

12 november 2019, ATV's Teknologiske Topmøde

nnovationsfonden

ProBu - Process technology for sustainable building materials production

Samarbejde accelererer klimavenlig industriproduktion

Lars Skaarup Jensen, FLSmidth Cement R&D

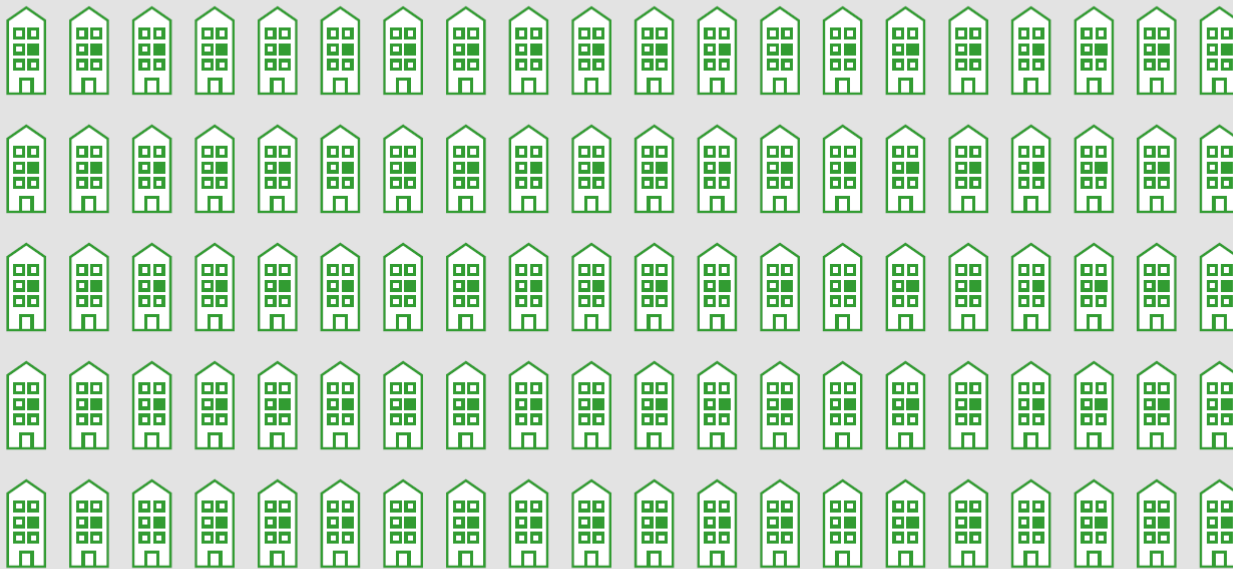


Stenuld har i forvejen en meget positiv miljøprofil

- klimaaftrykket fra produktionen kan yderligere reduceres

Building insulation: **Avoided carbon emissions**

CO₂ emissions saved during product lifetime of building insulation
= **100 times** the emissions in production²¹.



Key



1 tonne of CO₂
emissions avoided



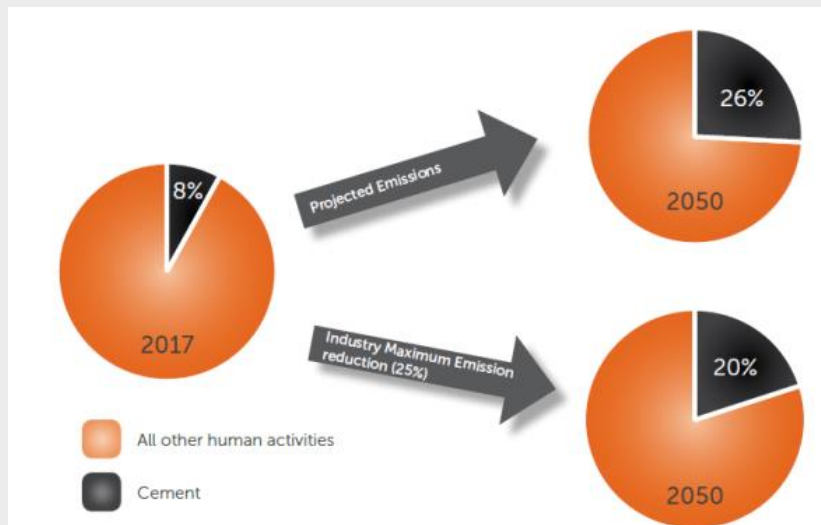
1 tonne of CO₂
emissions generated



Klimaaftrykket af verdens cementproduktion er betydelig – og stigende

- klimaaftrykket fra produktionen skal reduceres

- With current methods of production cement emissions are on course to consume 26% of the world's carbon budget by 2050
- Even if the global cement industry achieves its own reduction targets, cement-related emissions in 2050 will account for 20% of the world's remaining carbon budget.
- This refers to the carbon budget for a 50% chance of limiting warming to 2°C.

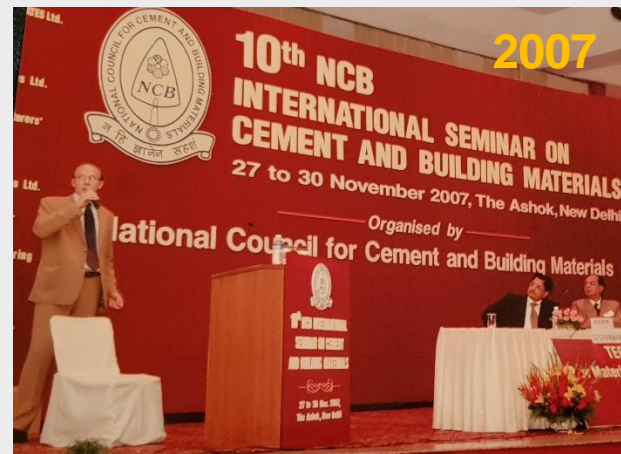
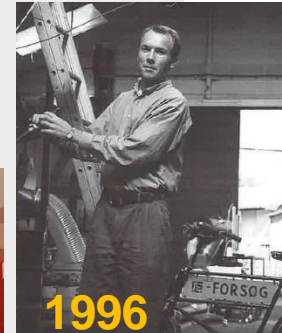


Projected CO₂ emission associated with cement production compared to all other human activity

Source:
**Zero Carbon Industry Plan
Rethinking Cement**
Published in 2017 by:
Beyond Zero Emissions Inc.
Kindness House
Suite 16, Level 1 288
Brunswick Street
Fitzroy, Victoria 3065
Australia
High demand scenario – 5.5
billion tonnes per year

Lidt om mig og min karriere i FLSmidth

- Kemiingeniør 1996
- Erhvervsforsker (Lav-NOx kalcinatorere) 1999
- R&D & emissions specialist 1999-2005
- Leder af Fuel Systems 2005-2007
- Leder af Alternative Fuels 2007-2010
- Leder af Sustainability Development 2011-2013
 - El-generering fra spildvarme (Kalina)
 - Alternative brændsler
 - Supplementary Cementitious Materials
- Leder af Cement Research 2014-2016
- R&D specialist og projektleder 2016-



Oversigt

- Hvad er ProBu projektet?
- Forretningsperspektiver for virksomheder
- Perspektiver for en bedre verden
- Opsummering

Hvad er ProBu projektet?

Formål: ACCELERERE KLIMAVENLIG INDUSTRIPRODUKTION

- Samlet projektbudget: 54 mio.
- Innovationsfondens investering: 20 mio.

- Et forsknings- og udviklingsprojekt til at yderligere **nedbringe CO₂-udledningen** fra to store danske industriområder
- Samarbejde mellem DTU Kemiteknik, FLSmidth og ROCKWOOL-koncernen om at:
 - udvikle **bæredygtige procesteknologier**, der mindsker **udledninger af CO₂ og andre emissioner**
 - øge brugen af **alternative brændsler og råstoffer**
- FLSmidth og ROCKWOOL-koncernen arbejder i forvejen med løbende at reducere klimaaftrykket fra deres produktion, som skal accelereres

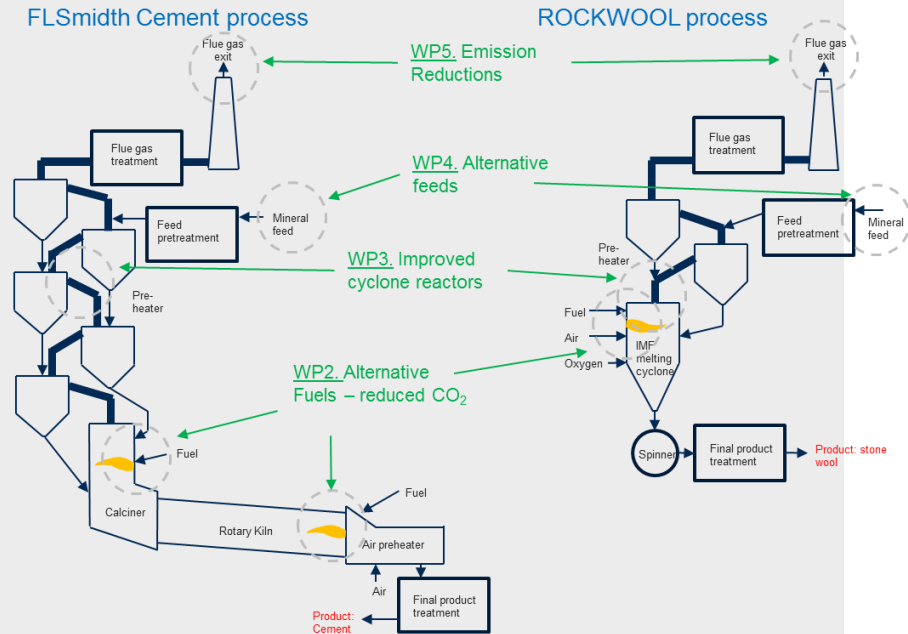


ProBu - Process technology for sustainable building materials production

Okt 2018 – Sept 2023; Budget: 54 mDKK

Et partnership for at løse 4 fælles udfordringer:

- Reduktion of CO₂ fodaftryk – ved brug af alternative brændsel og alternative råmaterialer
- Brug af alternative råmaterialer – cirkulær økonomi ved nyttiggørelse af affald
- Reduktion of SO₂, NO_x, NH₃, CO, TOC, Hg & HCl emissioner
- Forbedrede cyclon reaktorer – for at støtte ovenstående, samt for at reducere CAPEX as well as OPEX cost

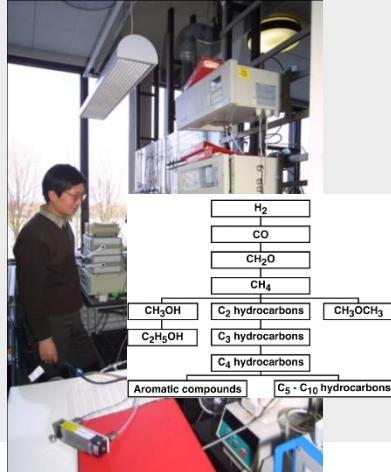


DTU participation: CHEC at Department of Chemical Engineering

Main research subjects: High temperature processes, fundamentals of heterogeneous and homogeneous reactions, emission abatement, high temperature inorganics processes, reactor design, modelling and diagnostics in full scale plants ...

- Combining the company experiences with DTU long standing international level research on high temperature processes contributes to the fundamental understanding needed for further process development

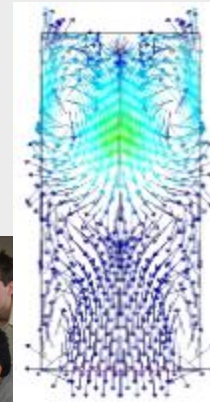
Fundamental studies



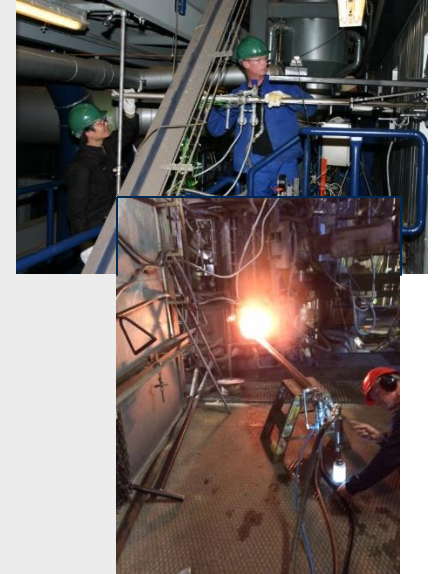
Pilot plant experiments



Modelling

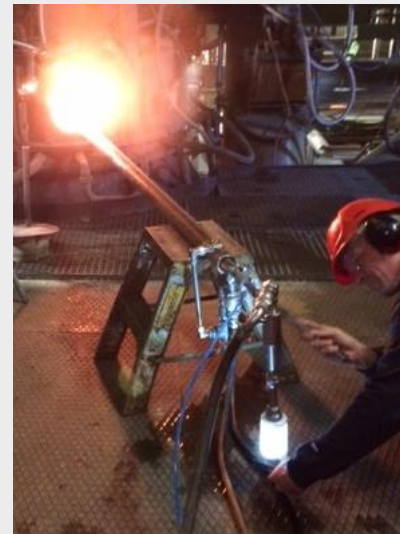


Full scale plant measurements



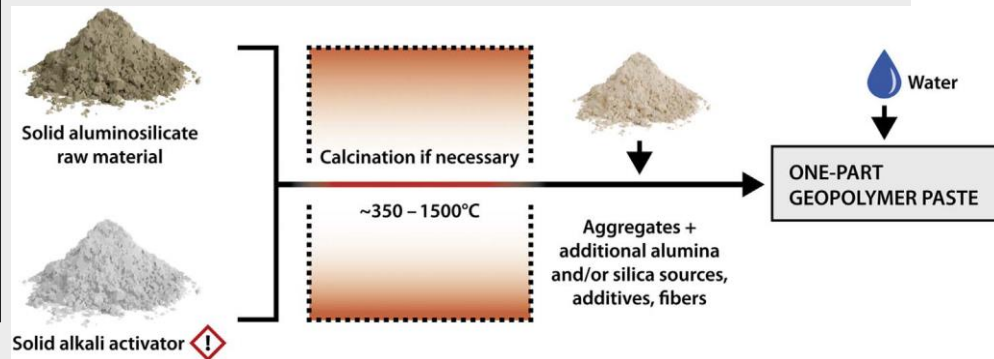
Alternativ brændsel

- Biomasse, fx:
 - Træ
 - Halm
- Affald, fx:
 - Solid Recovered Fuel (SRF)
 - Dried Sewage Sludge (DSS)
- Procesudfordringer
 - Opretholde nødvendig temperatur i processer
 - Indvirkning af brændende partikler i process, fx:
 - $\text{Fe}_2\text{O}_3 + \text{C} \Rightarrow 2\text{FeO} + \text{CO}$
 - $\text{CaSO}_4 + \text{CO} \Rightarrow \text{CaO} + \text{SO}_2 + \text{CO}_2$
 - Håndtering af urenheder; fx Cl



Alternative råmaterialer

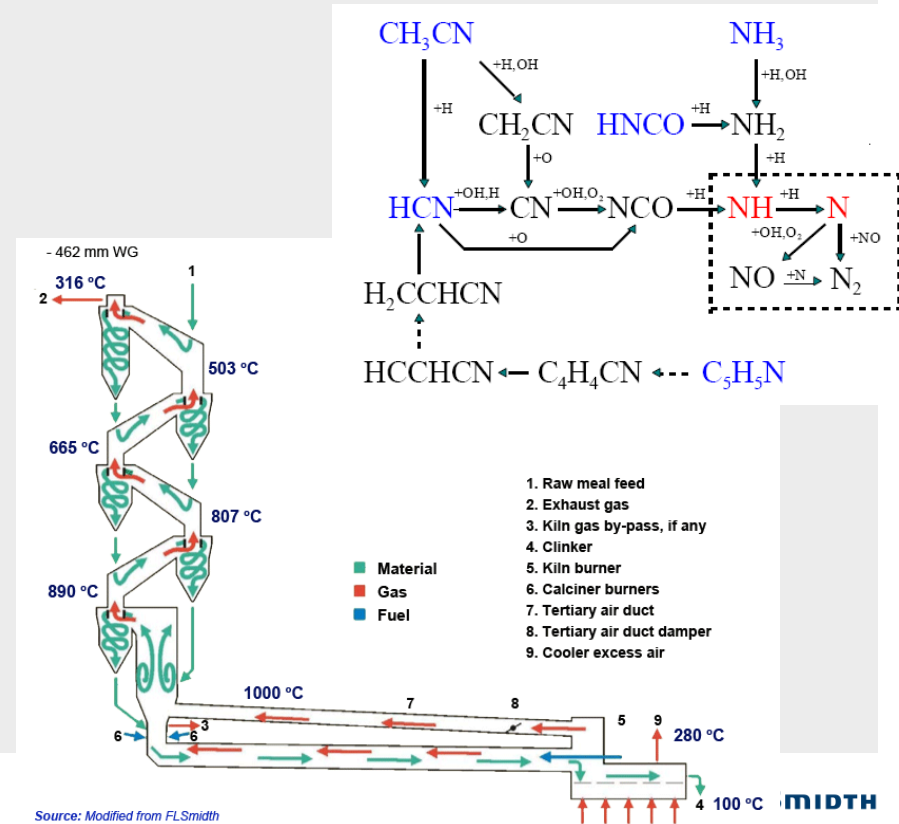
- Brug af restprodukter:
 - Genbrug af byggemateriale
 - Produktionsspild
 - Slagger, flyveaske, mineaffald
- Blended cement
 - Supplementary Cementitious Materials (SCM)
- Alternativer til Portland Cement
 - Geopolymer cement



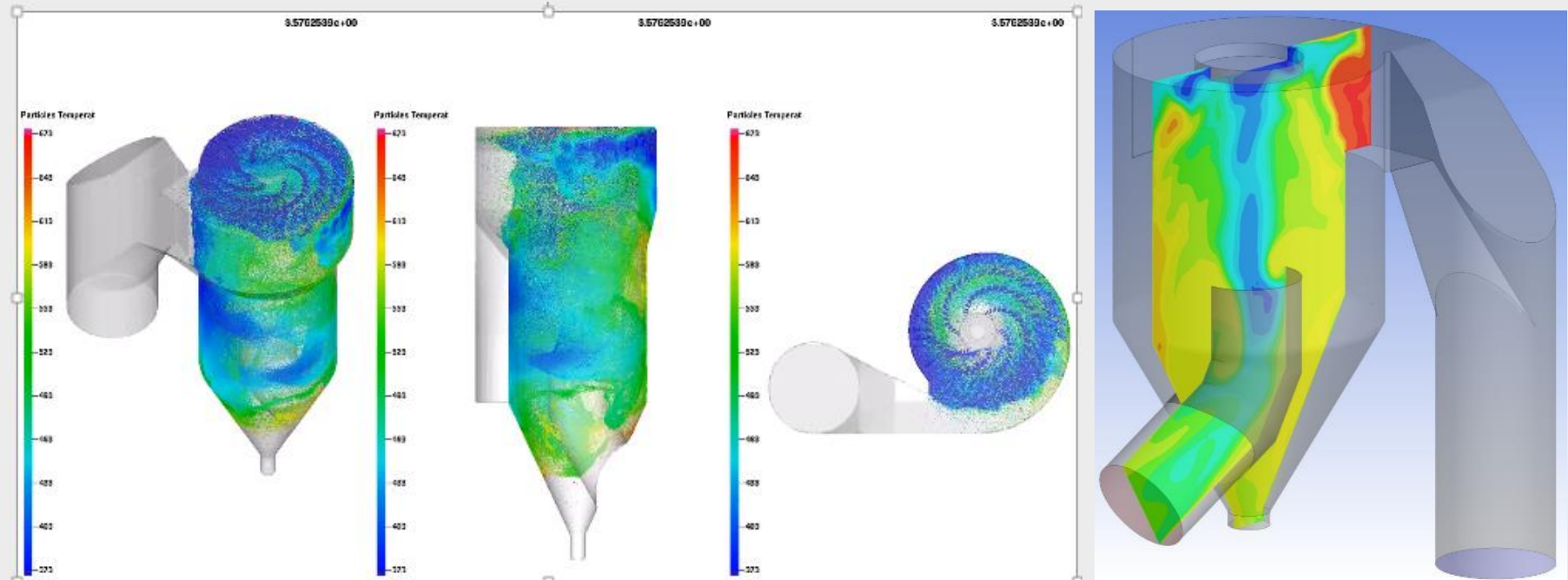
Kontrol af emissioner, der påvirker luftkvalitet (ikke CO₂)

- Dannelse af emissioner:
 - Forbrænding og højtemperatur
 - Frigivelse fra råmaterialer

- Fjernelse af emissioner
 - De-NO_x
 - SNCR
 - Reburning
 - Absorption
 - SO₂, NH₃, Hg
 - Oxidation
 - Kulbrinter (TOC), CO, NH₃



CFD simulering af design og drift



Forretningsperspektiver for virksomheder

ROCKWOOL has made a commitment to drive an increased positive contribution to 10 UN Sustainable Development Goals (SDGs)

Increasing our positive impact

We are increasing our positive impact on people and society by maximising our positive product impact and minimising our operational footprint.

Product impact metric ★ Our sustainability goals

Maximising product impacts



Minimising operational impacts

ROCKWOOL 2030 sustainability goals

CO₂ emissions



Our goal: Reduce CO₂ emission intensity (CO₂/t stone wool) from our stone wool production facilities by 20% by 2030 (10% by 2022)

↓ **20%**
by 2030

Energy efficiency



Our goal: Reduce energy consumption (kWh/m²) within own (non-renovated) offices by 75% in 2030 (35% by 2022)

↓ **75%**
by 2030

Safety, health and wellbeing



Our goal: Reduce Lost Time Incident (LTI) frequency rate by 10% and ensure zero fatalities annually

↓ **10%**
annually

Water consumption



Our goal: Reduce water intensity (m³/t stone wool) within our manufacturing facilities by 20% by 2030 (10% by 2022)

20%
by 2030



Reclaimed waste



Our goal: Increase the number of countries where we offer recycling services for our products to 30 by 2030 (15 by 2022)

5 → 30
by 2030

Landfill waste



Our goal: Reduce landfill waste (tonnes) from our manufacturing facilities by 85% by 2030 (40% by 2022)

85%
by 2030



6 CLEAN WATER
AND SANITATION



7 AFFORDABLE AND
CLEAN ENERGY



12 RESPONSIBLE
CONSUMPTION
AND PRODUCTION



13 CLIMATE
ACTION



We drive success through
sustainable productivity enhancement

Our sustainable ambition for 2030:

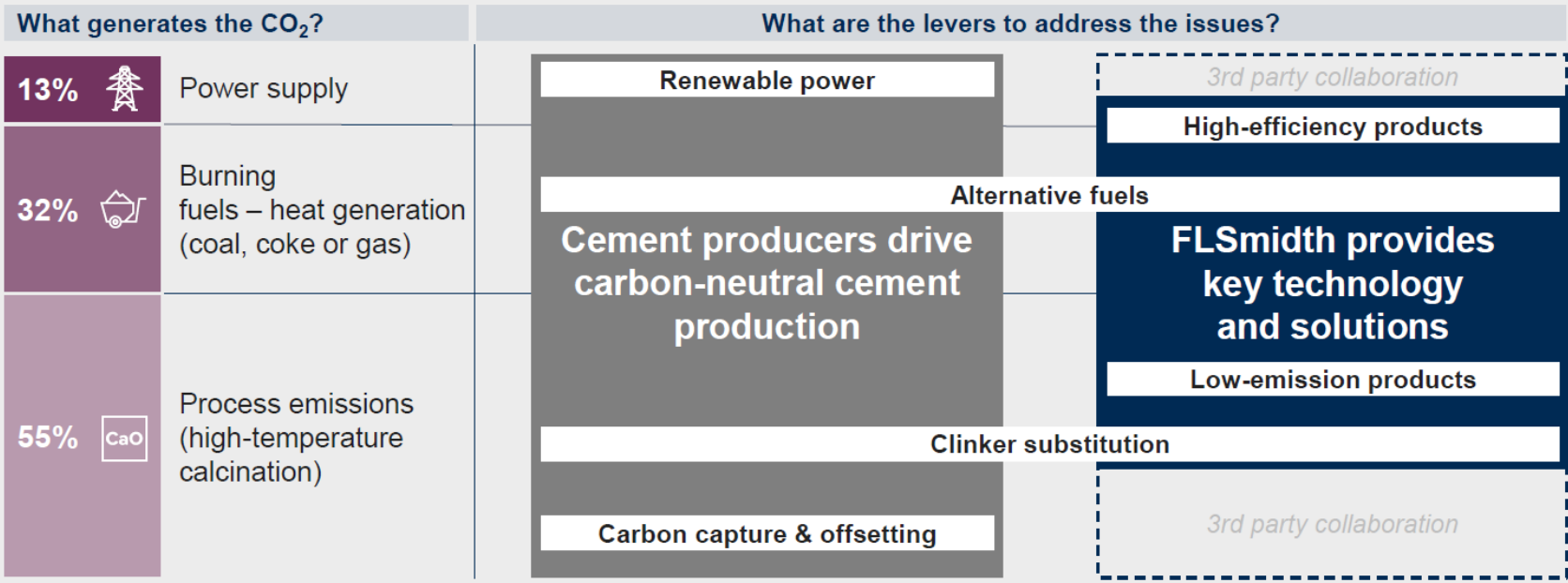
FLSMIDTH

Mission Zero

**Towards zero emissions
in mining and cement**

Our main sustainability ambition in Cement is to enable our customers to become carbon-neutral

How could a cement producer become carbon-neutral?



FLSmidth er godt positioneret til at have global effekt - med syv regioner tæt på kunder

1 NORTH AMERICA



2 SOUTH AMERICA

3 EUROPE, NORTH AFRICA & RUSSIA

5 ASIA

6 SUBCONTINENTAL INDIA

7 AUSTRALIA

4 SUB-SAHARAN AFRICA & MIDDLE EAST

Perspektiver for en bedre verden

Combatting climate change



ROCKWOOL insulation is one of the most cost-effective solutions to cutting building energy use and CO₂ emissions, now and for decades.



Energy efficiency contributes 40 percent of emission reductions in low-carbon scenarios that are designed to achieve the Paris Agreement's ambitions.



Our pioneering Rockflow offers new types of urban water management solutions.



As the effects of climate change increase, communities will need better defences against urban flooding.

Growing the circular economy



Grodan's solutions enable increased yields with less water, land and fertilisers.



As our population grows, we need to feed more people using fewer natural resources.



Our circular business model helps us turn waste into new raw materials and take back and recycle construction site waste and used products.



Embracing circularity minimises resource consumption and waste to landfill.

Safeguarding citizens' wellbeing



Thanks to excellent thermal and acoustic properties, our products support healthier schools, hospitals and other buildings.



In an increasingly urban world, people need comfortable, quiet places to live, learn, work and recover.



Our insulation withstands temperatures greater than 1000°C and can help prevent fire from spreading.



Non-combustible insulation improves building resilience and helps keep people safer indoors.



40% of all carbon emission reductions in low-carbon 2°C scenarios come from energy efficiency.



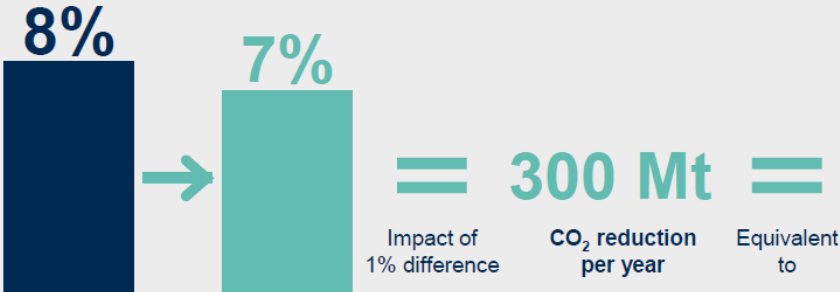
70% – the heating energy savings stone wool insulation can contribute in buildings.



660 million tonnes of carbon could be saved by retrofitting Europe's buildings with stone wool insulation – or twice the annual emissions of France.

Potential environmental and business impact

What if the cement industry would reduce its CO₂ footprint by using FLSmidth equipment and solutions?



Global CO ₂ footprint	
2.6bn t/year	2.3bn t/year
CO ₂ emissions per ton of Cement	
600-700kg	500-600kg

Cement industry share of global CO₂ emissions

DIRECTIONAL



485,000

km² of **forest** could absorb = an area larger than **Germany**



258M

households' annual electricity use powered by fossil fuels



DKK 40m

annual savings on CO₂ spend in a 6,000 tpd cement plant

Opsummering

- ProBu accelerer den grønne omstilling til klimavenlig industriproduktion for FLSmidth og ROCKWOOL i et samarbejde med CHEC DTU Kemiteknik
- Stenulds- og cementproduktion er baseret på energi-intensive højtemperaturprocesser, der processerer mineralske råmaterialer
- ProBu er organiseret i 4 arbejdsopgaver
 - Alternative fuels
 - Improved cyclone reactors
 - Alternative raw material feeds
 - Emission reduction
- Der skabes værdi for:
 - Danmark og danske virksomheder
 - Globalt for en bedre verden