A journey of discovery

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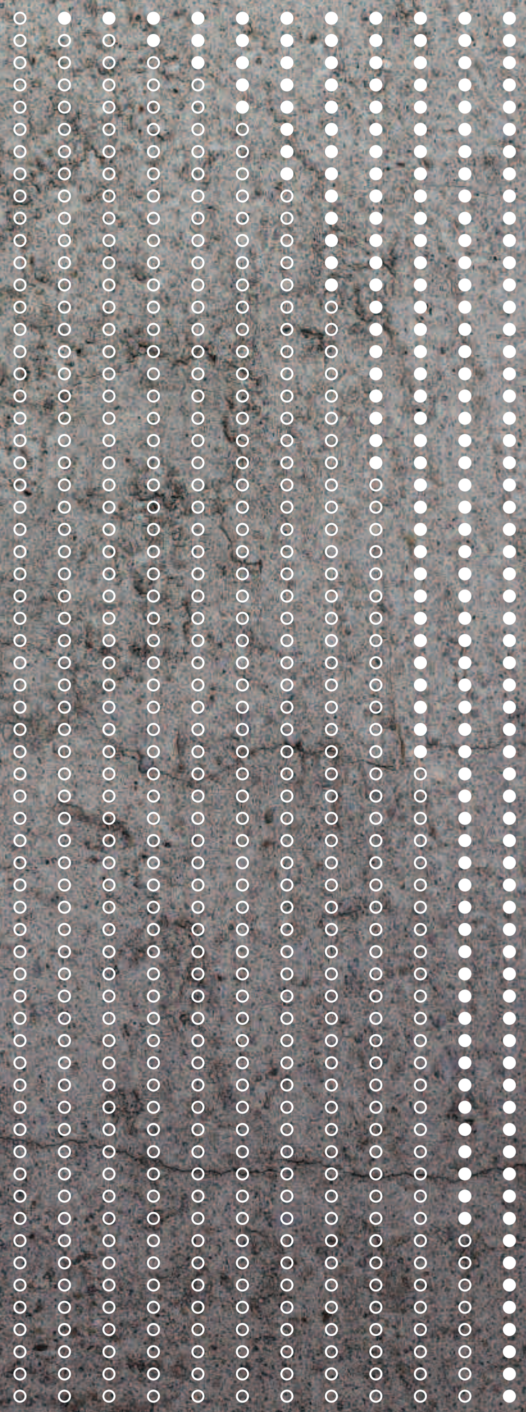

How many pairs of rabbits in a meadow?

More to the point, how can you build imaginatively and still protect the meadow?

Stand N1040

Ecobuild 2011

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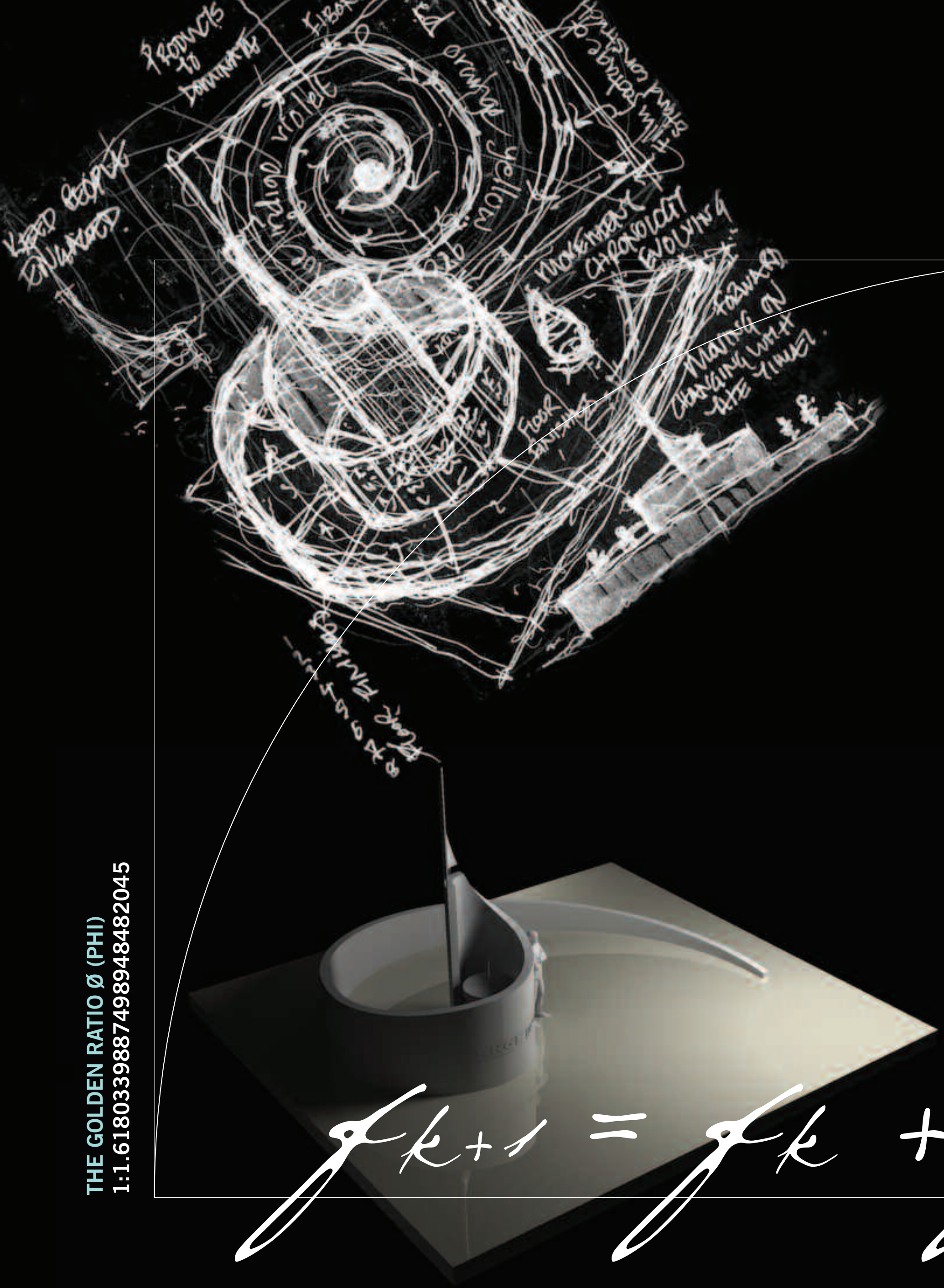
The 25,000th number in the Fibonacci sequence

The spiral is a magical shape. Its sweep is graceful; its appeal, universal.

One spiral excites the imagination more than any other. It reaches out to artists, naturalists, mathematicians, mystics, and infinity. The Fibonacci spiral is precise and numerical, yet it defines the beauty of much of the world around us. And the maths is so simple, a child can grasp it.

$$F_n = F_{n-1} + F_{n-2}$$



Stand N1040 represents the Fibonacci spiral – simple, sweeping, architectural – scaled to the size of **public sculpture.** At the apex, the spiral reaches to 3m. From there, a 2m flame of Ductal rises skywards (Ductal is concrete – thin, yet tough as steel).

Ecobuild 2011 is the sculpture's temporary home. We hope that it will become a permanent feature on a **wildlife haven** in a restored landscape.

THE GOLDEN RATIO Ø (PHI)
1:1.618033988749894848482045

$$f_{k+1} = f_k + f_{k-1}$$

STAND N1040

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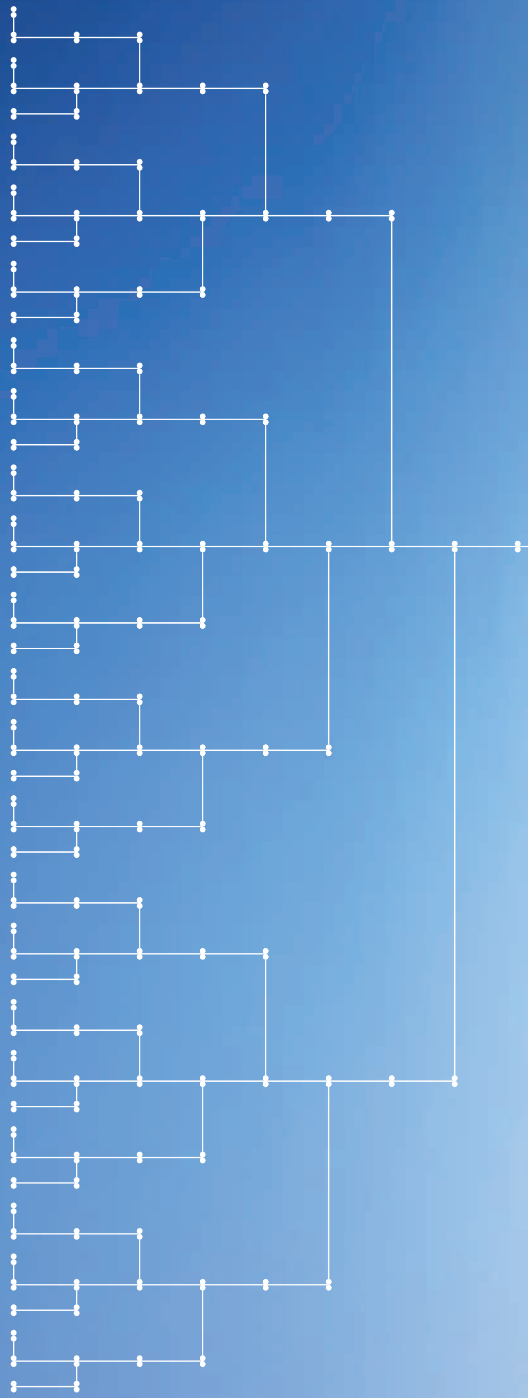


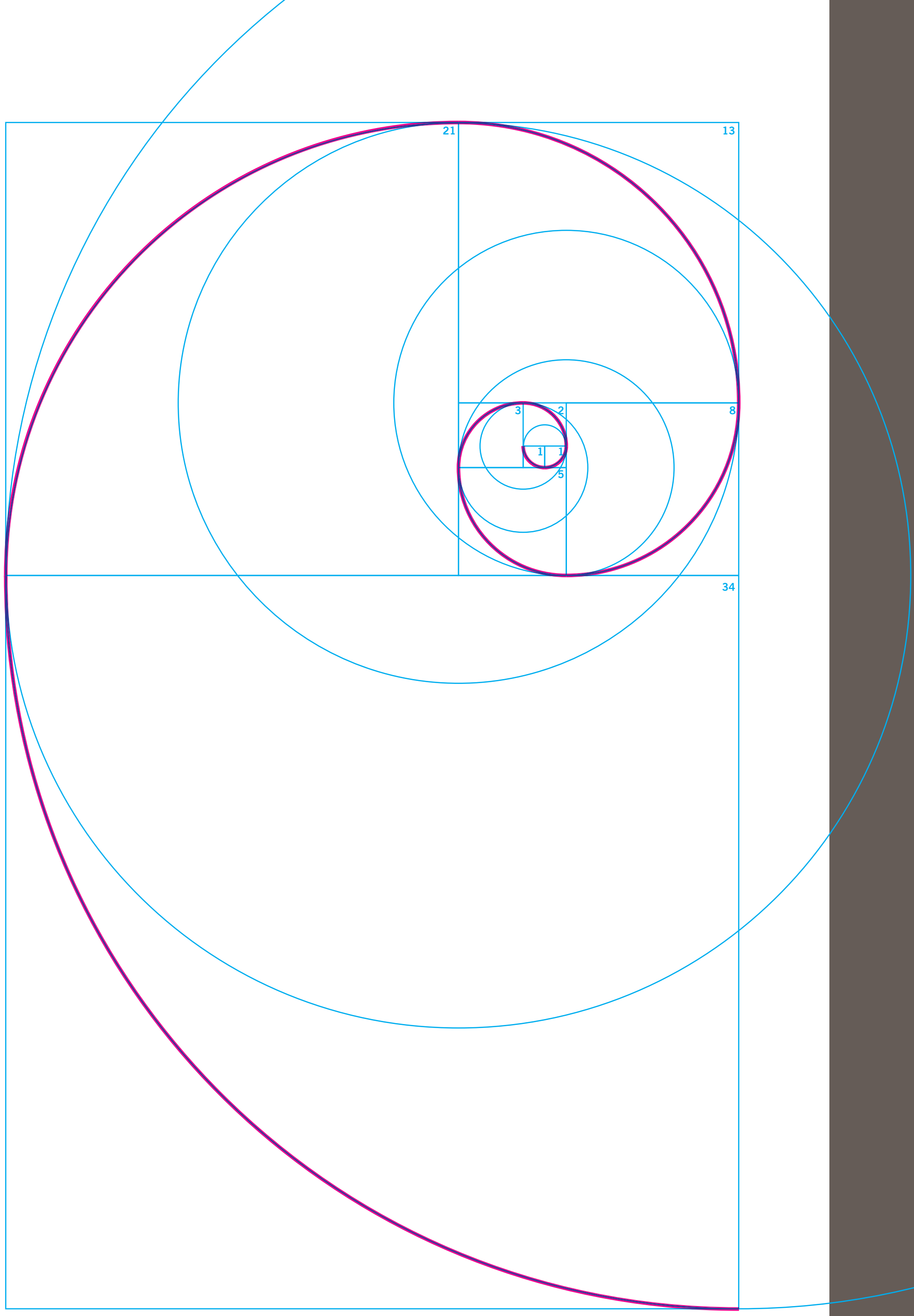
The Fibonacci spiral

began life as a mathematical exercise in rabbit population growth. A 13th-century mathematician called Leonardo of Pisa wanted to know **how many pairs of rabbits** there would be after several months of fast and furious breeding. It turns out that each month's total is the sum of the two preceding months. The monthly count goes like this:

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55…

That sequence is now known as the Fibonacci series. It crops up in countless examples of efficient natural growth from leaves to seed heads.

We usually call Leonardo by his other name, Fibonacci. It's a contraction of *filius Bonacci*, meaning 'son of Bonacci'.



You can represent the Fibonacci series geometrically as a set of squares and rectangles. You build the pattern by adding squares with sides equal to the next number in the series. Place each new square in a continuous sequence, working consistently clockwise or anticlockwise.

To create the Fibonacci spiral, draw an **arc between two opposite corners of every square.** Draw it in the same clockwise or anticlockwise direction that you laid the squares.

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As the size of the rectangles increases, the ratio of the long to short sides approaches the golden ratio, traditionally symbolised by Φ

“Nature’s great book is written in mathematical language”

Galileo Galilei (1564–1642)

The Fibonacci spiral is all around you. Nature tends to grow according to that simple, additive sequence. The result is beautiful and efficient.

“For the things of this world cannot be made known without a knowledge of mathematics”
Roger Bacon (1214–92)

$$f_{k+1} = f_k + f_{k-1}$$

The spiral is universal.

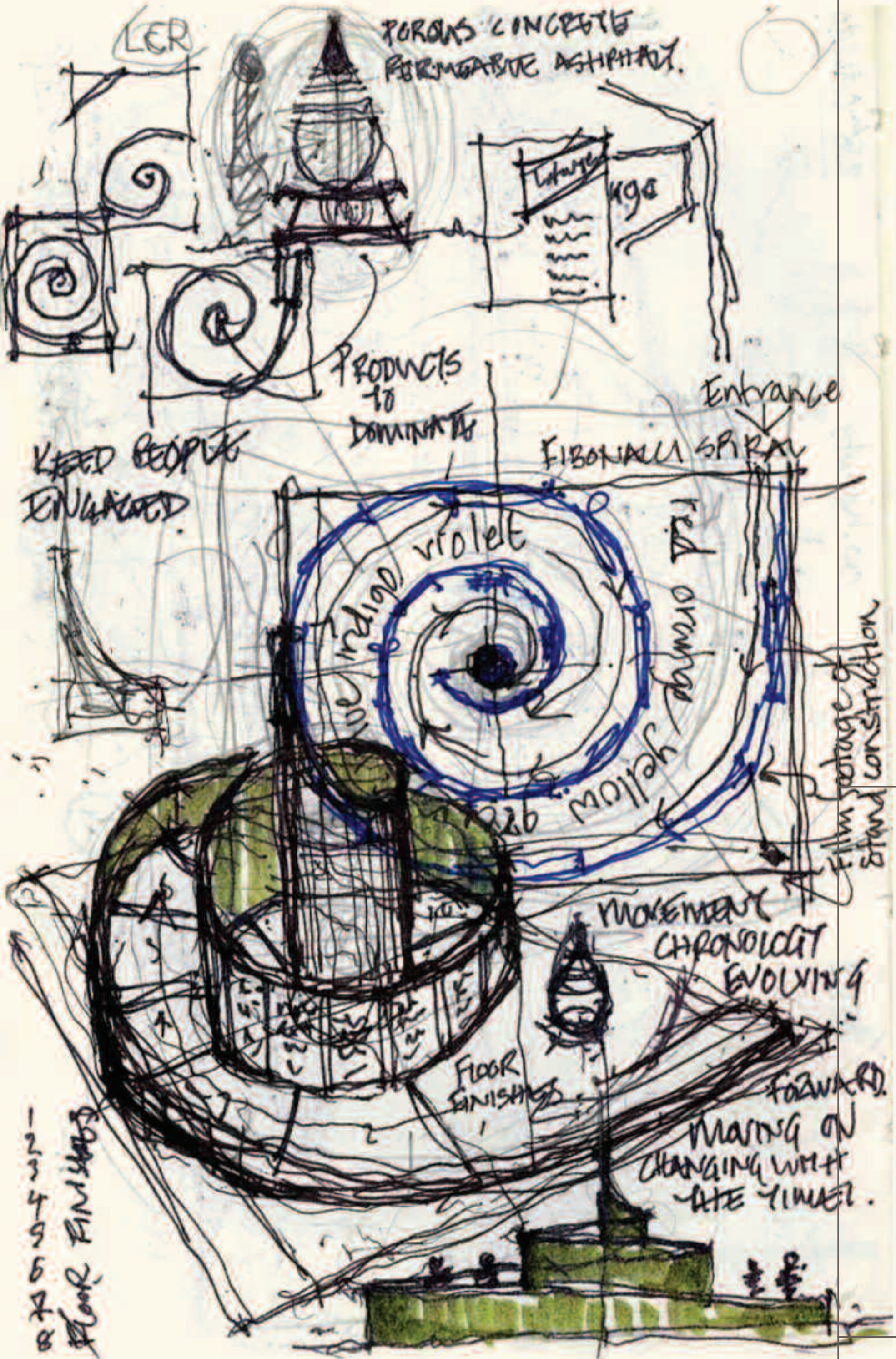
As well as the Fibonacci spiral, there are Archimedean, logarithmic, parabolic, and hyperbolic spirals. When you start looking, you see them **everywhere.**

Humans like spirals so much, they often make their own.

French city planners created one in Paris.

They numbered the 20 central districts known as arrondissements in a clockwise spiral that begins at the heart of the city.

89 144 233 377 610 987 1597



Lafarge UK drew inspiration for the Ecobuild spiral from Paris, the location of the group's global headquarters. The company sees the spiral as a motif for precision, thoughtfulness, natural beauty, restraint, and innovation.

This is a world under pressure from CO_2.

Temperatures could rise by anything from 1.4°C to 5.8°C by the end of the century. The global cement industry contributes about 5% of man-made CO_2 emissions.

Lafarge is playing its part to cut those emissions. In the Carbon Disclosure Project worldwide top 50, Lafarge ranks at position 6.

Lafarge CO_2 ambitions (1990–2010)	Target	Achievement
A worldwide cut in net CO_2 emissions per tonne of cement	20%	20.7% (2009)
A cut in absolute gross CO_2 emissions in industrialised countries (vs Kyoto commitment to a 5% cut)	10%	37.7% (2009)

Fossil fuels are a finite resource. Lafarge is reducing its dependence on them. In 2009, almost 11% of the fuel consumed came from alternatives sources such as waste and biomass.

Biomass is CO_2 neutral. Consuming local waste saves the community from having to dispose of it.

- ▲ Malaysia: 5% of the energy used by the Rawang and Kanthan cement plants comes from biomass (shells of palm oil nuts)
- ▲▲ Philippines: rice husks used as biomass
- ▲▲▲ Uganda: coffee pods used as biomass
- ▲▲▲▲▲ Germany: plastics, solvents, and old tyres used as biomass.

$$f_{k+l} = f_k f_{l+1} + f_{k-1} f_l$$

0 1 1 2 3 5 8 13 21 34 55

Under the Kyoto Protocol, developing countries earn certified emission-reduction credits through Clean Development Mechanism (CDM) projects. Many of Lafarge's biomass-burning projects fall into this category.

In Morocco, there's a CDM project involving wind power. The wind farm at Tétouan supplies 50% of the electricity consumed by the local Lafarge cement plant. It saves 30,000 tonnes of CO_2 a year.

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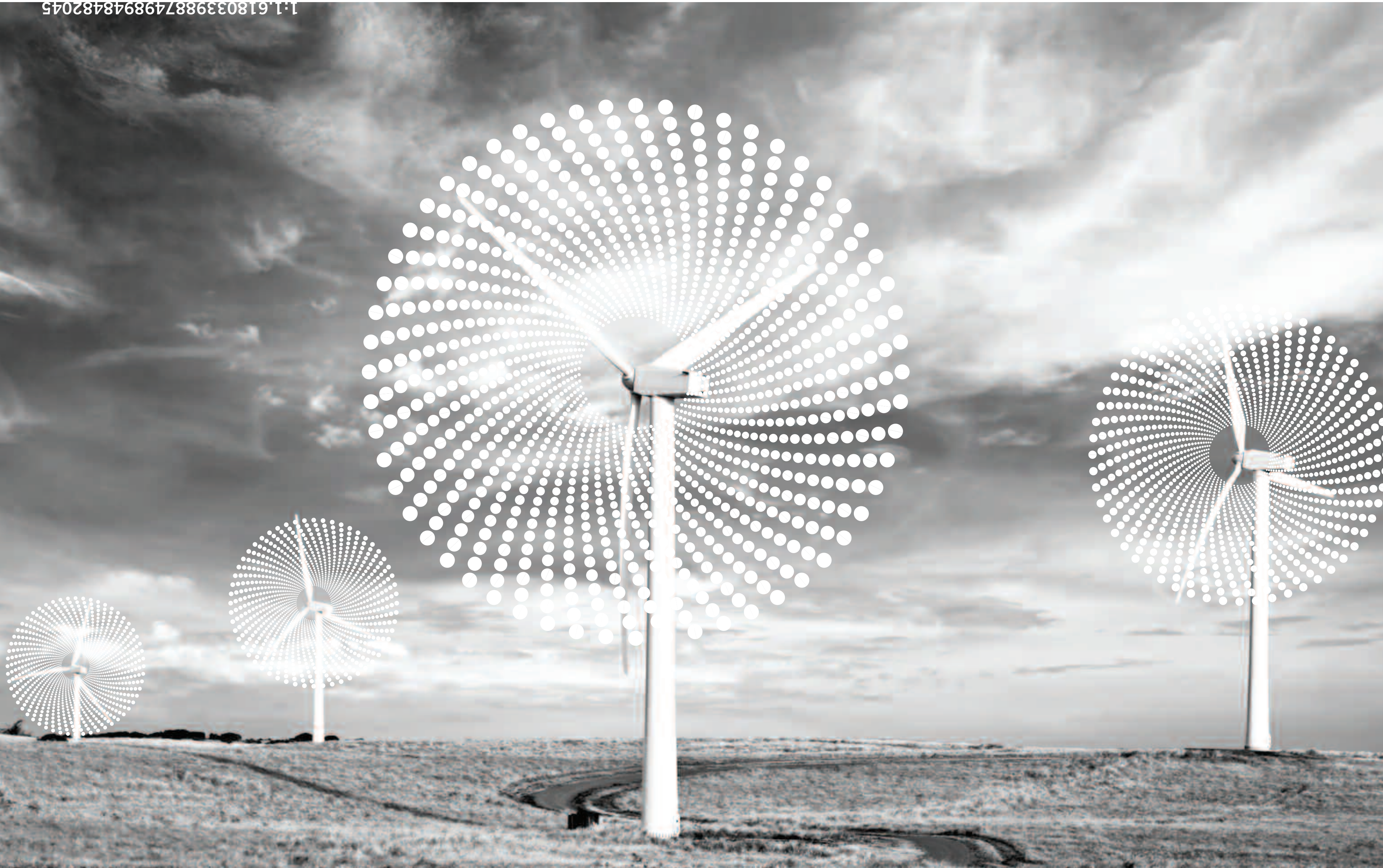


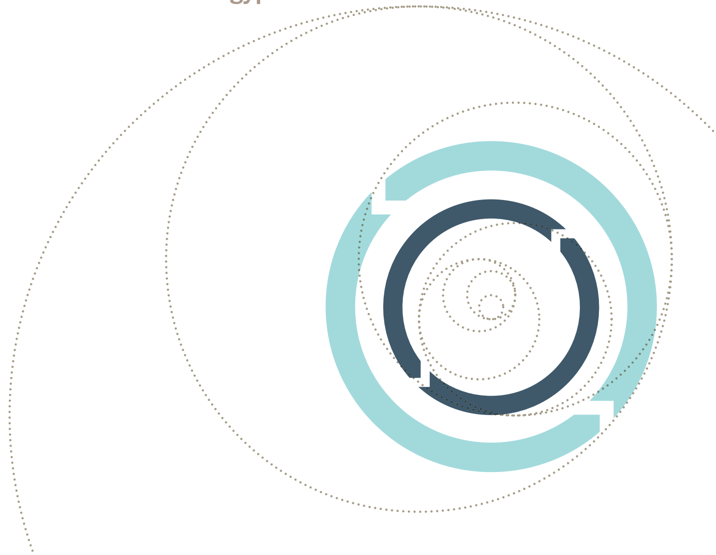
Industrial ecology is a Lafarge way of working inspired by the cyclical nature of ecosystems. It makes better use of resources by **designing cycles of production**, destruction, and **recycling** into industrial processes.

Recycled materials account for:

- **10%** of the raw materials used in cement production
- **50%** of the raw materials used in plasterboard production
- **50%** of the raw materials used in concrete and aggregates production

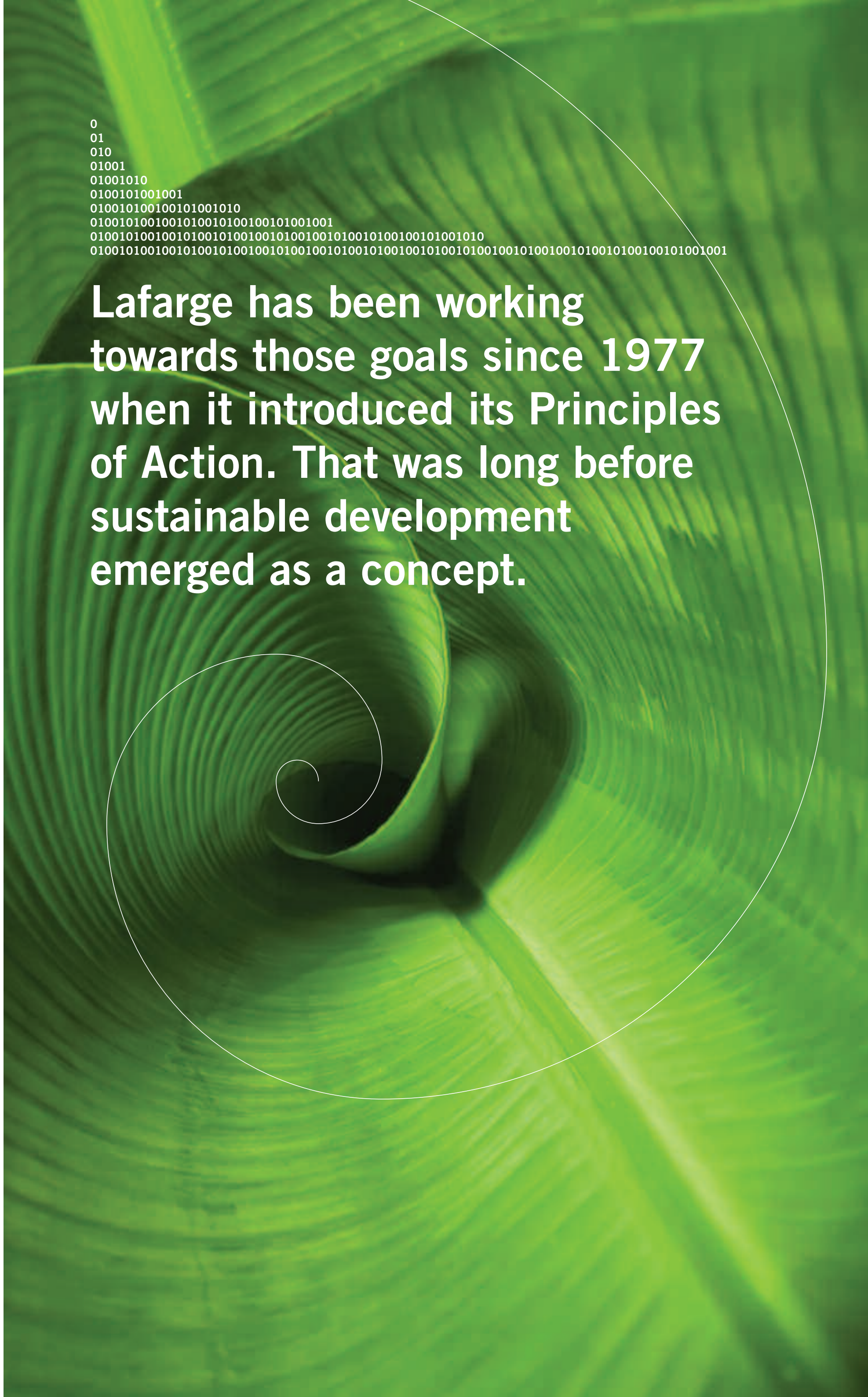
Water recycling occurs at:

- **83%** of cement sites
- **75%** of concrete and aggregates sites
- **68%** of gypsum sites.



Gro Harlem Brundtland coined the term ‘sustainable development’ in her 1987 report, *Our Common Future*. She defines it as:

“development that meets the needs of the present without compromising the ability of future generations to meet their own needs”



Lafarge has been working towards those goals since 1977 when it introduced its Principles of Action. That was long before sustainable development emerged as a concept.

Sustainability is at the heart of Lafarge's business vision and its day-to-day activities. The company's Sustainability Ambitions 2012 roadmap plots the way forward.

The Sustainability Ambitions are not a feelgood wishlist, but a set of measurable targets for each division of the company. They cover climate change, health and safety, and protection of the environment and biodiversity.

Where it can, Lafarge extracts its raw materials and manufactures its products close to where they will be used. The average distance from source to construction site for Lafarge Readymix is just seven miles. Working nearby contributes to the local economy while reducing transport costs and emissions.

$$F_{k+1} = F_k + F_{k-1}$$

Of the materials that are not sourced locally, around 4.5m tonnes travel by rail. That takes 340,000 lorries off the road each year.

Quarry restoration turns Lafarge's business full circle. The company won't start digging until it's developed a plan for future restoration. The end point of the cycle is the starting point of the process.

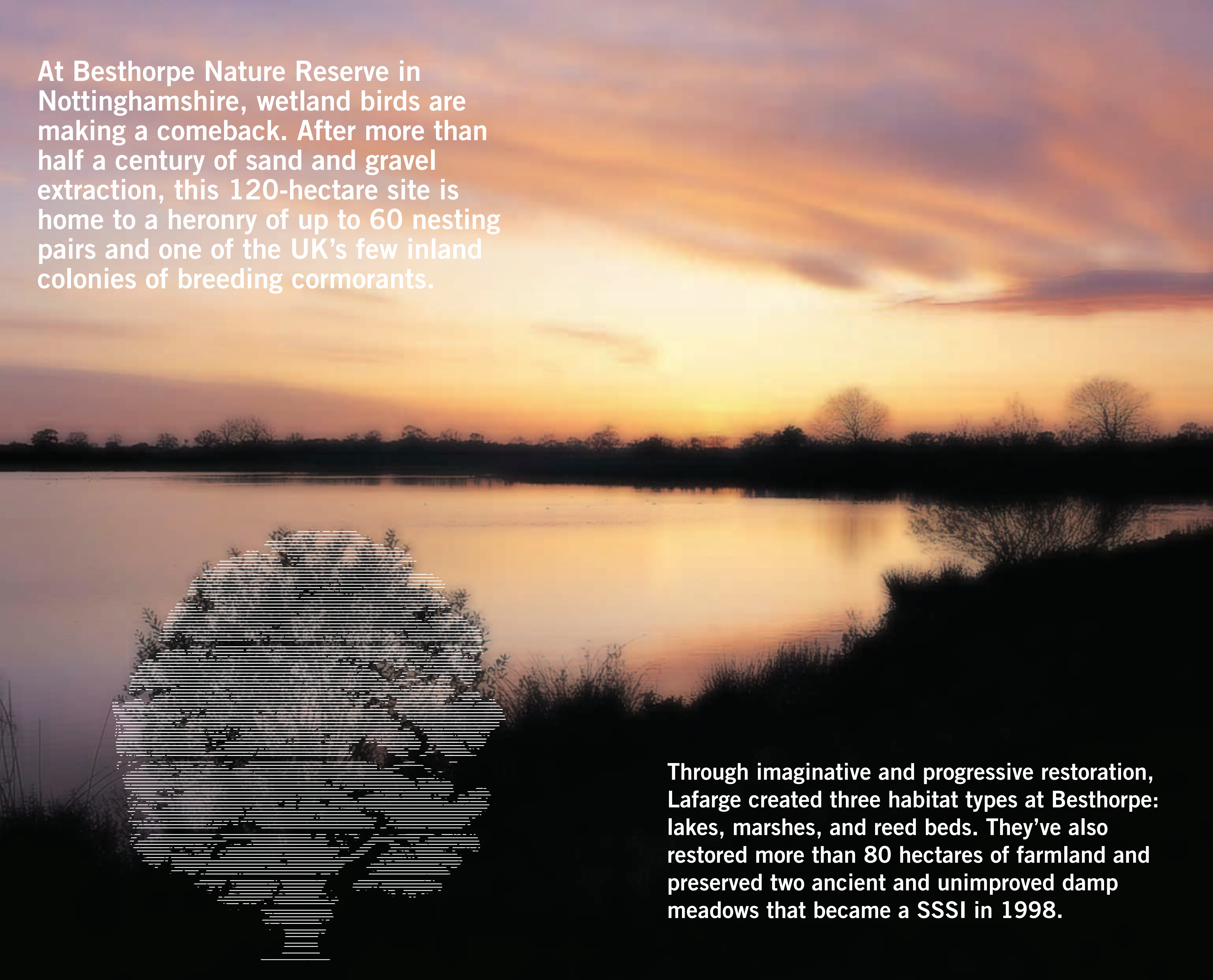
By involving people with local knowledge – from local wildlife trusts, the local community, and local authorities – and bringing in teams of land restoration experts, the company creates restored landscapes that are better in environmental terms than what was there previously.

Lafarge is the guardian of more than 16,000 hectares of land spread across about 200 locations in the UK. The land includes operational sites, woodland, restored land, and virgin land.

Through its land restoration projects, Lafarge has created award-winning open spaces (Whitlingham Country Park in Norfolk and the National Memorial Arboretum in Staffordshire), boating lakes, and educational centres. Across the UK, children learn about wildlife through pond-dipping, bug-spotting, leaf-printing, and numerous other activities at former Lafarge quarries.

The land in Lafarge's care is a vital national resource. It includes two national nature reserves at Thrislington and King's Wood, and 34 sites of special scientific interest.

Peter Stone, former Chief Executive of Nottinghamshire Wildlife Trust:
"Besthorpe has the potential to become one of the most important wetland sites in the UK"



At Besthorpe Nature Reserve in Nottinghamshire, wetland birds are making a comeback. After more than half a century of sand and gravel extraction, this 120-hectare site is home to a heronry of up to 60 nesting pairs and one of the UK's few inland colonies of breeding cormorants.

Through imaginative and progressive restoration, Lafarge created three habitat types at Besthorpe: lakes, marshes, and reed beds. They've also restored more than 80 hectares of farmland and preserved two ancient and unimproved damp meadows that became a SSSI in 1998.

There's plenty of water at the Cauldon Works in Staffordshire – enough for cement production and for wildlife.

By converting a former shale quarry at the site into a source of recycled water, Lafarge cut its water extraction to zero and improved biodiversity. Before the project, the Cauldon Works took 290,000m³ of water a year from the nearby Hamps river. Now it takes nothing.

The local community benefits too. They have a lake that's rich in birdlife, and a reduced risk of flooding in the village of Waterhouses. The scheme was so successful, it won two Environment Agency awards.

Panshanger Park in Hertfordshire is a Grade II-listed landscape designed by Capability Brown and Humphry Repton. The site also includes a working sand and gravel quarry. Working with the Herts and Middlesex Wildlife Trust, Lafarge has created a variety of habitats and increased biodiversity by:

- • creating a habitat for dragonflies
- •• planting conservation crops for wild birds
- ••• turning an ice house into a bat roost
- ••••• managing ancient woodland including the 600-year-old Panshanger Oak
- •••••••• diverting and restoring chalk streams
- ••••••••••••• creating new and restored lakes.

Across the UK, restored Lafarge landscapes are teeming with wildlife. Counting the rabbit pairs at these sites isn't easy.

But it is reassuring to know that there's a mathematical link between Fibonacci's rabbit-breeding formula and the arrangement of leaves on many of the plants they eat. On Lafarge landscapes, herb and herbivore are connected by habitat, by environmental design, and by maths.

$$P_n = P_{n-1} + P_{n-2}$$

Stand N1040
Designed by Jeremy Harrall, SEArch Architects

Book
Book commissioned by Lafarge Aggregates and Concrete, Cement and Plasterboard

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Paper
Cover - 9lives offset 100% recycled, Greyboard 100% recycled

Inside - 9lives offset 100% recycled

FSC

Forest Stewardship Council

FSC promotes environmentally appropiate, socially beneficial and economically viable management of the world's forests.

LAFARGE

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