.



Data tables

CIRCULAR ECONOMY

	Units	1998	2010	2011	2012	2013	2014	2015	2016
Total waste and by-products used as fuel and raw materials	**tonnes**	446,511	1,528,315	2,481,106	1,811,200	1,452,553	1,612,584	1,619,766	1,454,354
Proportion of fuel comprising waste material	**%**	5.7	38.2	39.7	40.4	44.0	43.0	41.6	39.2
Biomass fraction of fuel input (100% and part biomass fuels)	**%**	Not available	16.7	16.8	17.2	18.9	19.9	18.5	16.7
Proportion of raw material comprising waste	**%**	4.0	7.2	7.6	7.6	7.0	7.7	7.4	5.9
Process waste recovered on-site	**tonnes**	Not available	11,379	9,195	2,819	10,390	1,513	11,009	4,086
Process waste recovered off-site	**tonnes**	nil	36,945	47,796	57,471	47,238	33,988	35,103	49,238
Process waste sent to landfill	**tonnes**	289,207	14,021	4,631	nil	nil	nil	nil	nil

Data tables

DECARBONISATION

	Units	1998	2010	2011	2012	2013	2014	2015	2016
CO_2 emissions from calcination (process emissions)	**$kgCO_2$/ tPCe**	520	471	468	459	468	462	476	464
CO_2 emissions from combustion of fossil fuels	**$kgCO_2$/ tPCe**	387	187	177	169	164	158	172	172
Indirect CO_2 emissions from electricity use	**$kgCO_2$/ tPCe**	Not available	55	61	56	44	58	57	48

ENVIRONMENTAL

	Units	1998	2010	2011	2012	2013	2014	2015	2016
Emissions of NOx	**kgNOx/ tPCe**	3.34	1.35	1.31	1.31	1.25	1.27	1.04	1.12
Emissions of PM	**kgPM/ tPCe**	0	0.06	0.06	0.06	0.05	0.06	0.06	0.05
Emissions of SO_2	**$kgSO_2$/ tPCe**	2.56	0.33	0.40	0.48	0.48	0.41	0.31	0.45
Mains water use	**m^3/tPCe**	Not available	0.05	0.05	0.05	0.04	0.04	0.03	0.03
Licensed abstraction	**m^3/tPCe**	Not available	Not available	Not available	0.04	0.04	0.05	0.07	0.10

make the link
to mineral products

MPA Cement site locations

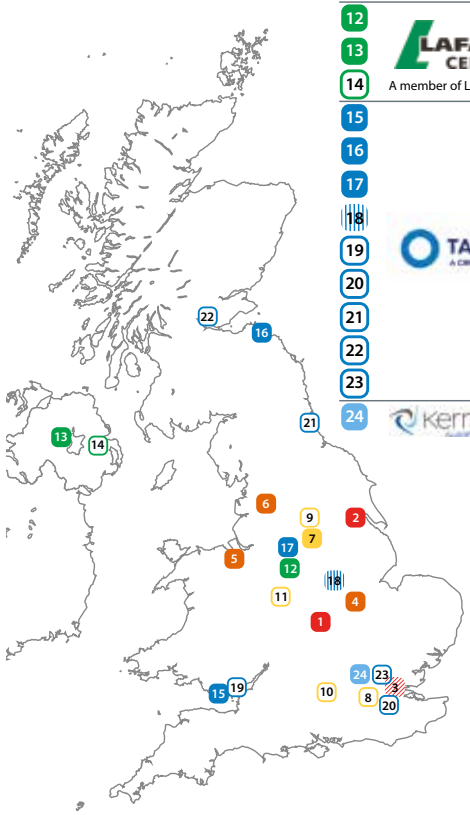
Key

Kiln sites

Grinding and blending sites

Grinding only sites

Blending only sites



1	CEMEX	Rugby
2		South Ferriby
3		Tilbury
4	Hanson	Ketton
5		Padeswood
6		Ribblesdale
7	BREEDON	Hope
8		Dagenham
9		Dewsbury
10		Theale
11		Walsall
12	LAFARGE CEMENT A member of LafargeHolcim	Cauldon
13		Cookstown
14		Belfast
15	TARMAC	Aberthaw
16		Dunbar
17		Tunstead
18		Barnstone
19		Celtic Ash
20		Northfleet
21		Seaham
22		Scotash
23		West Thurrock
24	kerneos	Purfleet

mpa cement members

CEMEX UK
Hanson
Breedon
Kerneos*
Lafarge Cement
Tarmac

This report has been titled as 2017 to follow the general MPA nomenclature to use the year of data collection rather than the year of performance.

**Kerneos are members of MPA but data from their operations has not been included in this report because they produce calcium aluminate cements rather than Portland cement.*

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The Mineral Products Association is the trade association for the aggregates, asphalt, cement, concrete, dimension stone, lime, mortar and silica sand industries.

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