Heidelberg Materials, A Profile in Leadership for Decarbonizing Concrete

Larry Rowland
Heidelberg Materials

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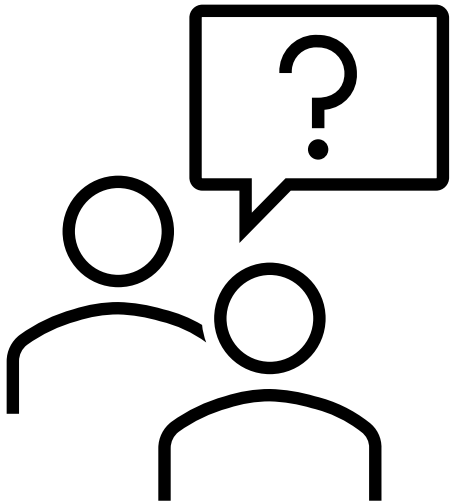
Presentation Notes

- Find presentation slides and post event recording at:
  - https://www.neuconcrete.org/events-and-education
- Attendees are in listen only mode.
- Ask questions via the Q&A dialog box in the zoom platform



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Disclaimer

As with all concrete mixtures, trial batches should be performed to verify concrete properties. Results may vary due to a variety of circumstances, including temperature and mixture components, among other things.

You should consult your materials, cement, and concrete professionals for design assistance. Nothing contained herein shall be considered or construed as a warranty or guarantee, either expressed or implied, including any warranty of fitness for a particular purpose.

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Today's Speaker

Larry Rowland

Sustainability
Market Manager
Heidelberg Materials

Larry Rowland is the Sustainability Market Manager for Heidelberg Materials. He is an accomplished speaker with more than 35-years of experience in the construction and concrete materials industries. Larry recently celebrated his 20th anniversary of being recognized as a LEED® Accredited Professional. He regularly consults on sustainable solutions with Owners, Architects, Engineers, Students, and Green Building Practitioners with a special focus on the topic of low carbon concrete.

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Heidelberg Materials, A Profile in Leadership for Decarbonizing Concrete

NEU Member Profile

5/30/2024

Heidelberg Materials

Agenda – A Profile in Leadership

1. **Why Decarbonize Concrete**
2. **What the Cement and Concrete Industry is Doing**
3. **How Heidelberg Materials is Raising the Bar**
4. **Applying Decarbonization Technology**
   - Carbon Capture Utilization and Storage
   - World's 1st Net Zero Cement, Without Offsets
5. **SCMs Today's Most Powerful Tools**
   - Coal Ash Reclaimed, Reborn, and Ready
   - What Makes Slag Cement Great
6. **Questions and Answers**

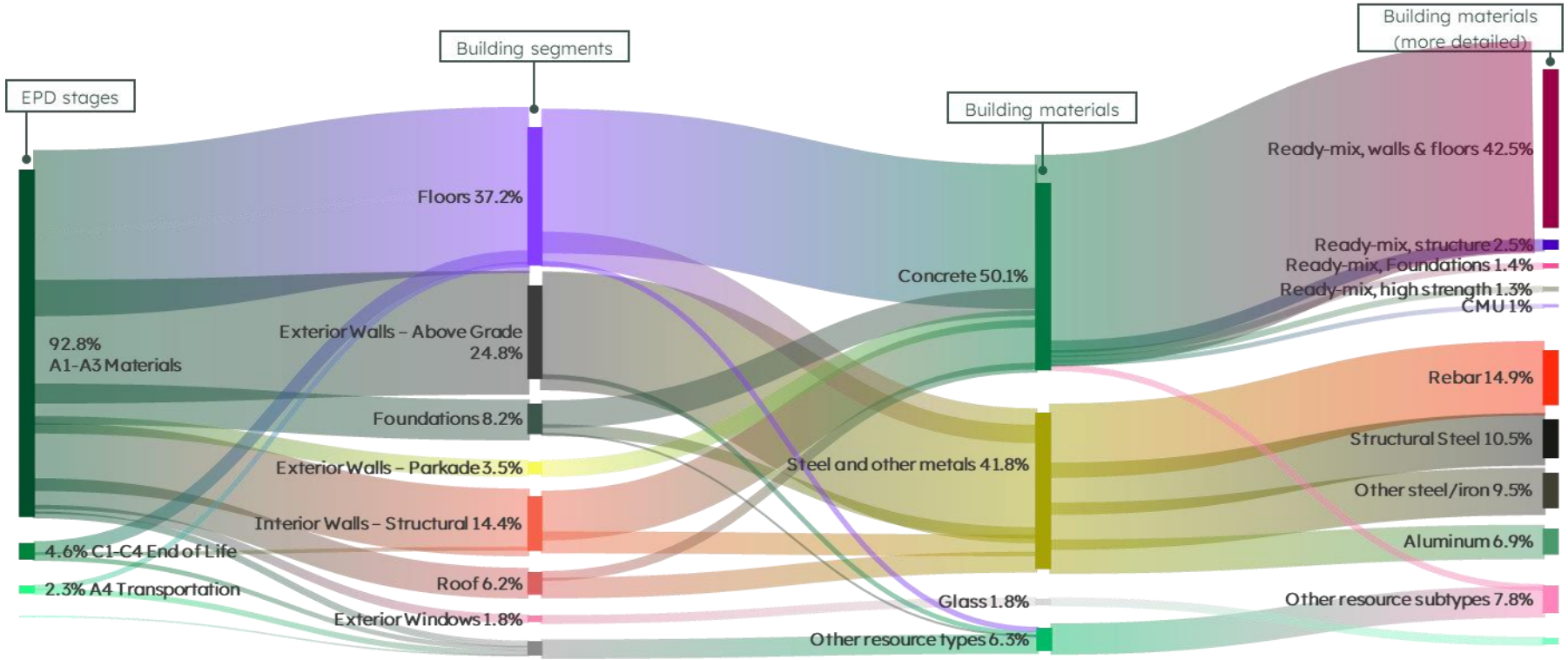
Concrete accounts for more than 50% of everything we make[1]

Most widely produced solid material on earth

- Concrete delivers…
  - Economy
  - Strength
  - Durability & Resilience
  - Versatility
- Because concrete is practically synonymous the term construction it….
  - Is responsible for 7% – 8% of global manmade CO2 emissions
  - It can be argued this is a relatively small CO2 investment for more than 50% of the stuff we make but, we are working to lower these #s

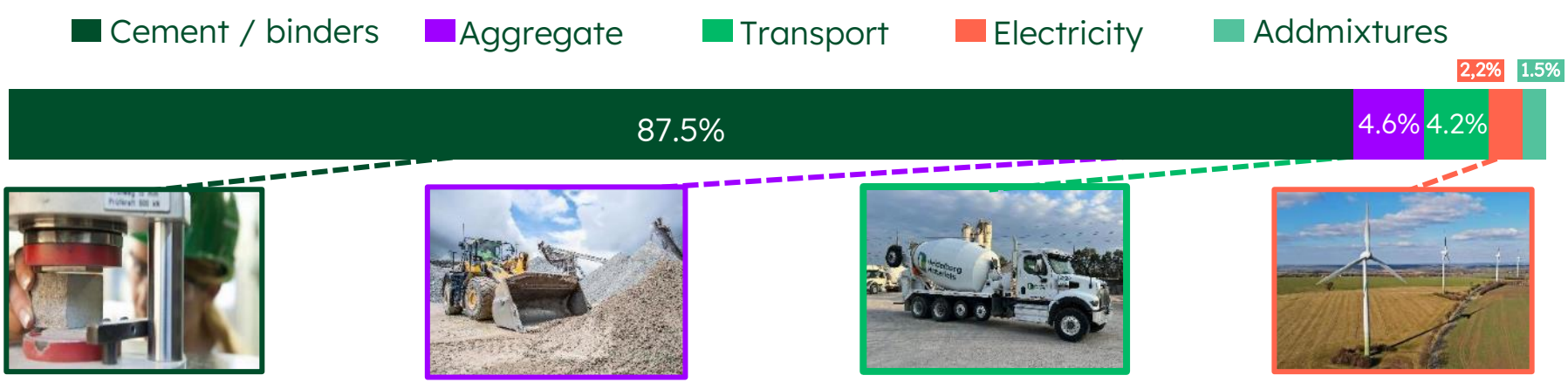
[1]Rencontre du Conseil d'Etat avec la Présidence de l'EPFL EPFL Fribourg, https://www.concrete.org/portals/0/files/pdf/webinars/ws_S23_KarenScrivener.pdf

~ 50% embodied carbon (CO_2) in a “Typical” building is from concrete



Source: Embodied Carbon: Key Considerations for Key Materials, A. Pak, Nov. 1, 2020 Canadian Architect

CO2 during ready-mixed concrete production



- Process technology in cement
- Alternative binding agents
- Implementation in concrete by utilising flexible concrete technology mean

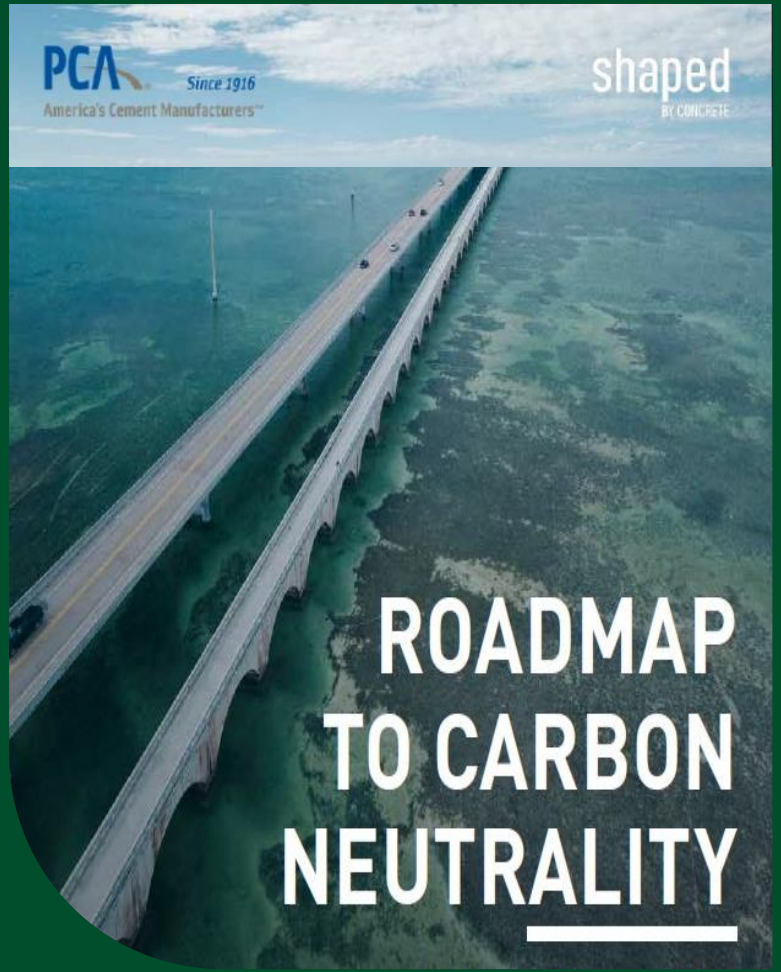
- Local, low energy and low GWP building materials are a central.
- An uncounted CO2 success factor

- Efficient logistics
- Utilising state-of-the-art drive units
- Openness for new technologies

- Optimize production to save power
- Renewable energy is a usable benefit today

CO_2 in concrete is more than just cement

The Cement and Concrete industries are responding



PCA's Road Map to Carbon Neutrality

Ambitious comprehensive plan by the Cement Industry

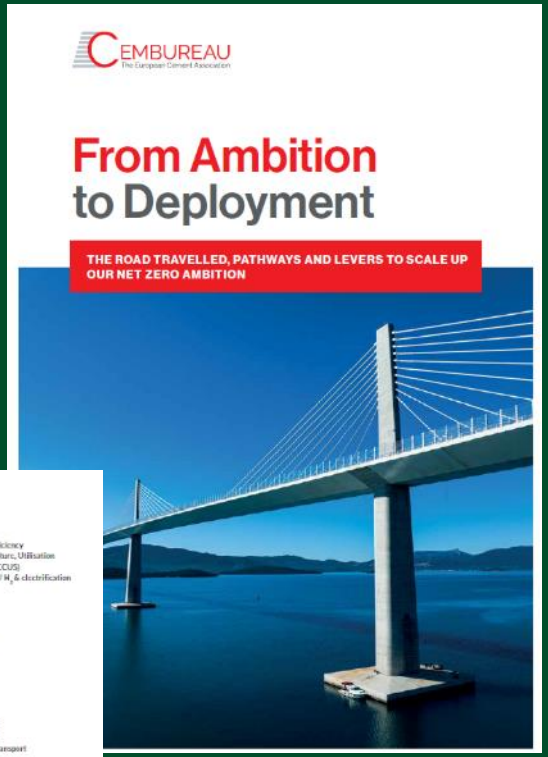
- Five key links in concrete value chain
  - Clinker – reduce A3 emissions from cement plant
  - Cement – reduce clinker factor and use SCMs
  - Concrete – optimize mixes & production
  - Construction – reduce over design w/performance specs.
  - Carbonation – account for it and encourage options

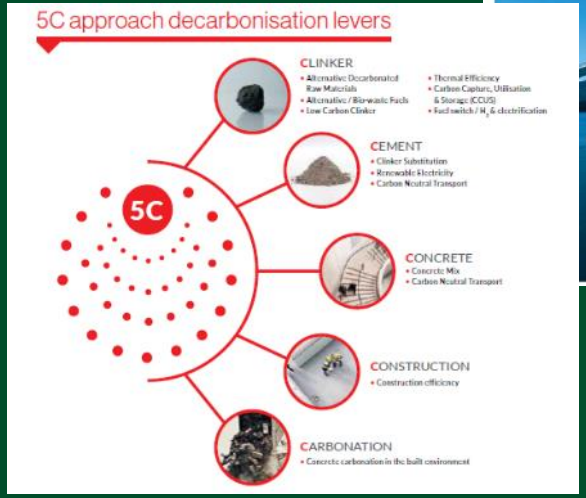
CEMBUREAU, the European Cement Association

5-year update to its Carbon Neutrality Roadmap

Same five key levers to decarbonization

1. Clinker – CCUS is largest pathway
2. Cement – lower clinker factor
3. Concrete – improved mix design
4. Construction – stresses circularity
5. Carbonation – enhance via recycling





The industry is responding

Ribbon cutting June 2023,– Mitchell, IN
Second largest cement plant in North America

Companies such as Heidelberg Materials are responding

- At the Cement Plant for Clinker & Cement
  - Alternative fuels and process efficiencies
  - Increase use of Blended Cements i.e. PLC
  - Carbon Capture, Utilization, and Storage (CCUS) technology
- In Concrete
  - Supplementary Cementitious Materials
  - Digital solutions driven by AI
- Collaborative Construction to drive Resilience & Whole Building LCA
- Carbonation, consensus-based accounting for natural sequestration

Heidelberg Materials is one of the world's largest building materials companies …

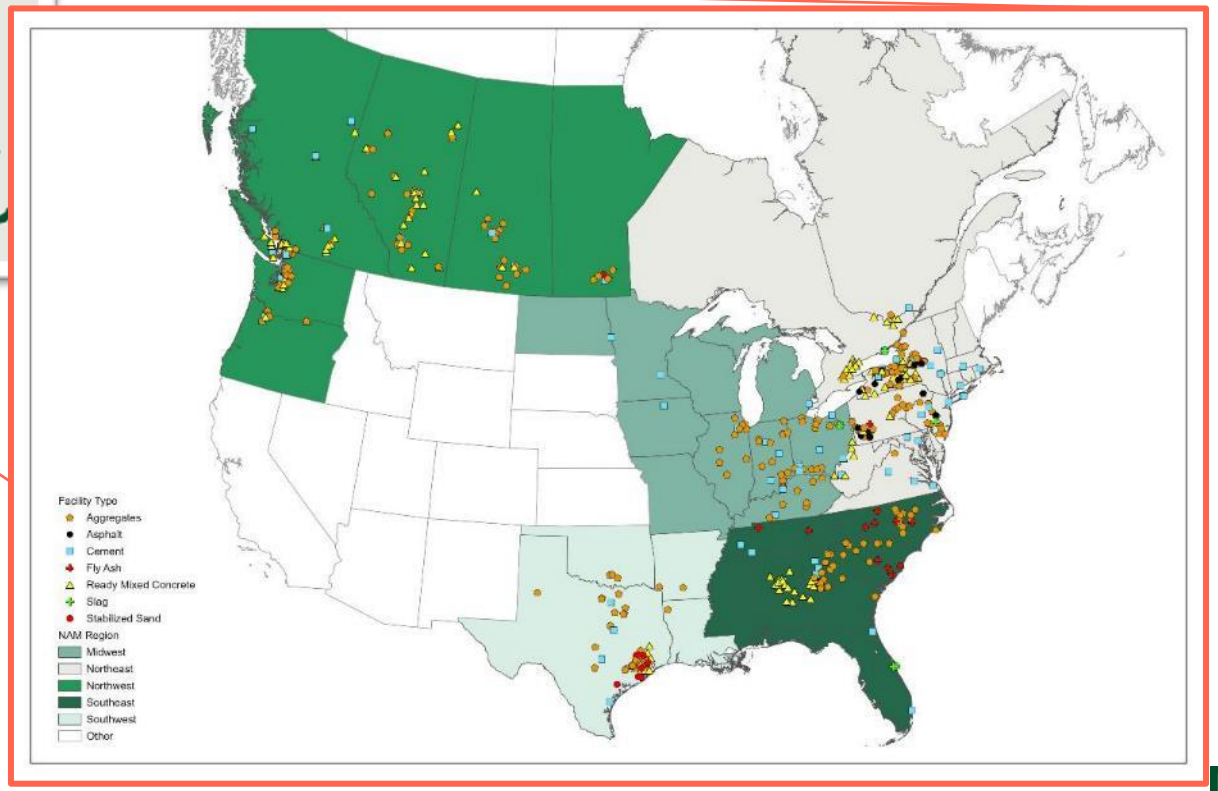
51,000
employees
on five continents

3,000
locations
worldwide

Leading positions in
cement, aggregates and
ready-mixed concrete

1st
large scale CCS cement
plant in the world

Well-positioned in North America in key markets with diverse materials



Heidelberg Materials

In North America

- ~ 8,500 Employees
- 450 locations

Heidelberg Materials Sustainability Commitments 2030

Net Zero: We drive the decarbonization of our sector and provide low-carbon products

Safe & Inclusive: We place the health and wellbeing of employees, communities, and suppliers at the core of our business operations

Nature Positive: We contribute to a nature positive world through our industry-leading biodiversity program and sustainable water management

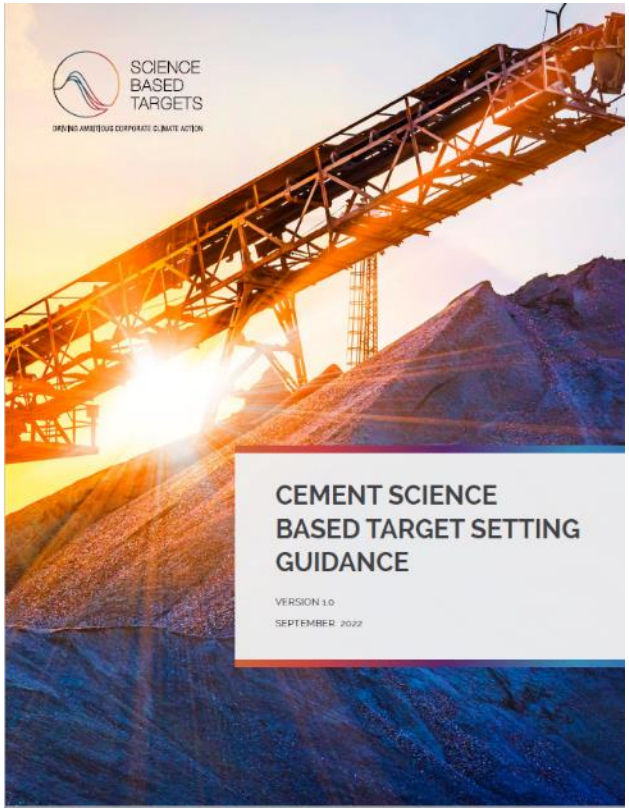
Circular & Resilient: We drive circularity to reduce and reuse materials and natural resources

Aligned with global initiatives to reduce Global Warming

As a corporate citizen we…

- Have a global perspective and take the Paris Climate Agreements seriously, to limit Global Warming to 1.5°C
- Have verified Science Based Targets and are on a pathway to be Net Zero by 2050

> “ The Science Based Targets initiative defines and promotes best practice in science-based target setting, offers resources and guidance to reduce barriers to adoption, and independently assesses and approves companies’ targets. It also provides a framework for companies to set greenhouse gas (GHG) emissions reduction targets based on the latest available science.



Raising the bar by lowering environmental impacts and carbon emissions

10mt

cumulative CO_2 reduction through CCUS by 2030

400kg CO_2/t cementitious material as average across the whole portfolio in 2030[1]

47% emission reduction[2] across the cementitious materials portfolio by 2030

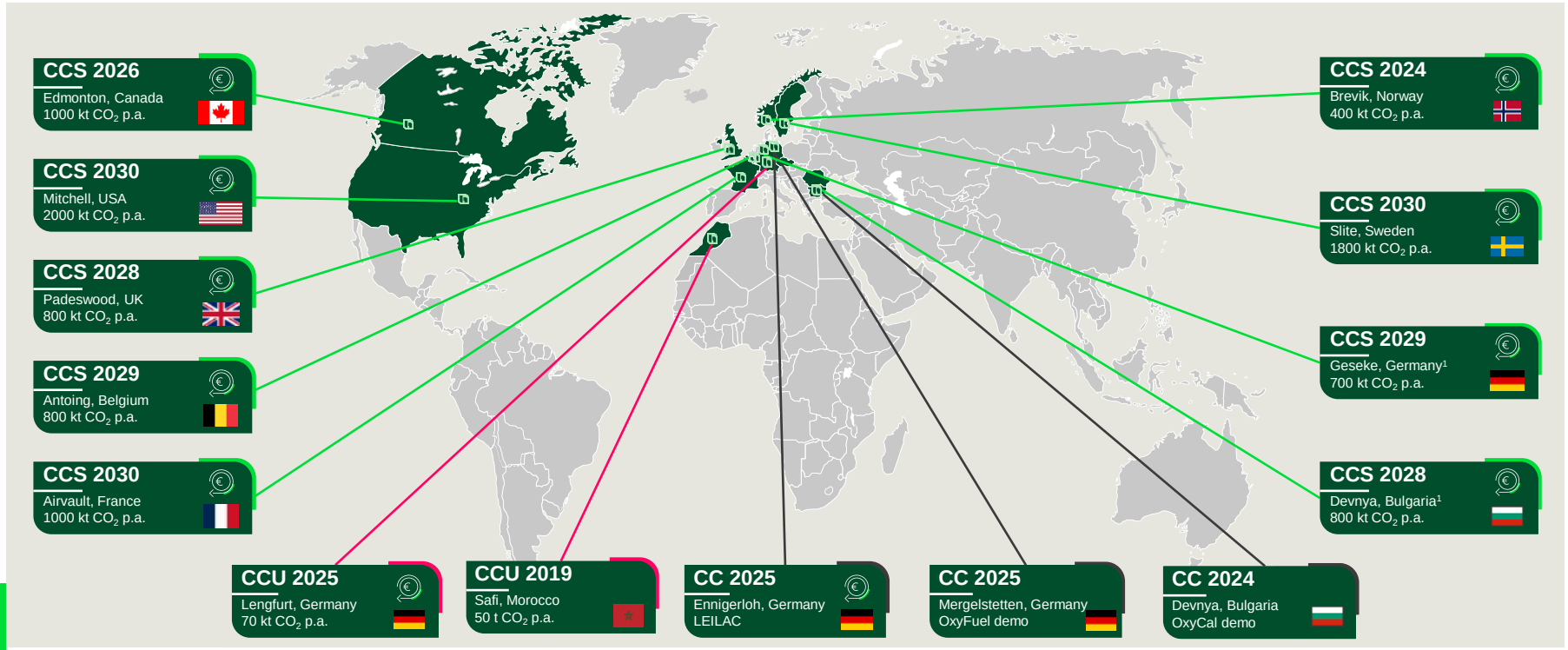
50% of our revenue will be generated from sustainable products by 2030

Corporate carbon footprint reduction in line with SBTi 1.5°C path by 2030

[1] Scope 1, 2 acc. to GCCA;

[2] Reference year 1990 with an average of 750 kg CO2/t of cementitious material

The published CCUS portfolio is only the tip of the iceberg

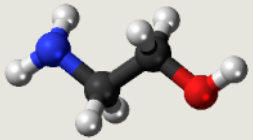
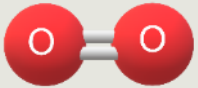


We will capture 10 Mt CO_2 cumulatively and invest 1.5b€ by 2030

Subsidies required

1 - EU funded projects

We continuously explore and invest in capture technologies

	Amine technology	Oxyfuel based technology[1]	Cryogenic technology	Other new capture technologies
				• **Leilac-2** • Membrane • MOF[2] • Potassium
Maturity				
Energy use				
Cost efficiency				

- **Diversified portfolio approach, to mature different technologies**
- **Intelligent combination of different technologies**

1 - Combination with other technology necessary
2 - Metal-organic framework

Carbon Capture and Storage

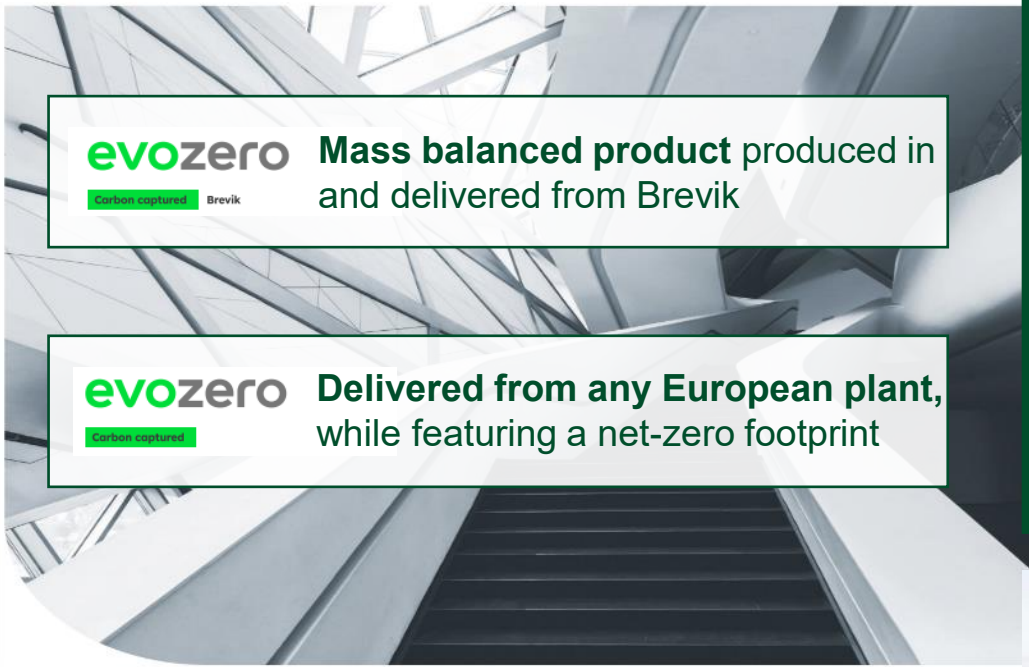
Brevik, Norway

- Worlds 1st Industrial Scale CCS plant
- Operational in 2024
- 400,000 tons/year ~ 50% of total

evoZero Cement

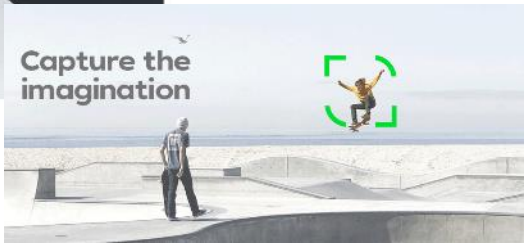
- For the European market

Introducing evoZero® products – world's first carbon captured net-zero cement



evoZero®

- CCS Brevik **world-first site** to capture carbon emissions from clinker production at industrial scale
- Net-zero attribution is based on **book-and-claim,** backed by block-chain technology
- **Uniqueness**: Regular cement with regular strength without CO2



Edmonton's Net Zero Future

1 million

mt CO_2 p.a.

via Carbon Capture Utilization and Storage

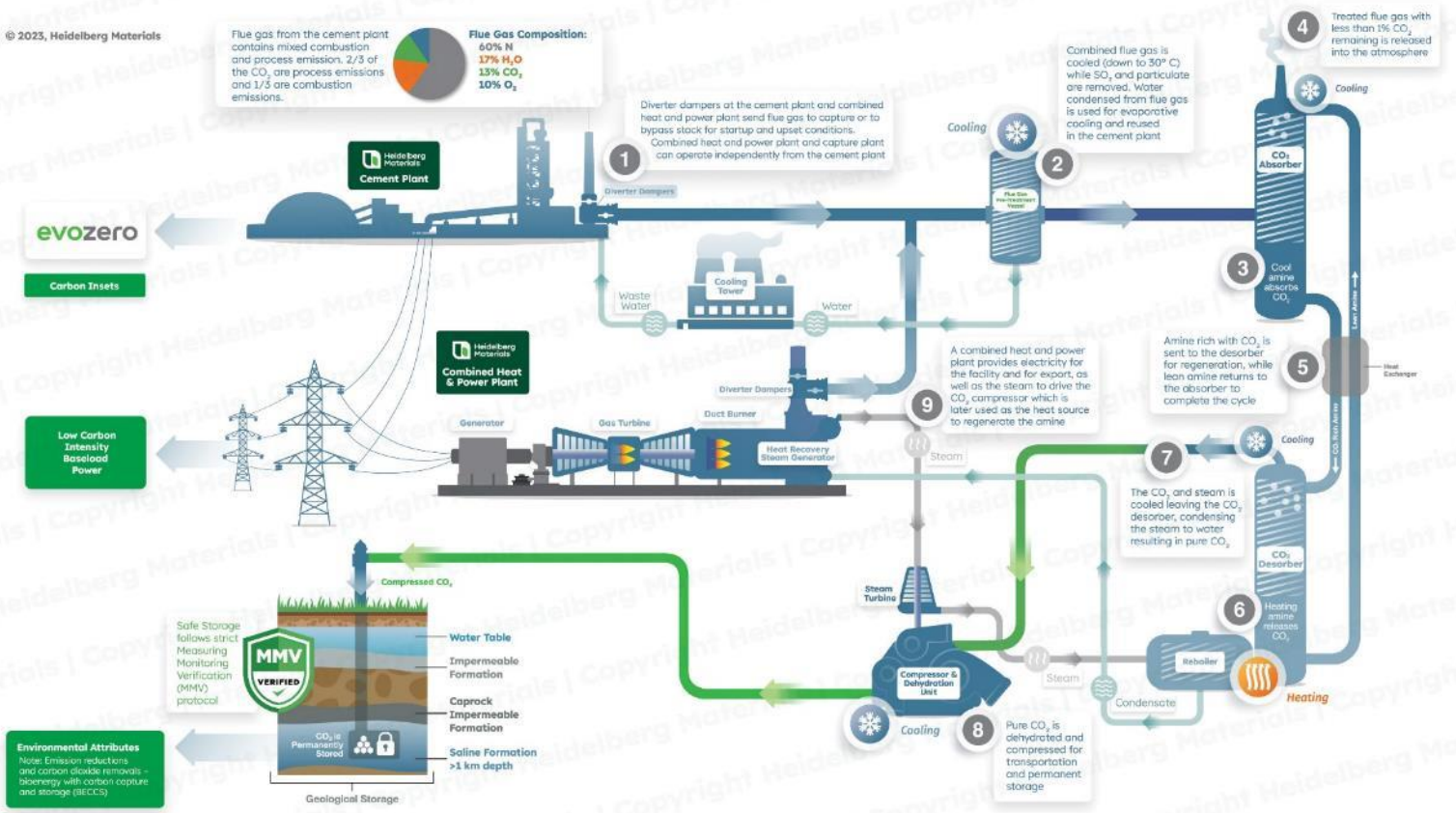
Scope: Amine-based CO_2 removal system & Combined Heat & Power Plant

Status: Feasibility study complete and project preparation on track (Commissioning: 2026)

Objective: The world's first full-scale carbon neutral cement plant

Rendering Edmonton, Alberta

Heidelberg Materials Edmonton Cement CCUS, Combined Heat & Power Plant



Secure Carbon Capture and Storage in action

Measured, Monitored and Verified (MMV) Storage

- CO_2 to be stored in deep saline reservoirs
  - Permanent storage 1,500-3,000 meters below ground in porous rock filled with brine with multiple overlying layers of impermeable cap-rock
  - Far below potable water and oil and gas reservoirs
  - Current global storage capacity 40 million tons/yr.
- Examples of CO_2 Storage
  - Alberta – Shell's Quest project has permanently stored over 6 million tons of CO2 since 2015
  - Saskatchewan – Aquistore project permanently stored 500,000+ tons of CO_2 annually since 2015
  - Illinois – Decatur project permanently stored over 1 million tons from 2011 to 2014

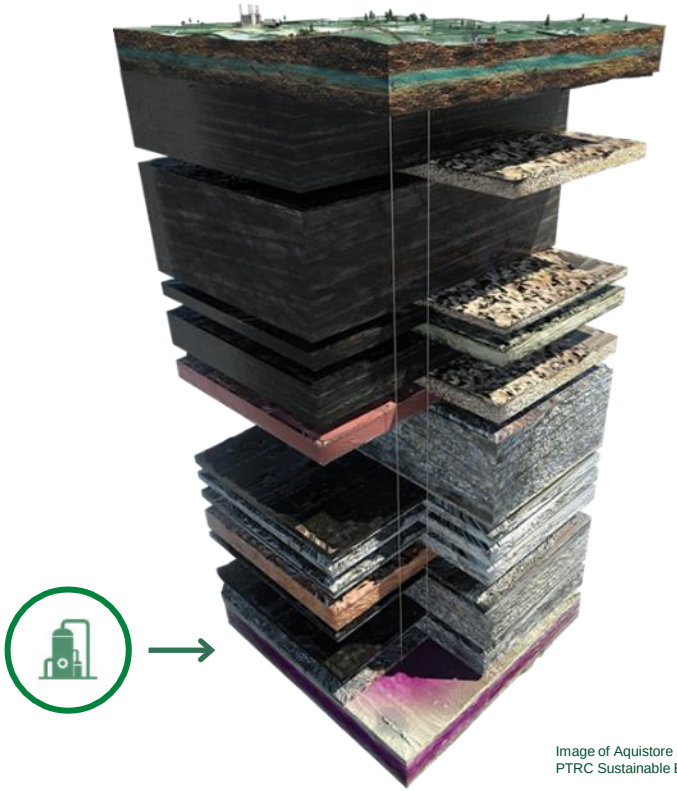


Image of Aquistore site courtesy PTRC Sustainable Energy

Mitchell K4 - One of the most technologically and sustainable cement plants ever built

Carbon Capture Utilization and Storage - by 2030

2 million

mt CO_2 p.a.

via Carbon Capture Utilization and Storage

Systems: The new plant has three-times more capacity, added new equipment and many efficiencies with latest technologies. Use Natural Gas and alternative fuels when permitted

Products: The Kiln 4 project came online in mid 2023 to produce primarily EcoCemPLC and Masonry Cement (both lower carbon products)

Status: Feasibility study for capture and onsite storage; three DOE grant awards with goal of first full-scale carbon neutral cement plant in the US

Next Steps to transform the industry together!

Capture technologies need to be further developed to gain maturity and increase resource efficiency.

We need Class VI well and pipeline infrastructure to accelerate CCS and CCUS deployment.

Investment and funding remains key to support the deployment of this key decarbonization technology.

Evolve™ family of low carbon building materials in North America

OPC / Portland

~ 94% Clinker ≤ 5% Limestone

PLC Type IL / GUL

~ 82% Clinker ≤ 15% Limestone

Blended Cements
Type IT (P20)(L10)

~ 67% Clinker ~ 20% SCMS + 10% Limestone

Innovative Products

Low Carbon Cements for Concrete Mixes

Clinker reduction

- Key strategy for reducing embodied CO_2 aka GWP
- Performance Specifications enable their use
- Significant reduction potential depending on available materials and type of application

ASTM C595 / AASHTO M 240 / CSA A3001

- Portland Limestone Cement allows up to 15% limestone
- Binary & Ternary Blended Cements… i. e. IT(P20)(L10)

European Cement Standard is EN 197

- 27 Products in the “family” of common cements

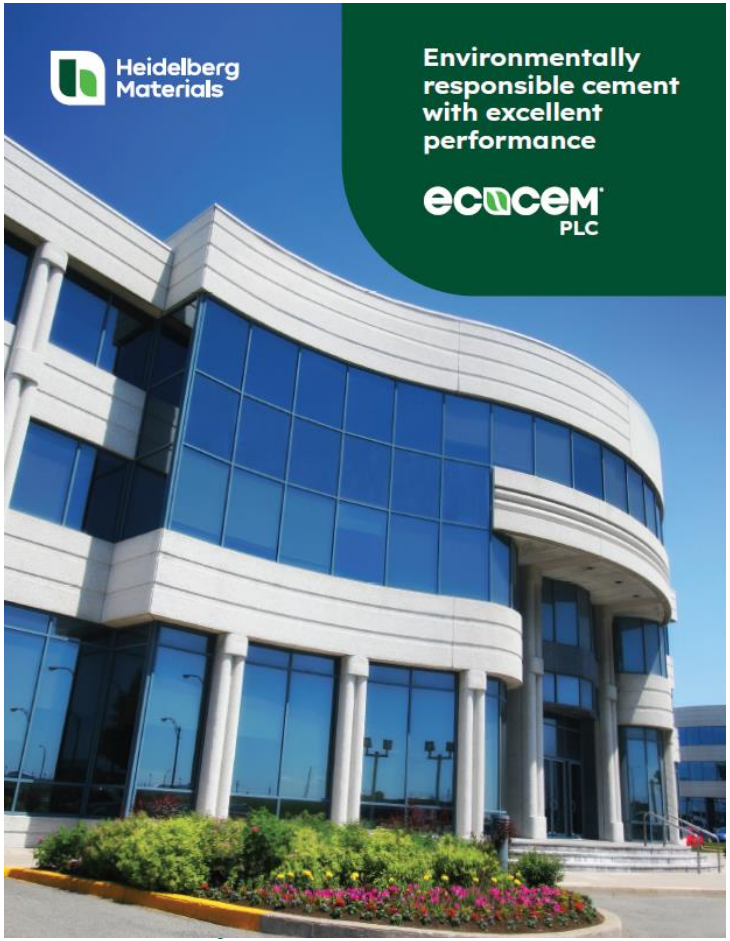
Cement's carbon footprint

2/3 of CO2 from heating limestone

- Calcining limestone releases CO2 from CaCO3
    - Heat + CaCO3 → CaO + CO2

1/3 of CO2 from everything else

- Fuel for pyroprocessing
- Grinding via finish mill
- Raw materials extraction, transport and prep.
- Misc. energy & process emissions



Expertise in Blended Cements

Rigorous internal test & field trials starting years prior to wide-spread distribution…

- Reliance on field trails, comparative data with OPC and IL from four MW plants in standard concrete mix design for…
  - Plastic and hardened testing: Slump, air, bleed rate, set time, mix consistency
  - Compressive & flexural strength
  - Shrinkage
  - Slump loss
  - Durability
  - Admixture and SCM compatibility
  - Finishability

TX Active® Photocatalytic Cement – concrete that reduces smog

Reduces NOx and is self-cleaning

TX Active's photocatalytic properties help protect the environment by abating noxious substances produced by activities such as industry, transportation and residential heating systems. It can be used anywhere cement-based products are used, including

TX Active®

Science-Based Approach to Lower the Embodied Carbon of Concrete

Decarbonizing concrete today

Low Carbon Concrete via

- Choose Cement for Low Clinker Content
- Optimize Aggregate gradations
- Supplementary Cementitious Materials
- Dial in Admixtures
- Utilize digital and AI enabled tools

Collaborative Construction & Design

- Schedule for extended strength gain
- Consult suppliers and all stakeholders

Advanced mix design optimization through chemical and materials engineering

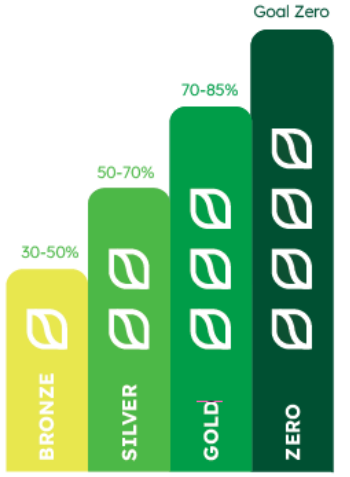
Target concrete performance

Maximize aggregate grading & SCMs

Optimized for carbon reductions

EvoBuild™ Low Carbon Concrete

Dial up the green, Dial down the CO_2



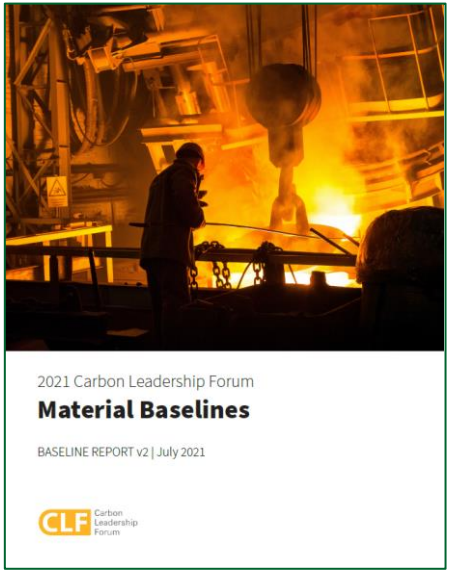
The EvoBuild™ Range: reducing the carbon footprint of concrete

EVOBUILD™ LOW CARBON CONCRETE BRONZE

EVOBUILD™ LOW CARBON CONCRETE SILVER

EVOBUILD™ LOW CARBON CONCRETE GOLD

EVOBUILD™ LOW CARBON CONCRETE ZERO



- **EvoBuild Bronze (30-50%),**
- **Silver (50-70%)**
- **Gold (70-85%)**

Savings levels are measured against 2021 CLF Materials Baselines for Concrete (Typical Values)

Dial up the Green. Dial down the CO_2 with EvoBuild™

* vs. GWP (kg CO_2 eq./m^3) Benchmark: 2021 Carbon Leadership Forum Materials Baseline

EvoBuild™ in the USA

Strength (PSI)	Global Warming Potential, Industry Benchmark* (kg CO_2 eq per cubic meter)	EVOBUILD™ LOW CARBON CONCRETE BRONZE Reduction Percentage 30 – 50%	EVOBUILD™ LOW CARBON CONCRETE SILVER Reduction Percentage 50 – 70%	EVOBUILD™ LOW CARBON CONCRETE GOLD Reduction Percentage 70 – 85%	EVOBUILD™ LOW CARBON CONCRETE ZERO
3000	291	203.7 – 145.5	145.4 – 87.3	87.2 – 43.7	Consult your sales rep on how you can participate in getting to zero
4000	343	240.1 – 171.5	171.4 – 102.9	102.8 – 51.5	
5000	406	284.2 – 203.0	202.9 – 121.8	121.7 – 60.9	

Supplementary Cementitious Materials are key to lower carbon mixes

Supplementary Cementitious Materials

- Defined by ACI Concrete Terminology ACI CT-23

  > “Supplementary cementitious material - inorganic material such as fly ash, silica fume, metakaolin, or slag cement that reacts pozzolanically or hydraulically”

- Combined in concrete mixes in conjunction with and to replace some of the Portland Limestone or Portland Cement binder
- Slag and Coal Ash aka “Fly Ash” are most used SCMs in North America

SCMs reduce emissions by replacing cement and can improve concrete

Many are byproducts or waste from other industries…

- “Slag” Ground Granulated Blast Furnace Slag Cement
- Coal Ash, includes Fly Ash, Harvested, & Bottom Ash
- North America assigns these zero CO_2 cradle to gate
    - LCA module A1 of zero/near zero GWP big plus
    - CO_2 burden comes & transportation & processing
- Can improve mixes:
    - Make them stronger
    - Make them less permeable
    - Make them less susceptible to ASR & chemical attack

Adapting our business to build a Net Zero future

We are increasing our abilities as Slag Cement supplier

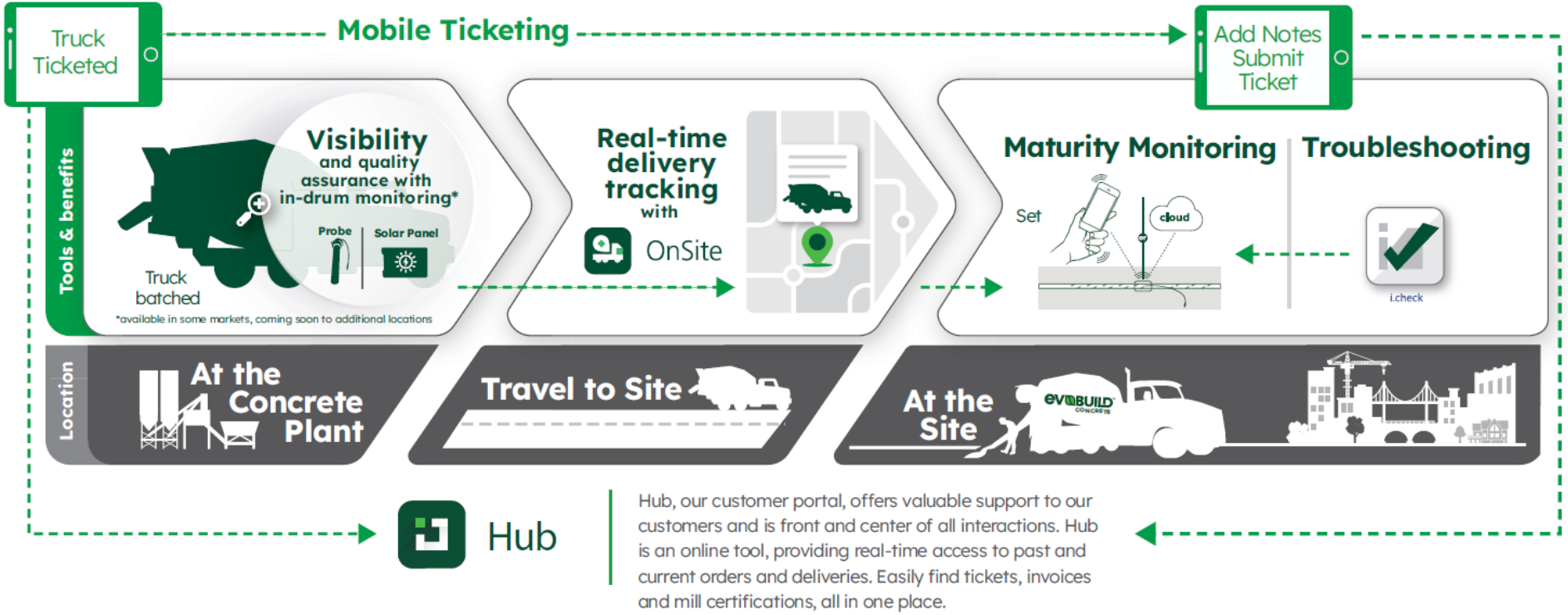
- Slag is byproduct of iron produced in blast furnace
- Slag contains calcium, alumina and silica is hydraulic
- Granulation of the molten slag by quenching is critical
- **Air cooled** slag will crystallize and become non-reactive and is only suitable for use as aggregate
- Globally many blast furnace operations would benefit from installing granulators to produce slag cement
- Requires significant capital investment & steady market
- Typical doses start at ~ 40% replacement

Adapting our business to build a Net Zero future

Securing fly ash supply to further reduce our CO2 footprint

- Acquired SEFA Group in 2023, has 47-years of success in fly ash market
- STAR Technology is proprietary thermal beneficiation process to reclaim ash
  - Produces consistent low-carbon ash
  - Provides access to Coal Ash landfilled as waste representing 1+ billion-ton resource
  - Extends available ash resources by 40+ years

Bringing delivery & material transparency to concrete construction



Digital solutions enhance quality control/assurance and construction schedule

In-truck monitoring

- Load data can aid in evaluating and optimizing mix designs, reducing overdesign while ensuring project specifications are met.
- Waste is reduced, rejected loads are minimized.
- Save time adjusting loads

Powered by Comand Alkon: Real-time quality assurance methods with in-drum monitors
Capture visibility into exactly what's going on inside the drum of your ready mix truck. Be in the know all the way to the job site on:

- Slump
- Temperature
- W/C Ratio
- Water Added
- Drum Speed
- Volume

Command Alkon

Maturity Monitoring

- Provides highly accurate, nondestructive method to measure the strength of concrete; easy to re-verify and reduced human error
- No need to wait on break tests to move on to next project/construction stages
- Added confidence and performance assurance when using with EvoBuild low carbon concrete.
- In-Situ readings inform concrete mix selections as part of a feedback loop in real-time, allowing for deeper levels of carbon savings to be realized

The bottom line: save time, money and skip the headaches with results you can rely on

- Reduced construction time
- Reduced cost
- Reduced project risk
- Improved transparency
- Easy-to-access repository of project information

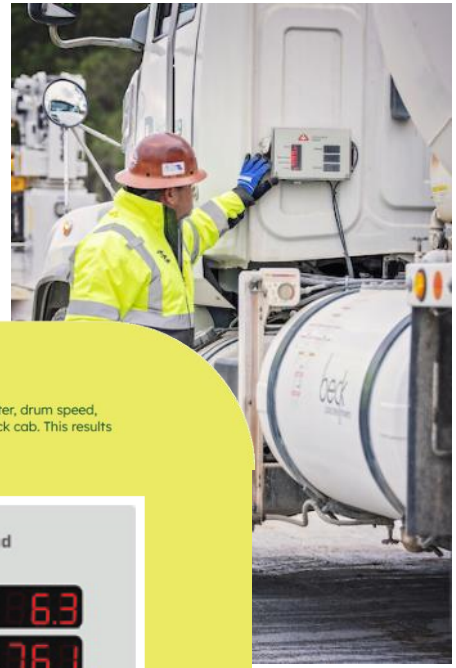
Powered by Giatec SmartRock: Digital maturity concrete sensors can capture the required data inputs in real-time, and thus determine the strength of concrete in place based on mix calibration data.

Travel to Site

Benefits of In-Truck Monitoring – improved QA/QC

In truck monitoring utilizes cloud-based, sensor technology to provide visibility to mix properties and performance as changes occur in transit. Benefits include:

- Data displays and notifications enable users to determine when the load is fully mixed, when it is ready for discharge, and verify the concrete meets specifications -- saving time and hourly rates of on-site finishers, operators, and other site personnel
- Confirm volume of pour and materials ordered
- Measure and track how much water is added (better manage the performance of pumpers, placers, and finishers, and provides greater transparency and accountability in the concrete delivery process)
- Improved communication across project stakeholder groups

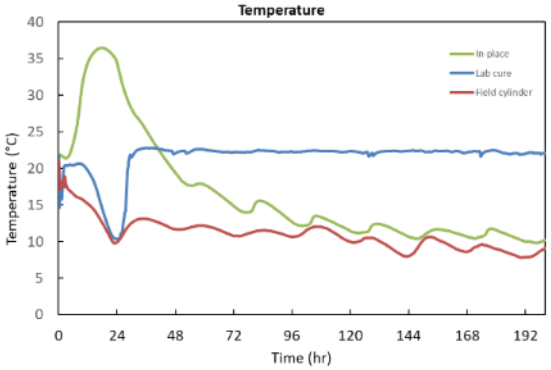


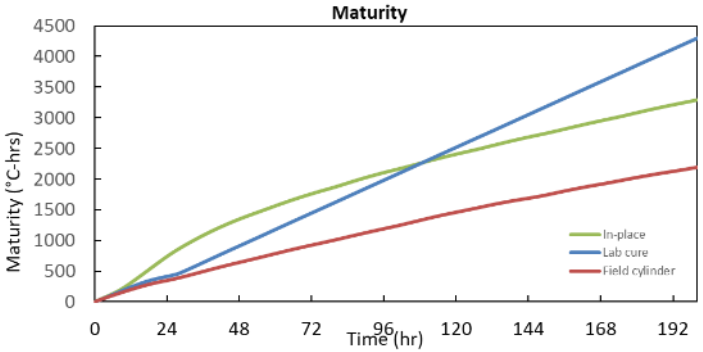
Clear insights to make informed decisions

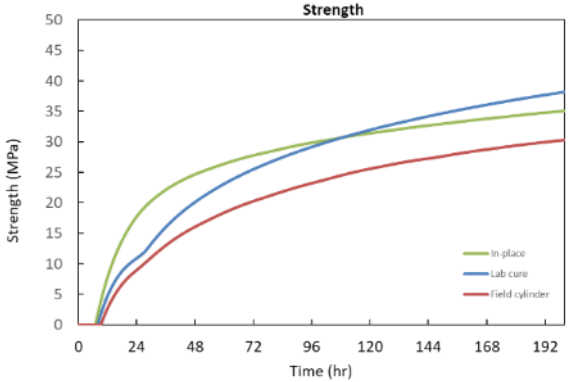
All loads will display slump, temperature, volume, water, drum speed, and pressure on a real-time display board on the truck cab. This results in time saved and quality assured.

Command Alkon

Strength development measurements across testing methods







Field-cured specimens

Does not represent the actual concrete in-situ (smaller volume and different temperature)

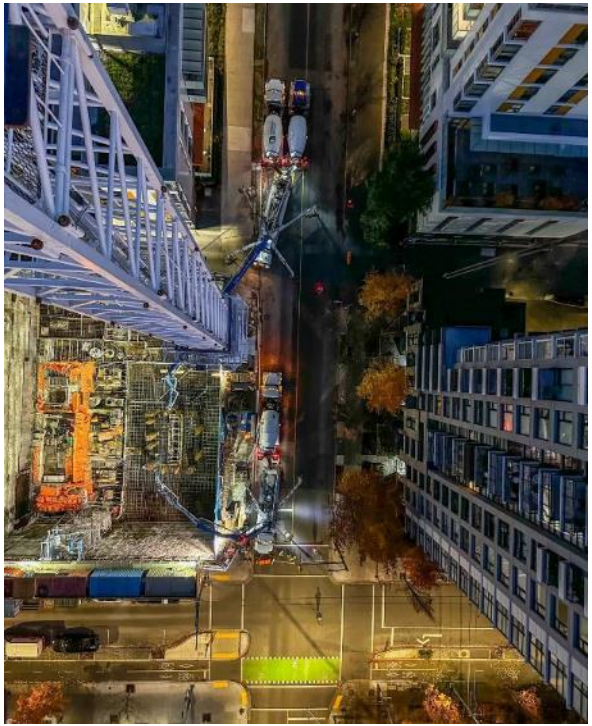
Lab-cured specimens

Does not represent neither the curing condition nor the in-situ concrete

Maturity meters

Measures the real temperature and strength in the concrete element every 15 minutes

Where Specifiers, Owners, Construction Professionals, Designers, & Stakeholders Fit In



Changes to drive decarbonization

- Specify rigid concrete pavements improve vehicle fuel efficiency
- Use Low Carbon Concrete performance specs for buildings (most energy efficient buildings to operate and maintain – whole LCA)
- Concrete performance specifications and incentivize innovation
- In-place (non destruction testing) – maturity (reduce over-design)
- Work with industry to use Type IL and Type IT cements
- Allow/specify the use of recycled materials in mixes, i.e. RCA
- Educate design and construction community
- Account for natural carbonation process where CO_2 is absorbed by concrete, especially in Use and End of Life stages of LCA

Thank You.

Larry Rowland

Heidelberg Materials

Sustainability Market Manager

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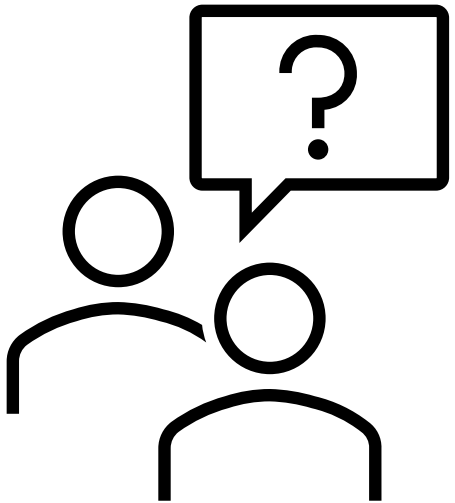
Questions?

- Ask questions via the Q&A dialog box in the zoom platform
- You can also ask questions via email at info@neuconcrete.org.



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Thank you!

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