



Innovation in low CO₂ products and solutions

Driving the transformation of the construction sector

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LafargeHolcim

“The 2030 Plan” demonstrates our ambition and our determined way forward for implementation



**40% reduction
target**

in net CO₂ emissions
per ton of cement

We will help our
customers avoid

10 million tons

of CO₂ from buildings

One Third

of our turnover from
innovative and
sustainable solutions

LafargeHolcim invests in R&D to help “the world build better”

New clinker types, new binders, new concrete solutions

- LafargeHolcim invests in R&D to develop **new clinker types, new binders** and **new concrete solutions** which can dramatically reduce the embodied CO₂ of buildings and structures
- This R&D takes place in our facilities of Lyon, in an open innovation approach - working closely with start-ups and academics
- The market deployment of these alternatives still require a significant amount of technological innovation (e.g. reinforcement for infrastructural use), in parallel to advancements on the **standardization agenda** and **effective carbon pricing** (ensuring a level playing field across industrial sectors and across regions)

A new class of lower-carbon clinkers for cement production
(patent: FR2 873 366, July 2004)

Belite (C ₂ S):	40 – 75%
Yeelite (C ₄ A ₃ SO ₄):	15 – 35 %
Ferrite (C ₄ AF):	5 – 25%



- ✓ Clinker requiring less CaCO₃ in the raw mix
- ✓ Lower clinkering temperature (1250 instead of 1450°C)
- ✓ Less energy required for grinding.
- ✓ Fabrication in existing cement plant with light investment
- ✓ Meeting the same customer specifications as Portland cements

→ 20-30 % less CO₂

Prototype → Industrial trials

LafargeHolcim
patent



2004

2006

2011

2012

2014-2018

→ 2020

Exploratory
phase

Pilot and industrial production
2011: trademark deposit

Product
applications

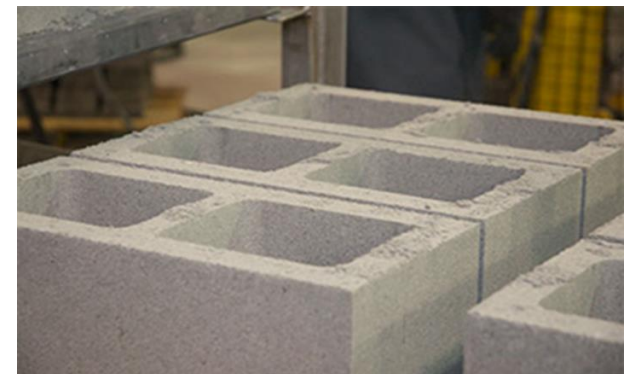
Solidia binder

Solidia Technologies

- Start-up founded in 2009
- Funding : USD 80 Millions from investors
 - Kleiner Perkins Caufield & Byers, Bright Capital, BASF Venture Capital, BP Ventures, LafargeHolcim, Total...



Development of a non hydraulic binder for precast concrete



Solidia solution

Solidia binder is a “carbonatable binder”

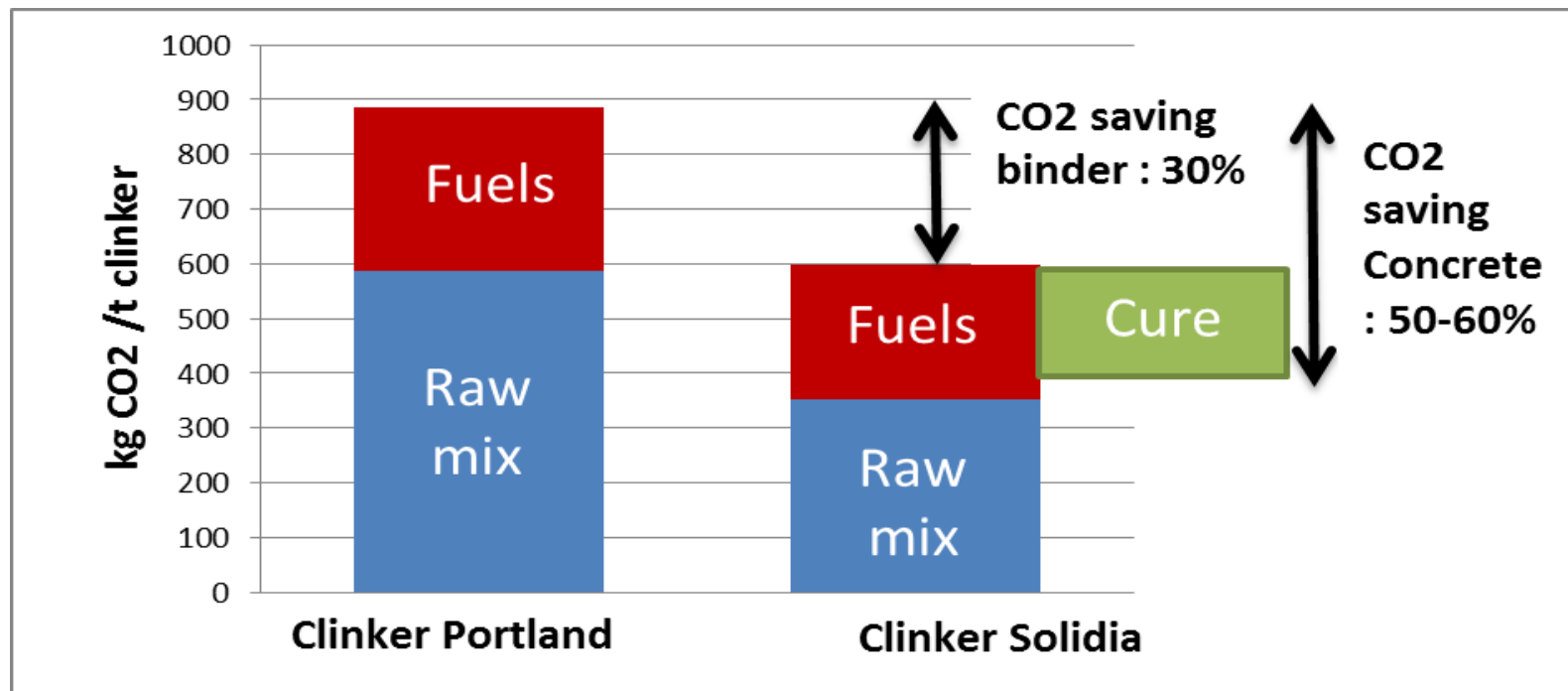
- Strength development when concrete is in presence of CO_2 at 40 to 70°C
- Compressive strength after **1 curing day : ~40- 60 MPa on mortar**
- Adapted curing chambers for precast concrete



Solidia solution

... and Solidia production emits much less CO₂ than Portland clinker

- Clinker composition : Wollastonite CS, Rankinite C₃S₂ & Belite C₂S
 - Different raw mix and lower clinkering temperature than for Portland clinker
- CO₂ balance of Solidia binder:



Solidia solution

Solidia cement & Solidia concrete



- Same Raw Materials



- Same Kiln



- Same Mix Components
- Same Mixer
- Same Cycle Time



- Same Forming Casting
- Same Cycle Time



- CO2-Curing
- Reduced Curing Times

Solidia Cement™

CO₂ emissions at cement plant
reduced
by 250 kg (per tonne of clinker)

Solidia Concrete™

Up to 300 kg of CO₂ permanently
stored in concrete (per tonne of
cement used)

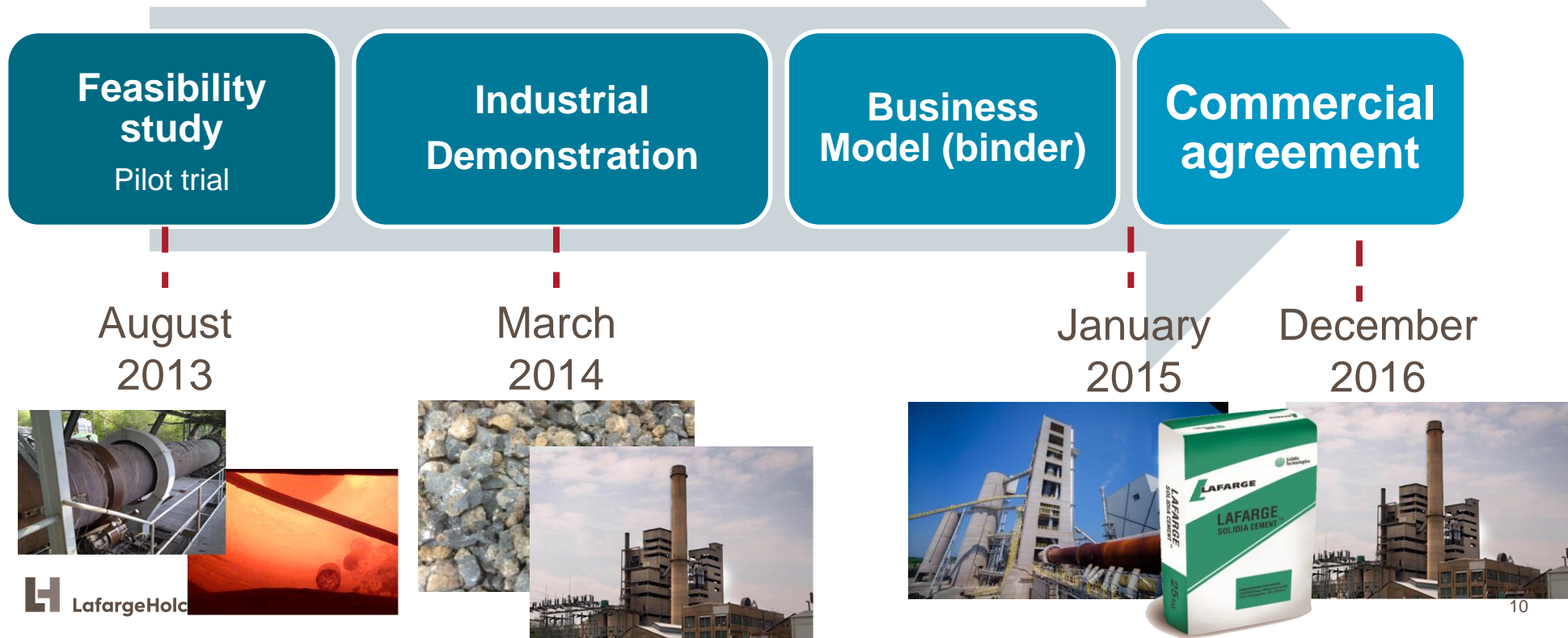
From partnership to commercial agreement

Partnership LafargeHolcim/Solidia

Step 1, August 2013 : JDA between Lafarge and Solidia

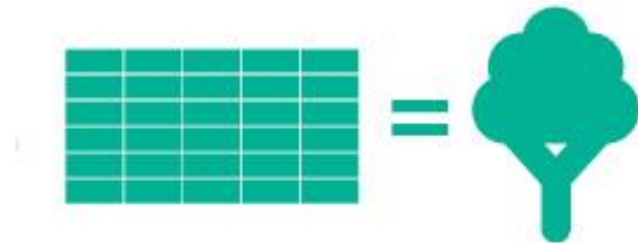
Step 2, January 2015: Commercial agreement

Commitments
Lafarge/Solidia :
5 + 5 years



Solidia project

30 Solidia Concrete™ blocks will absorb
22kg of CO₂ at production.



In one year, a tree will do the same.

Solidia's CO₂-curing technology reduces water consumption
in the production of concrete up to 80%.



If global concrete production converted to Solidia's systems,
the world could realize an annual water savings of
2 trillion liters.





CCU: carbonatation is a real opportunity

- LafargeHolcim has accumulated experience in CCS and CCU, and follows up all promising developments in that matter
- One of the possible pathways for CCU is the **production of building materials** through carbonatation
- Today: niche market

But economically and technically realistic (in comparison to other CCU options) and with a real potential for large-scale multiplication.

Real opportunity for European companies to be at the leading edge on the development of low-carbon innovations

Multiplying our impact through addressing life-cycle emissions

- LafargeHolcim also develops solutions which reduce the total CO₂ footprint of buildings over their life-cycle
- With a much bigger potential impact on climate protection than by addressing embodied emissions
- Investments are required to bring these innovative technologies to the market

Mineral foam **Airium**

*A patented technology
LafargeHolcim*

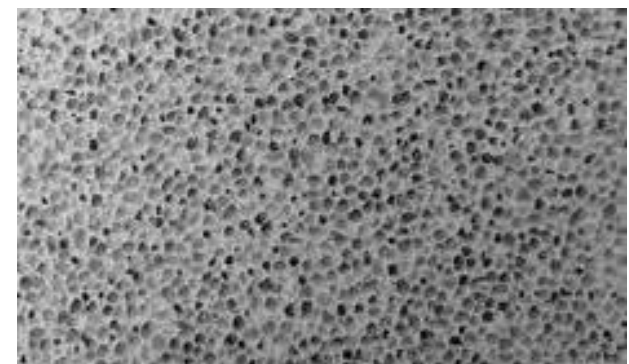
The thermal insulation made with cement

- Ultra low density foam concrete : from **50** to 500 kg/m³
- Thermal conductivity comparable to conventionnal insulation material : from **0,039** to 0,1 W/K.m
- Flowable in the fresh state, solid after setting

AIRIUM Insulation
Redefined

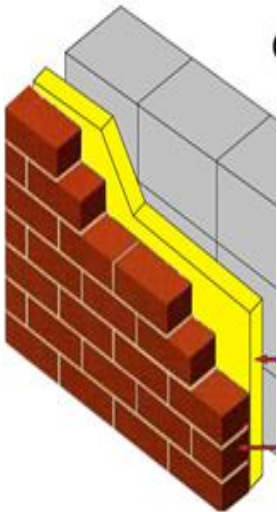


Material			
Composition		100% mineral	
Properties			
Fire protection class		A1 (incombustible)	
Heat conductivity	mW/K.m	Variable between 35 to 60	
density	Kg/m3	Variable between 40 to 200	
Compressive strength	kPa	Variable between 20 to 500	
Sound Absorption (20cm width)	-	0,6	
Water absorption (EN 1609)	kg/m²	4	
Vapour diffusion resistance	m	7	
Srinkage	m/m	0,40%	
Insect/mildew resistance		yes	
Application			
On-site foaming		yes	
Cavity filling		yes	
production rate	m3/h	variable between 5 to 30	
automated production		yes	
Curing			
Moisture content		%RH	50
Drying time (20°C,/ 40% RH)		h	24
Setting time (20°C)		h	<10

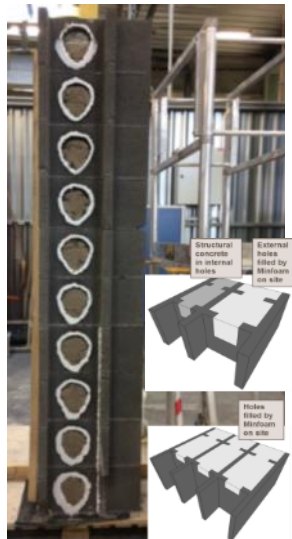


Jobsite application

Renovation
(fill foam into the voids space
of double wall system)



New building system
(blockfill system including
jobsite filling)



Precast application

Attics fill



Insulated wall



foam Panel (ITE mainly)
(higher density & lambda)

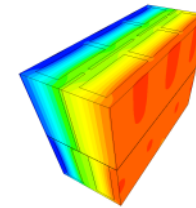


BlockFill : Stakes

BlockFill strategy: a combination of mineral foam and concrete block

→ Improve the thermal properties of the hollow block

- Block design → decrease the thermal bridge
- Lightweight block → decrease the lambda value of the concrete
- Fill the void by insulating materials → improve the R value of the block



R value calculation:

Hollow concrete block : 0,68 m².K/W

Mineral foam impact



Blockfill (Airium inside): 1,65 m².K/W



Benefit of using Mineral Foam

- Easy to fill solution
 - Good filling ability
 - Injection on the production line (no additionnal step)
 - No reduction in production time
- Low cost insulated material
 - 2 to 3 time lower compared to Rockwhool , EPS...

People will always build.

LafargeHolcim's mission is to help the world build better.