/NV/E

28/09/2023

The development of CO_2 neutral binder

Anja Buchwald | Netherlands

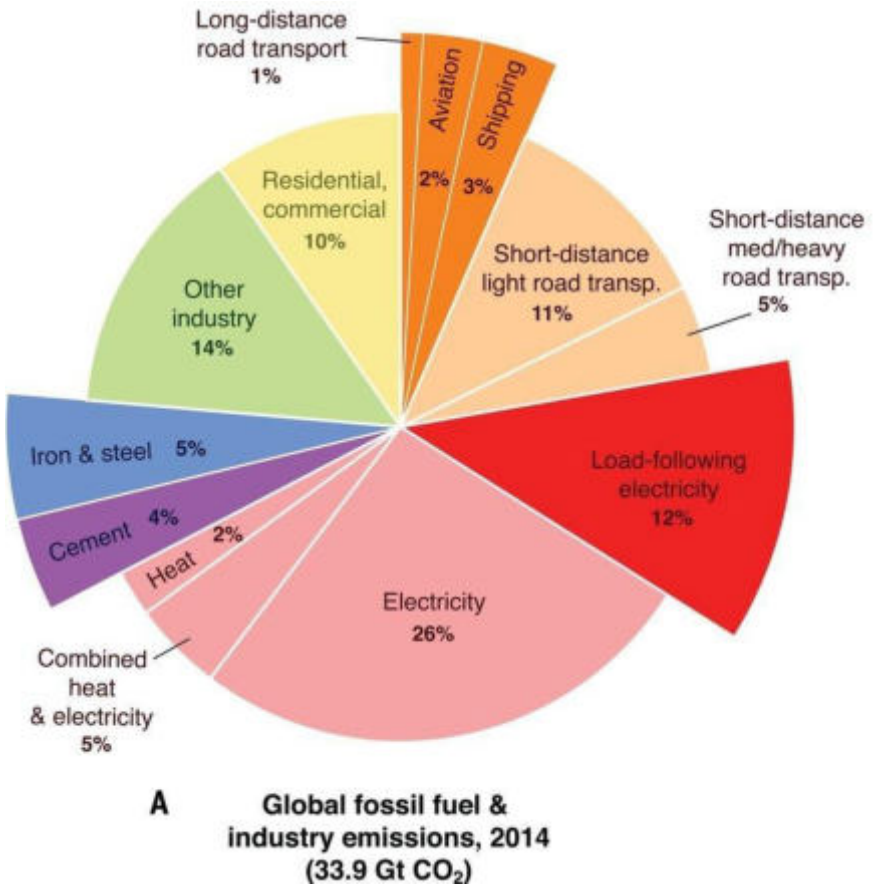
ascem special technologies

onderdeel van BTE GROEP

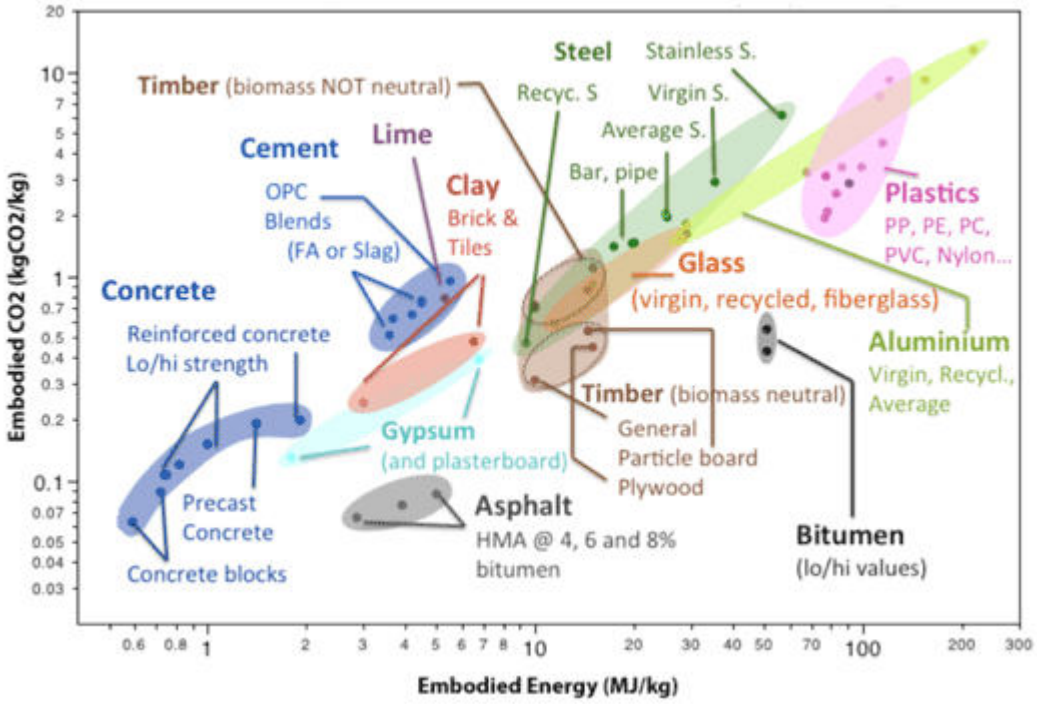
Why?

Climate change -
challenge and chance for
the pre-fab industry!

CO_2 emissions and building materials



A **Global fossil fuel & industry emissions, 2014 (33.9 Gt CO_2)**

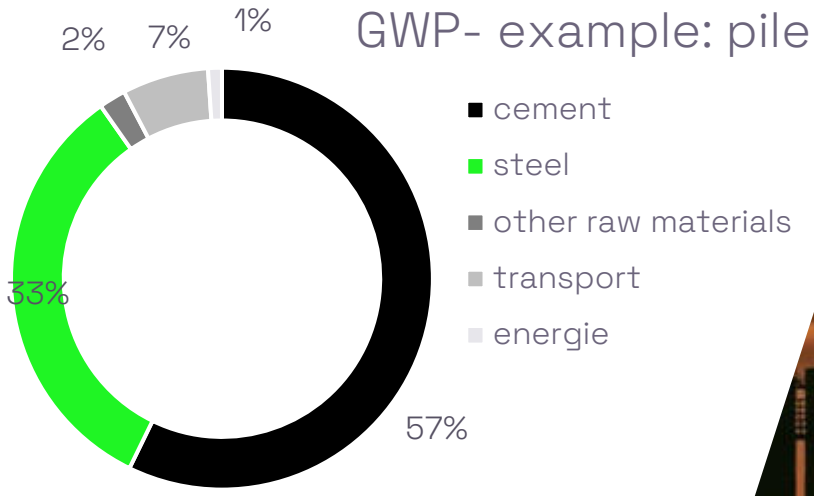


Concrete is a successful building material
easy, available, cheap → high amounts

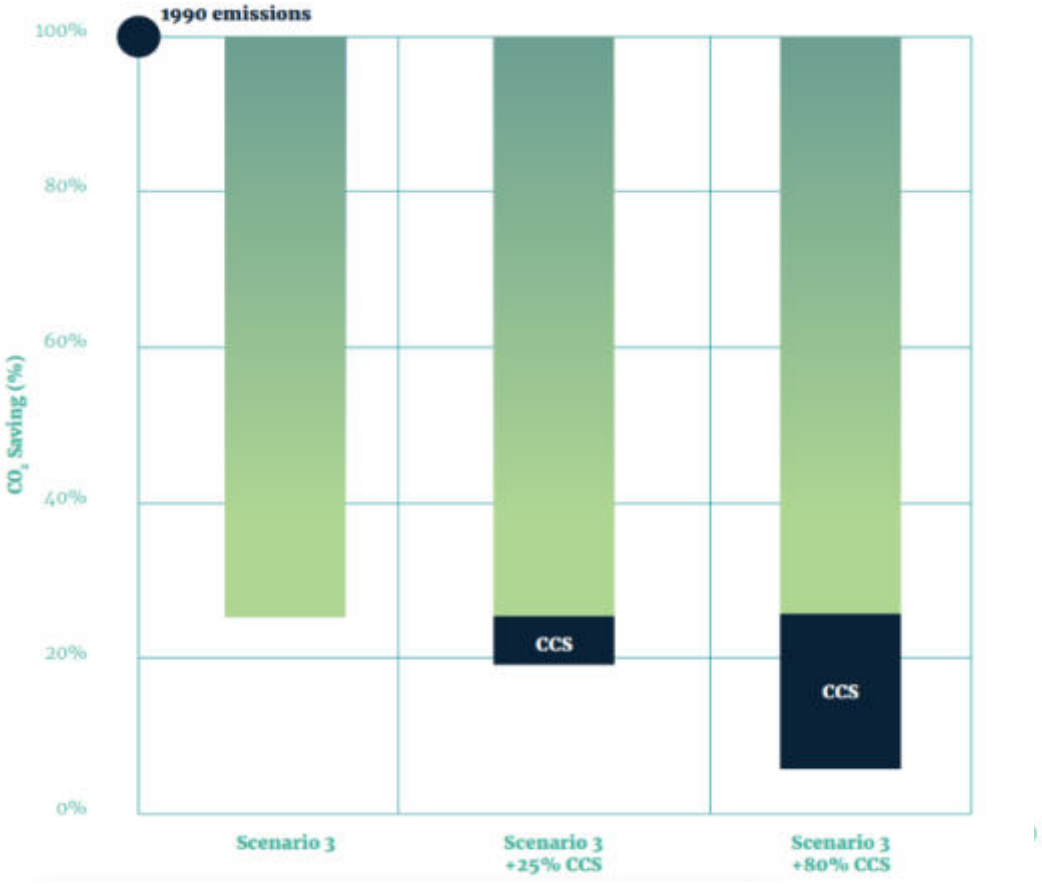
= 0,8-1 m³/year/person

Where comes the CO_2 from?

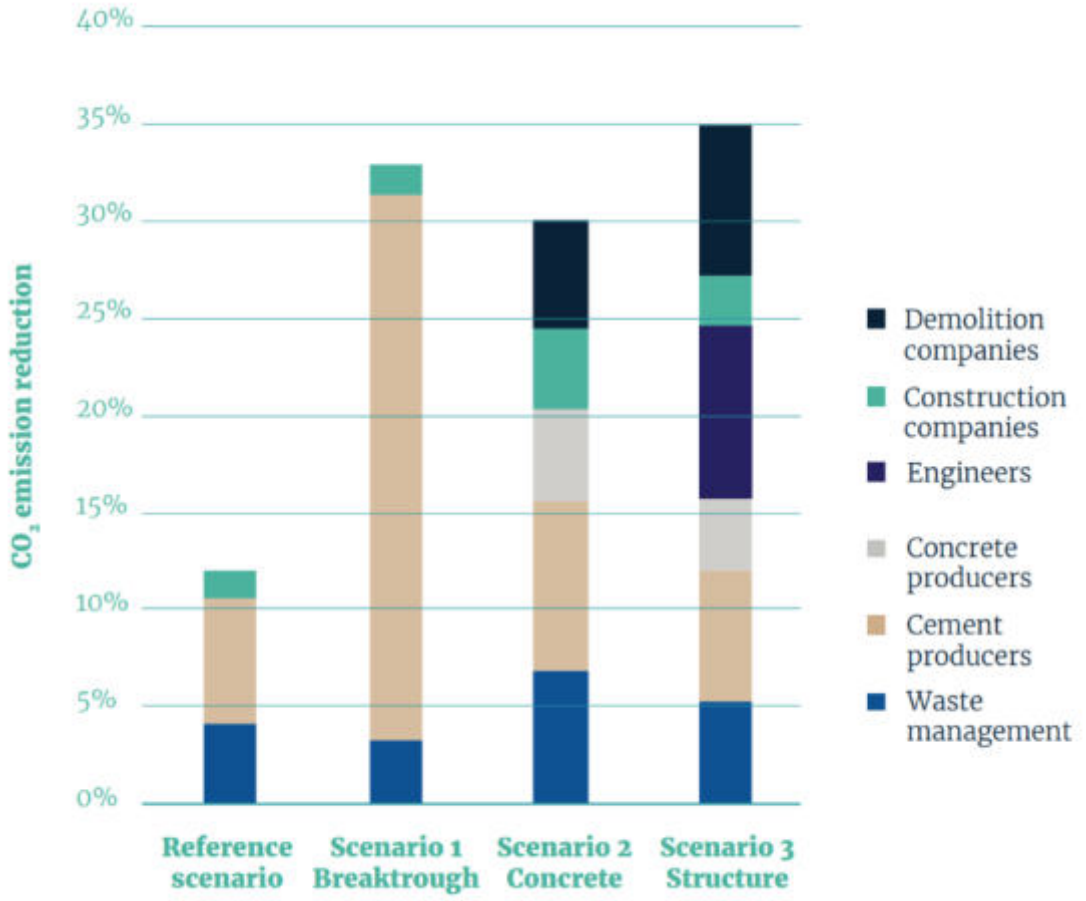
- Cement production
  - Raw materials
  - Fuels
- Steel (reinforced concrete)
- Concrete production itself
  - Electricity (production machines)
  - Heat (curing)
- Transport



Mother of Roadmap (s)

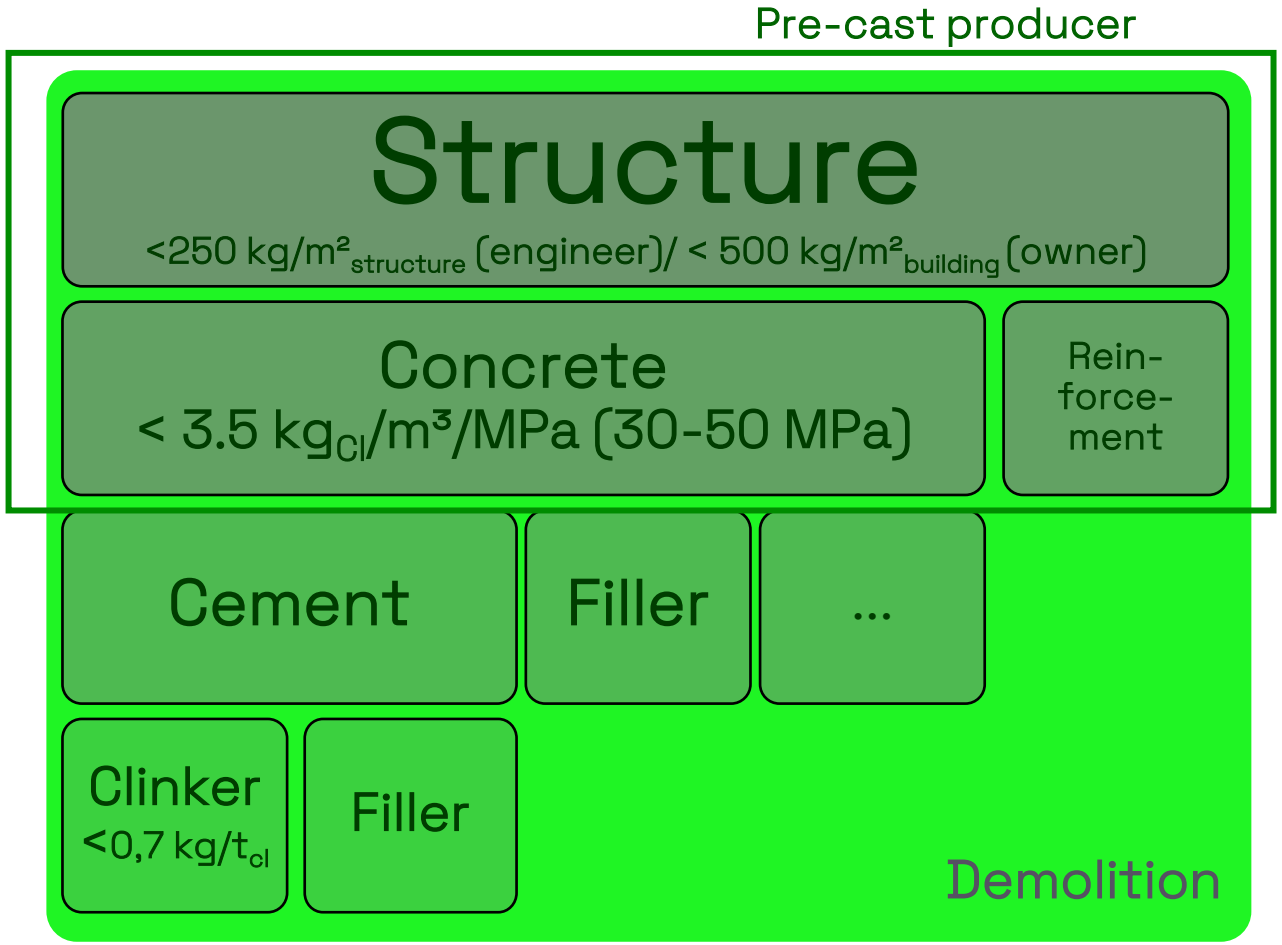


CO_2 emission 2015-2050



A. Favier, C. de Wolf, K. Scrivener, G. Habert:
A sustainable future for the european cement and concrete industry. Technology assesment for full decarbonisation of the indystry by 2050

Span of controle along the value chain



- Cooperation along value chain
- Beyond the standards
- New constructions
- Resource efficiency and low climate impact
- Re-use of buildings & elements (long life time, modulair & demontabel)
- Focus on the right KPIs
- Preferabel pre-cast

A. Favier, C. de Wolf, K. Scrivener, G. Habert: A sustainable future for the european cement and concrete industry. Technology assesment for full decarbonisation of the indystry by 2050

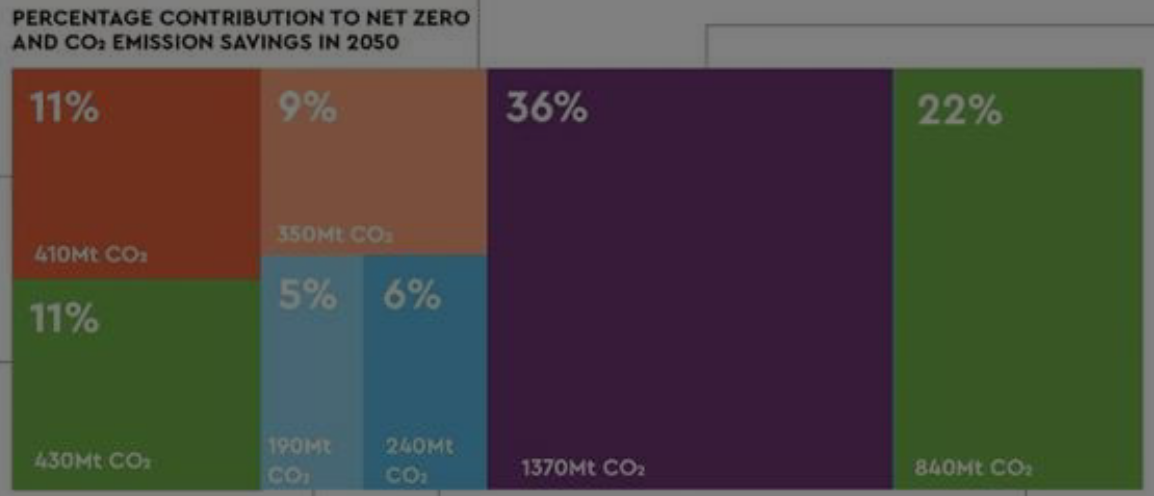
ACTIONS TO A NET ZERO FUTURE

GCCA net zero

Savings in clinker production

Savings in cement and binders

Carbon capture and utilisation/storage



Efficiency in concrete production

Decarbonisation of electricity

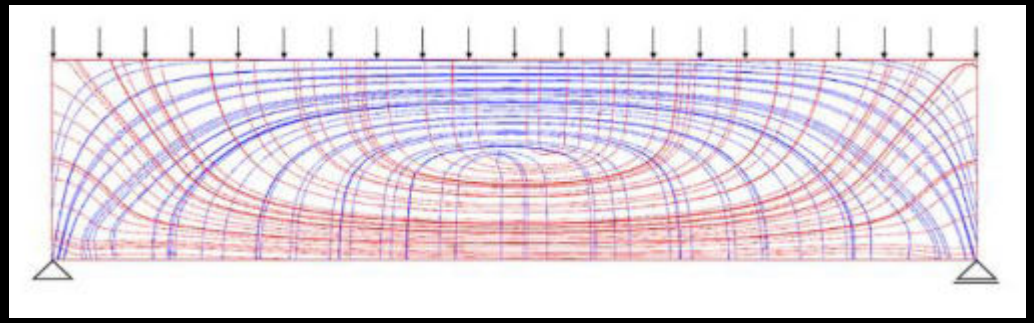
CO_2 sink: recarbonation

Efficiency in design and construction

/ Efficiency in design and construction/Examples

Organic forms

Shel & net construction



Form follows force

Less material is more strength

Material only where needed

Space no more without

Lightweight constructions

Combined functions, beter recyclable

/NV/E

What about alternative binders?

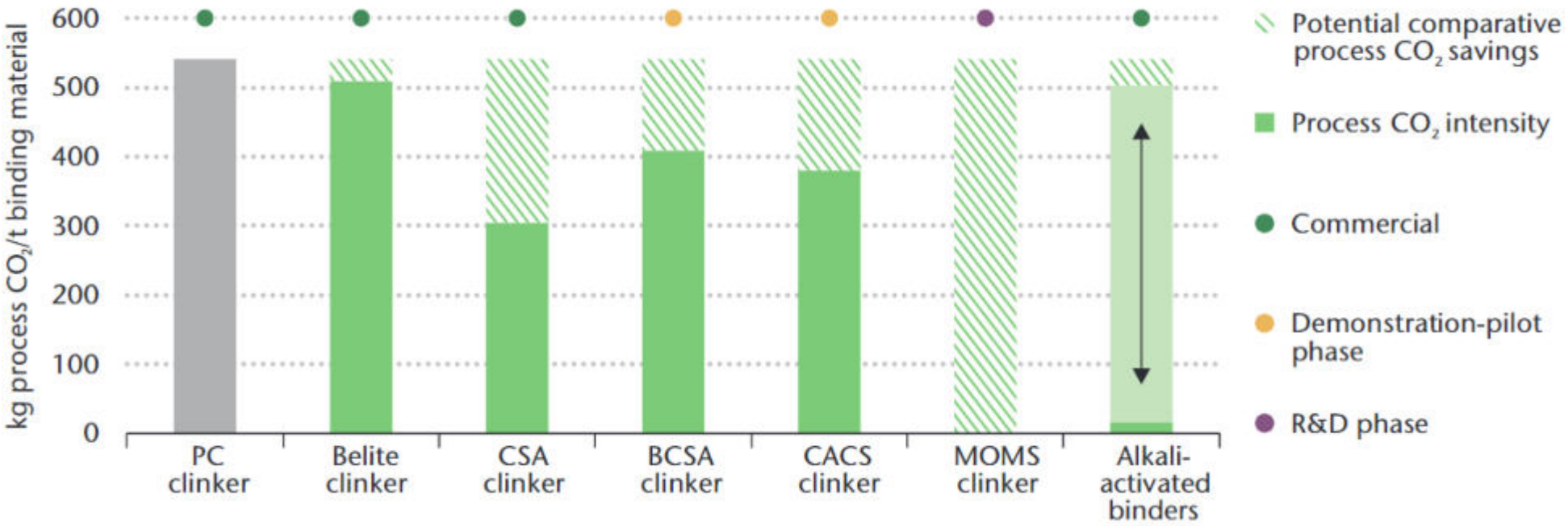
INVIE cement

"I am not believing in alternative binders, and anyway it should come from the cement industry"

"Solutions has to be available at very large scale (general) same as portland-clinker"

"CCS needs large investment, infrastructuur, small (cement) companies will not survive"

Potential of saving CO_2 with alternative binder



PC = Portland cement, Belite=Belite
CSA = calcium sulphoaluminate, BCSA = belite calcium sulphoaluminate,
CACS = carbonation of calcium silicates (Wollastonite based),
MOMS = magnesium oxide derived from magnesium silicates.

Source: Quillin, K., 2010, Scrivener, K. L. et al., 2016 and Sui, T. and Gartner, E., 2017.

Source: Technology Roadmap Low-Carbon Transition in the Cement Industry. IAE,CSI, WBCSD

What are Geopolymers /alkali-activated binders?

2-component binder (fluid activator)
1-component binder (dry activator)

1. Precursor (reactive powder)

- Metakaolin
- GGBS
- Fly ash
- Calcined clay
- … INVIE®glass

Mixing

2. Alkaline activator

- NaOH/KOH
- Waterglas
- Alkalicarbonaat/-sulfaat
- Portland clinker …

+ Water

Binder

Successful if:
- Additional resources based on waste streams
- Reactive, high quality
- Production with green energy

Large possibility of combinations of
- precursors
- composition of activators
- combination precursor + activator

⟺

Will be influencing
- technical
- ecologic and
- economic KPIs

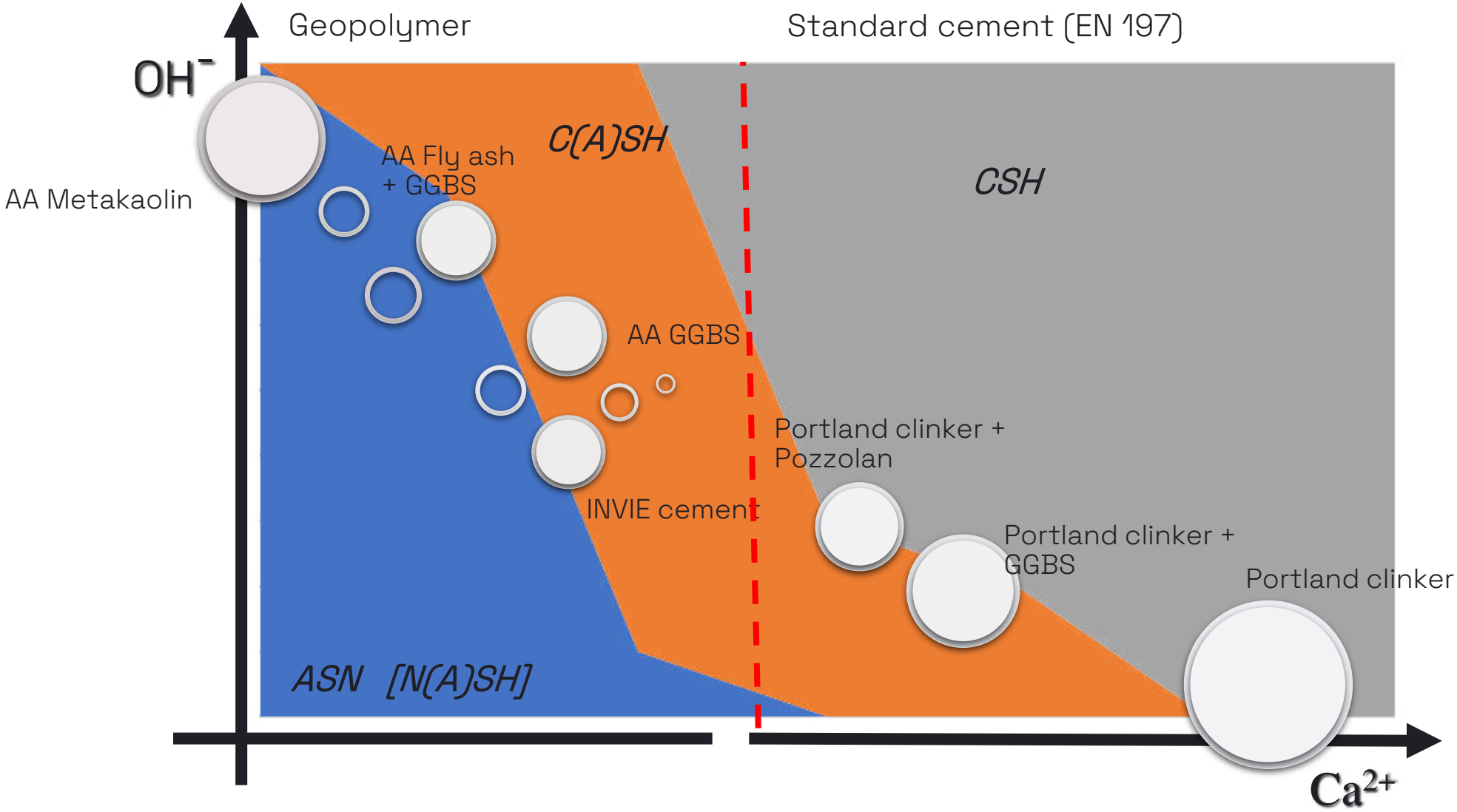
Buchwald A.: Was sind Geopolymere? Stand von Forschung und Technik sowie Chancen und Bedeutung für die Fertigteilindustrie. BFT 2006;72(7):42-9.

INVIE versus standard cement

Constructing a better world with a sustainable binder that makes powerful use of surplus industrial productions is powerfully utilized.

Photos taken from small scale production plant

Reaction products



INVIE & other geopolymers

	Geopolymer	INVIE® cement
Definition	Alkali-activated binder	Special Alkali-activated binder
Reactive phase (precursor)	Depends on type precursor: • GGBS • Fly ash • Metakaolin/calcined clays • Other pozzolanic raw materials	INVIE® glass, Melted from different secondary materials
Raw material quality	differs	differs
Quality precursor	Depends on raw material (slow or quickly reacting), Can not be changed	constant at high quality as adjusted in production
Need of alkaline activator (reactivity)	Metakaolin > Fly ash >> GGBS > INVIE® glass	
Reaction velocity	Fly ash << metakaolin < GGBS < INVIE® glass	
Compensation of varying composition of raw materials	Only by milling, mixing or type & amount activator	Correction material during melting, milling and mixing
Flexibility	Low, Depending on raw materials and activator mix	Higher, not dependent on one raw material, different glass qualities possible

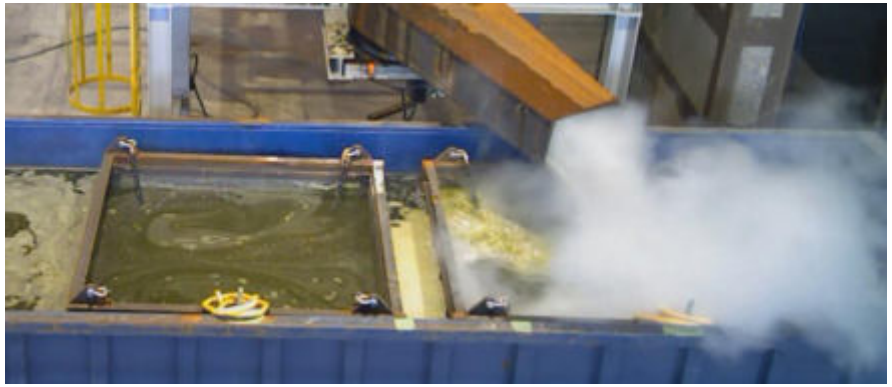
Status development

Cement production

- Pilot installation of glass production has been running since 2019, capacity 50 t/d
- Smelting campaigns took place 1-2 times per year
- Granulation with water
- Milling in ball mill
- Mixing with filler and (optional) activator in separate mixing plant

Financial support by RVO/DEI

Smelting campagne in pilot installatie



Status development

Concrete production & test projects

- Several production test and test applications were done since 2019 incl. type testing
- Product development and validation project are going on with focus on reinforced concrete elements and durability
- >2000t cements available for tests or production over the coming year
- Standardisation activities
- Monitoring of products in test projects

Financial support by RVO/DEI
& LIFE21-ENV-NL-CIRRCON

/NV/E

Examples Testprojects

Retaining walls

FBB/D 2012
Testlocation Eastthüringia/G

Bycicle plates

Meteoor 2021
Leiderdorp/exchange

Retaining wall

Kemper 2022
ProRail, train station

Diver/ Plates

Romein/2020
for element tests

/NV/E

Examples Testprojects

Sewage pipes

De Hamer 2020/2022
Testlocation Nijmegen

Levelbloks

2020
Afsluitdijk Ijsselmeer

Hollowcore slabs

VBI/Consolis 2022/2023

Pavement stones

De Hamer/2020
Ede/Wekerom

Beyond the standards

- How to speed up implementation of innovation?
- From descriptive to performance-based design and measurements
  - Design by testing
- Cooperation with engineers, scientists, owners, government and certification institutions
- …its not all about technical aspects!

Thank you for your attention.

Questions?

Bart van Melick
CEO BTE B.V.
b.v.melick@bte.nl

Anja Buchwald
Director ASCEM B.V
a.buchwald@ascem.nl

Harald van der Sloot
adj. Director ASCEM B.V.
h.vandersloot@ascem.nl

/NV/E

A WAY BETTER MATERIAL
FOR A WAY BETTER WORLD

ascem special technologies

onderdeel van BTE GROEP