



# **Innovation in low CO<sub>2</sub> products and solutions**

## **Driving the transformation of the construction sector**

**Bernard Mathieu**  
Head Sustainable Development



**LafargeHolcim**

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

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**40% reduction  
target**

in net CO<sub>2</sub> emissions  
per ton of cement

We will help our  
customers avoid

**10 million tons**

of CO<sub>2</sub> 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

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- LafargeHolcim invests in R&D to develop **new clinker types, new binders** and **new concrete solutions** which can dramatically reduce the embodied CO<sub>2</sub> 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 <sub>2</sub> S):	40 – 75%
Yeelite (C <sub>4</sub> A <sub>3</sub> SO <sub>4</sub> ):	15 – 35 %
Ferrite (C <sub>4</sub> AF):	5 – 25%



- ✓ Clinker requiring less CaCO<sub>3</sub> 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 CO<sub>2</sub>

## Prototype → Industrial trials

LafargeHolcim  
patent



2004

2006

2011

2012

2014-2018

→ 2020

Exploratory  
phase

Pilot and industrial production  
2011: trademark deposit

Product  
applications

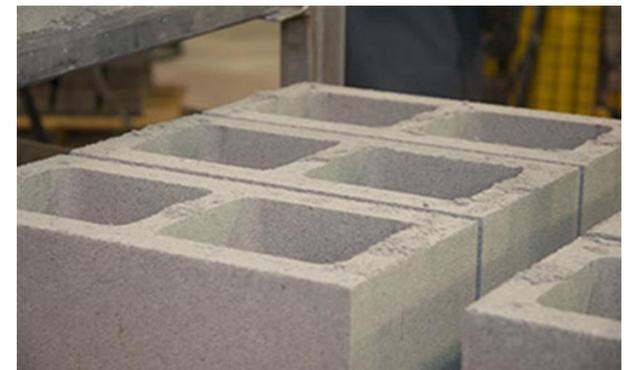
# Solidia binder

## 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

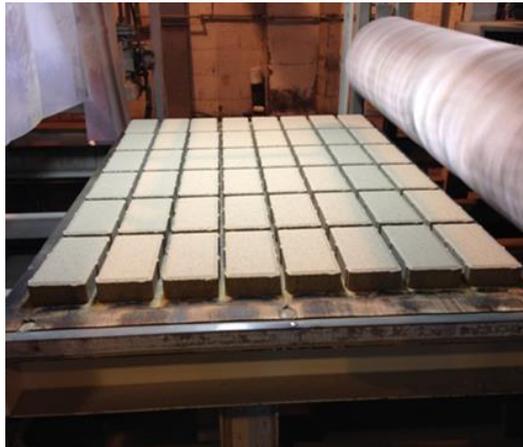


# Solidia solution

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## Solidia binder is a “carbonatable binder”

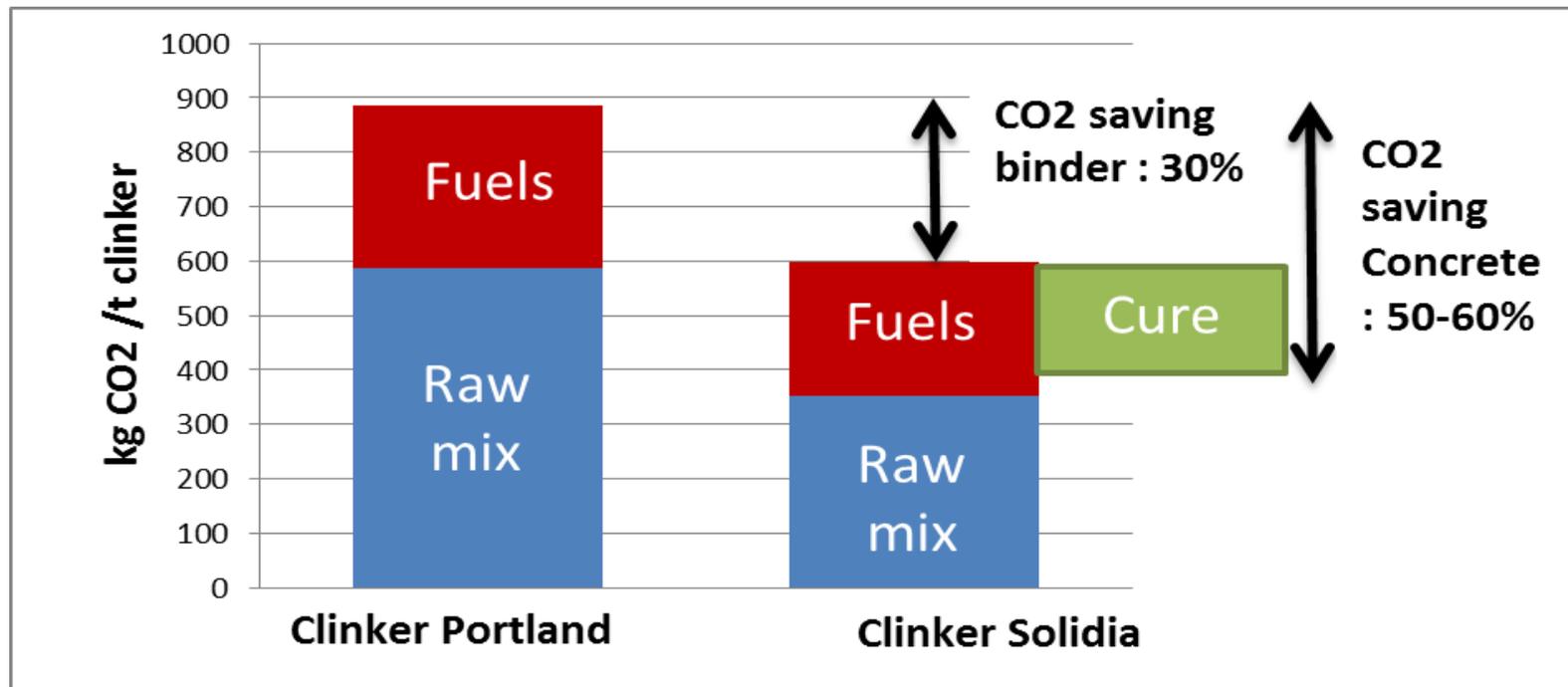
- Strength development when concrete is in presence of CO<sub>2</sub> at 40 to 70°C
- Compressive strength after **1 curing day** : ~40- 60 MPa on mortar
- Adapted curing chambers for precast concrete



# Solidia solution

## ... and Solidia production emits much less CO<sub>2</sub> than Portland clinker

- Clinker composition : Wollastonite CS, Rankinite C<sub>3</sub>S<sub>2</sub> & Belite C<sub>2</sub>S
  - Different raw mix and lower clinkering temperature than for Portland clinker
- CO<sub>2</sub> 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™

CO<sub>2</sub> emissions at cement plant reduced by 250 kg (per tonne of clinker)

### Solidia Concrete™

Up to 300 kg of CO<sub>2</sub> permanently stored in concrete (per tonne of cement used)

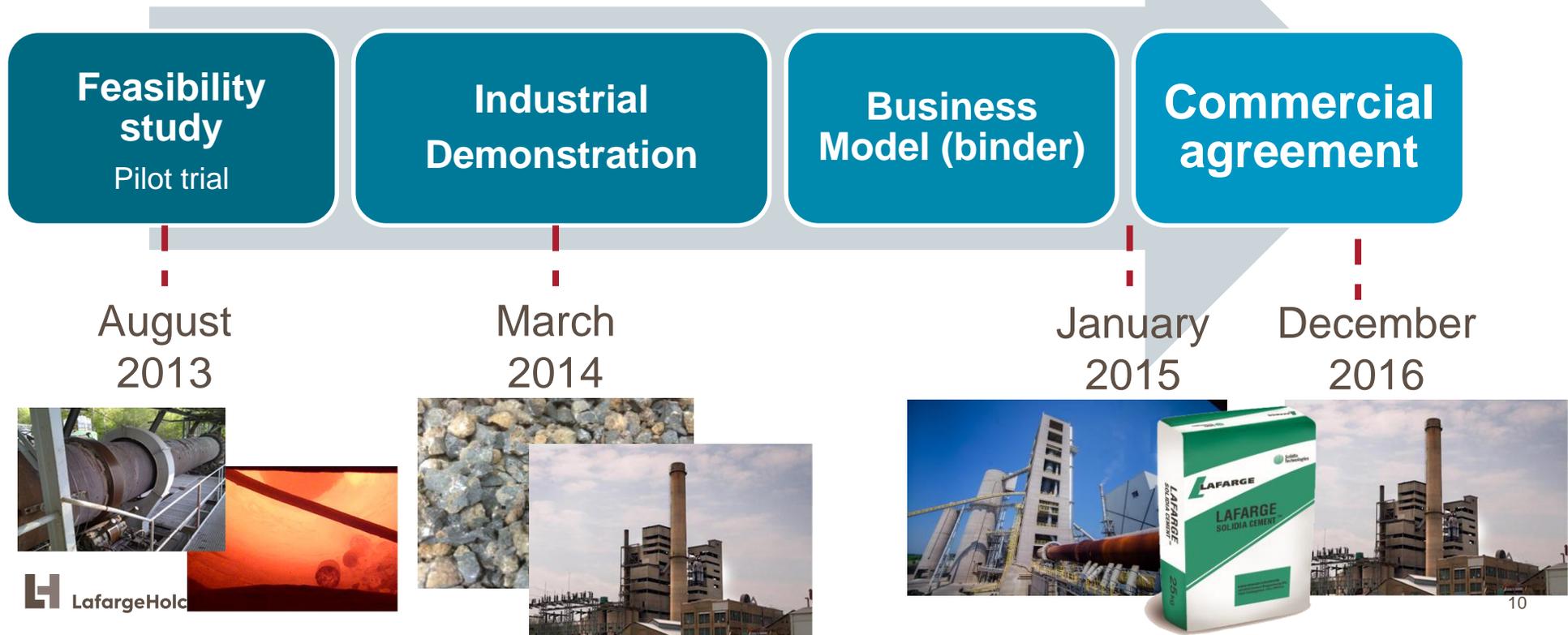
# From partnership to commercial agreement

## Partnership LafargeHolcim/Solidia

Step 1, August 2013 : JDA between Lafarge and Solidia

Step 2, January 2015: Commercial agreement

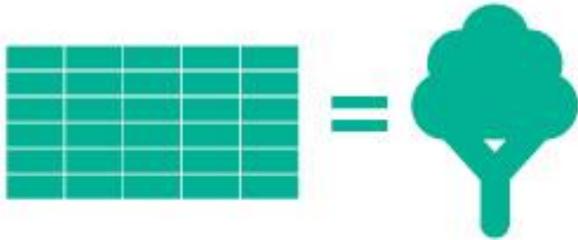
Commitments  
Lafarge/Solidia :  
5 + 5 years



# Solidia project

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30 Solidia Concrete™ blocks will absorb 22kg of CO<sub>2</sub> at production.



In one year, a tree will do the same.

Solidia's CO<sub>2</sub>-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

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- 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

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- LafargeHolcim also develops solutions which reduce the total CO<sub>2</sub> 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*

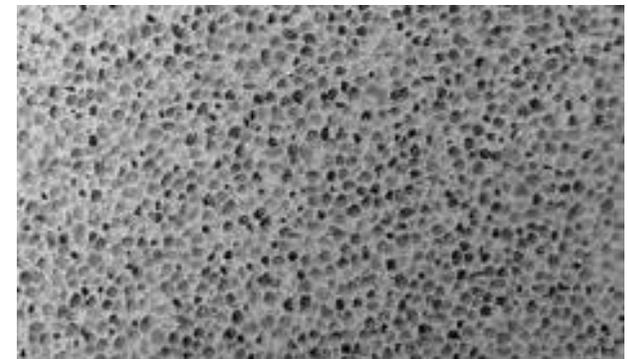
The thermal insulation made with cement

- Ultra low density foam concrete : from **50** to 500 kg/m<sup>3</sup>
- Thermal conductivity comparable to conventional 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/m <sup>3</sup>	Variable between 40 to 200
Compressive strength	kPa	Variable between 20 to 500
Sound Absorption (20cm width)	-	0,6
Water absorption (EN 1609)	kg/m <sup>2</sup>	4
Vapour diffusion resistance	m	7
Shrinkage	m/m	0,40%
Insect/mildew resistance		yes
Application		
On-site foaming		yes
Cavity filling		yes
production rate	m <sup>3</sup> /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



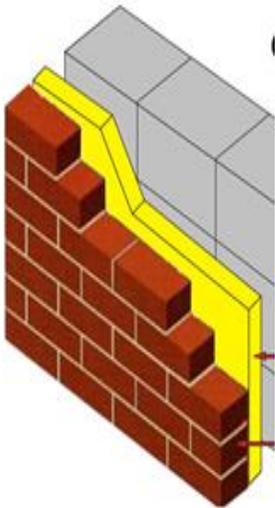
LafargeHolcim Mineral Foam:  
Technical features

# Mineral foam **Airium**

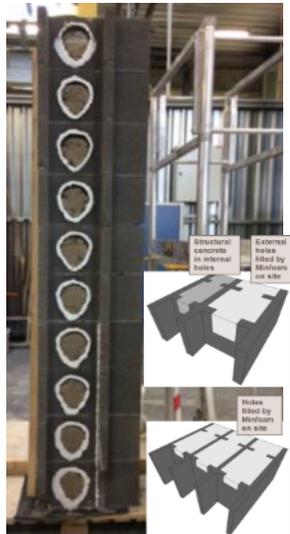
# Applications

## Jobsite application

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



New building system  
(blockfill system including jobsite filling )

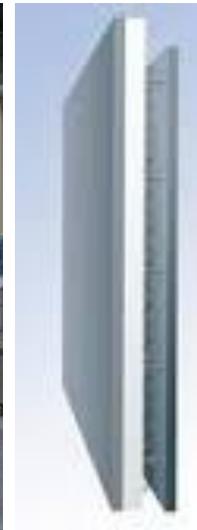


## Precast application

Attics fill

Insulated wall

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

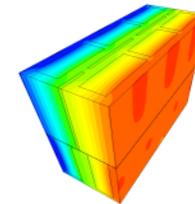


# BlockFill : Stakes

## 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 m<sup>2</sup>.K/W

**Mineral foam impact** ↓

Blockfill (Airium inside): 1,65 m<sup>2</sup>.K/W

### Benefit of using Mineral Foam

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

**People will always build.**

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