SUBSPACE ENERGYHUB

SubSpace Energy Hub

SCAUT EVENT 13.12.2022
M. KOMPATSCHER

AMBERG GROUP
V-S-H- VersuchsStollen Hagerbach
Xerotech
normet
MOTICS Electric driven innovation
ALUMINA BATTERY SYSTEMS
FORTESCUE FUTURE INDUSTRIES
SCAUT Swiss Center of Applied Underground Technologies

SUBSPACE ENERGYHUB

Concept for sustainable and CO_2 neutral technologies in tunnels, mines and urban Sub-Spaces

KICK-OFF, JUNE 2022

AMBERG GROUP · V-S-H- VersuchsStollen Hagerbach · Xerotech · normet · MOTICS Electric driven innovation · ALUMINA BATTERY SYSTEMS · FORTESCUE FUTURE INDUSTRIES · SCAUT Swiss Center of Applied Underground Technologies

SUBSPACE ENERGYHUB

Initiated and driven by leading Industries with a VISION

- of sustainable underground / above-ground construction methods and technologies based on green energy concepts, like e-drive and hydrogen propelled machinery and auxiliary installations, low carbon footprint designs, materials and processes
- to link equipment manufactures, mine operators, contractor and infrastructure owners as potential stakeholders with academia and auxiliary application provider for energy capturing, storage, transportation and consumption solutions, advanced software programs and engineering capabilities
- of energy capturing, storage and transfer systems in tunnels, mines and underground spaces for smart cities

The final goal is to position the unique set-up at the already existing and internationally well-recognized Hagerbach Test Gallery (VSH) on a worldwide base, in order to become an international benchmark of alternative and sustainable combined underground / above-ground energy systems for the international markets.

V-S-H-
VersuchsStollen Hagerbach

SUBSPACE ENERGYHUB

The main reasons:

- Due to severe climate, ecological and inequality crises persons, organizations and markets must reinvent ways of how to do business and work together.
- An adequate physical HUB must be available as a kind of gravity center to enable the sustainable progress for people and goods.
- Prototyping, testing and demonstrating of new equipment and systemic solutions in a real and market related environment is a must. The HUB offers an ideal set-up to do so.
- The new HUB integrates the entire eco-system of interconnected industry sectors through a holistic approach.

The ultimate goal of the HUB is to contribute to a saver, cleaner, equitable and inclusive society

Offering

Worldwide unique underground set-up / infrastructure for:

- Design and manufacture application-ready technologies
- Usage as a market-oriented showcase / product launch
- Organization of seminars, deminars, trainings and education programs

Experienced international staff, experienced and ready to:

- Set-up, prepare and carrying out real-size / real-term test, prototypes
- Promote and disseminate new technologies and engineering solutions
- Interlink companies, organizations, persons etc to create powerful and market-oriented networks and eco-systems

Extensive worldwide networking power through contacts to:

- International and multi-national companies
- International norming and standardization bodies
- International educations institutions and academia
- Decision makers and opinion leaders

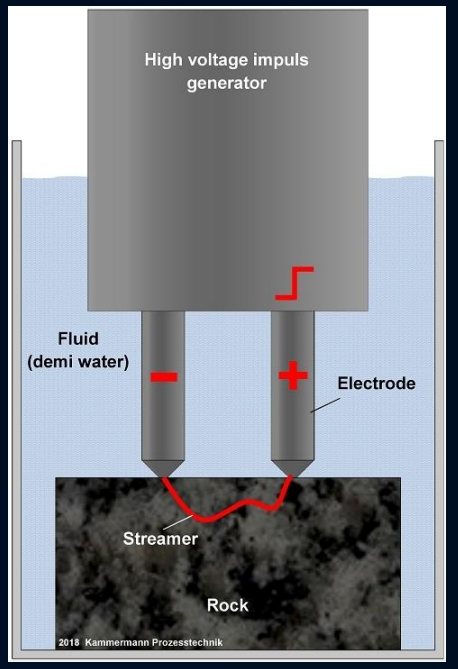
Proven track record for similar break-through projects like:

- Rock support systems with novel machinery and materials for single shell tunnel linings
- Fire prevention solutions in tunnels (after the catastrophic tunnel fires)
- Novel underground space use for edge computing and block-chain technologies, agriculture etc

Workstream 1: Energy Production

CO_2 free Production of Electric Power

- solar, wind, geothermal energy (deep or shallow), underground biogas, air flow turbines etc
- prototypes of new drilling technologies, geothermal energy harvesting, flexible solar panels, underground hydropower etc



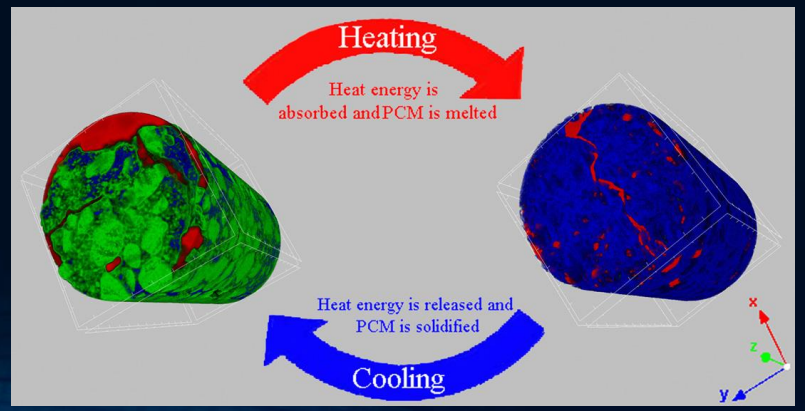
Workstream 2: Storage

Storage

- compressed air, ice, batteries, hydrogen, heat storage etc
- prototypes of safe, easy to charge and discharge high-efficient underground storages
- rapid charging and discharging equipment

Transfer and AC/DC Grid

- small smart grids for high complex distributions
- peak loads and grid overloads
- bi-directional charging: storage to grid to consumer and vice versa
- DC network and fast charging infrastructure



Standardized Test Run for large, construction BEV

- Defined test round through the SS EH area
- Monitoring and benchmarking of performance parameters
- Performance Report

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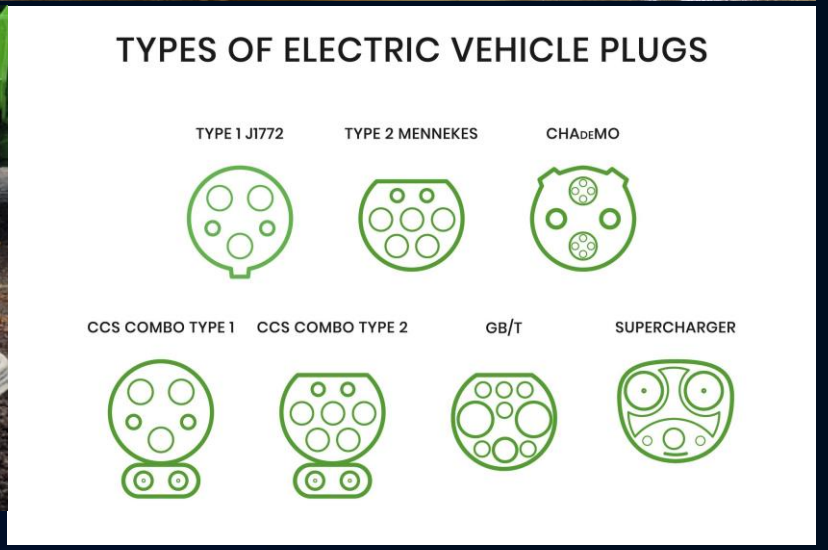
Workstream 3 : Low Carbon materials and Applications

a) Equipment and Tools

- e-powered vehicles and tools
- availability
- rapid charging and discharging of equipment

b) Material Solutions

- Low carbon concrete solutions incl. recycling materials
- Circular economy
- Carbon capturing



Workstream 4 : Risk Assessment & EHS solutions

a) Testing

- Production
- batteries
- grids
- consumers

b) Solution dissemination

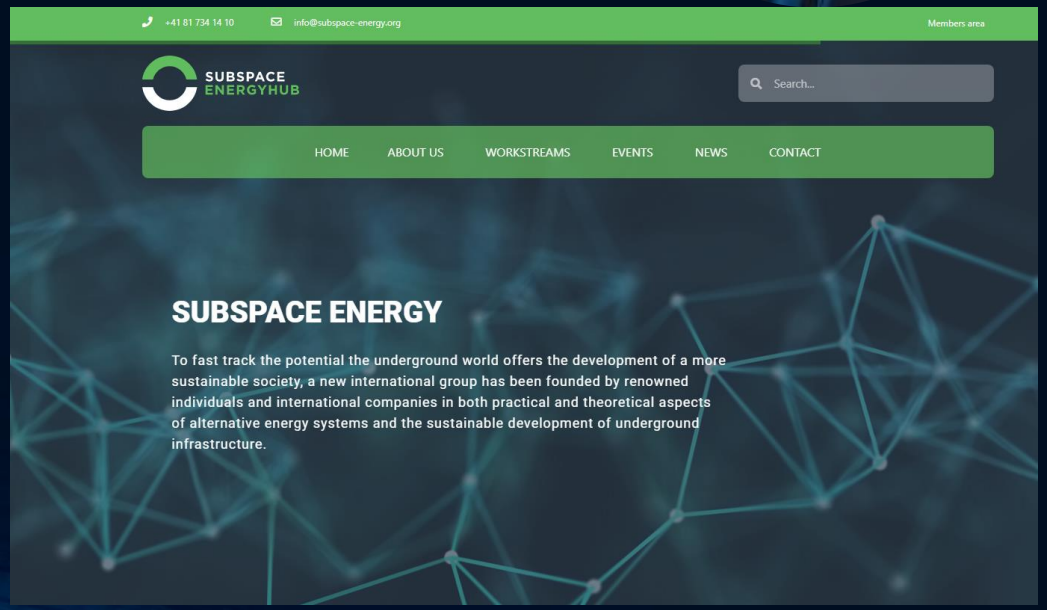
- Reports
- Conferences / Events

Website, material available, NDA, promotion, …

- Welcome AURORA PURIQI – Business Development SS EH
  apuriqi@hagerbach.ch

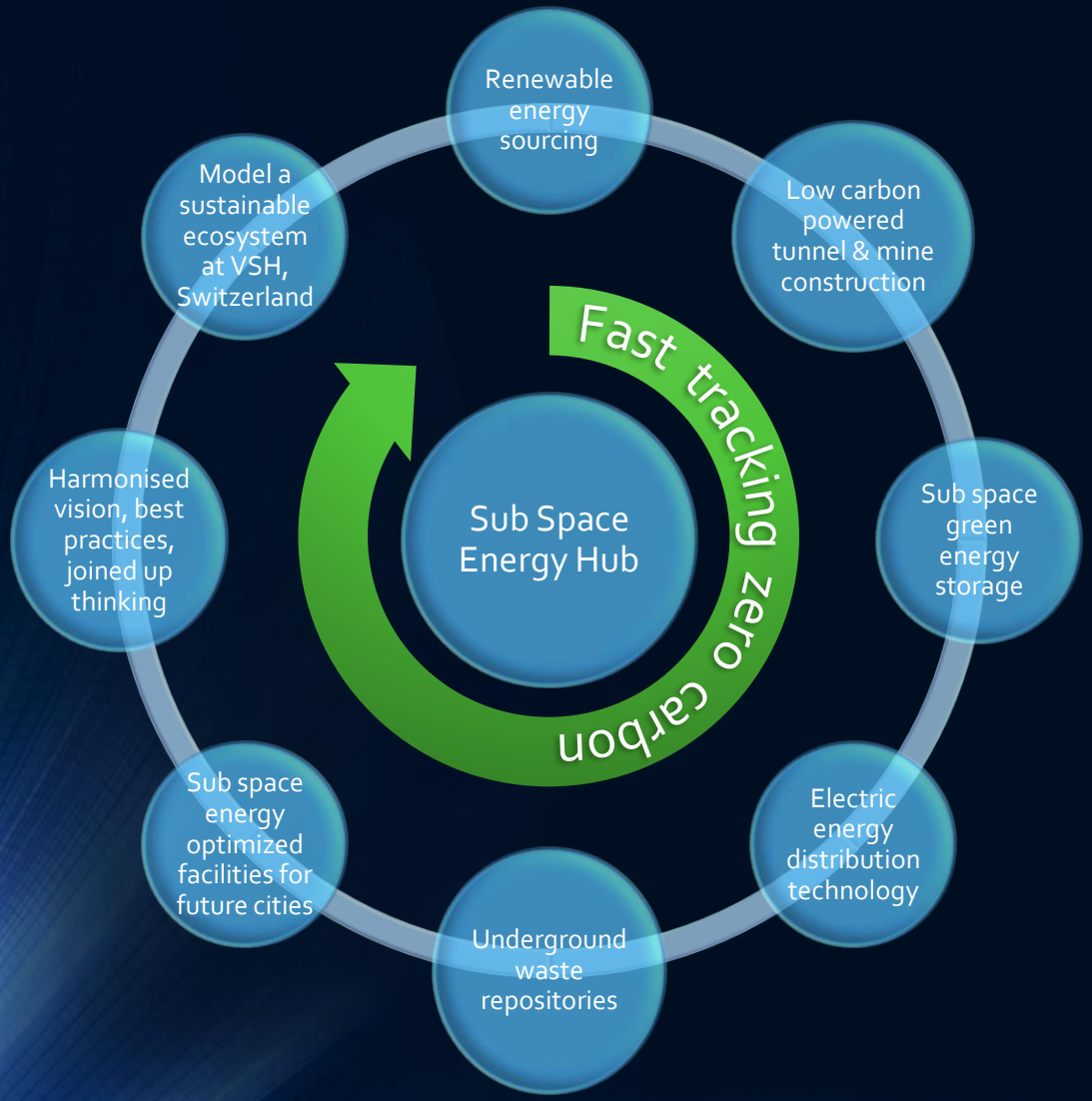
- SS EH Material:
  - Flyer
  - Vision Paper & Termsheet
  - Application Form
  - NDA Form
  - Report & PPT Template for Workstreams

- Website: www.subspace-energy.org



International Sub Space Energy Hub

SUBSPACE ENERGYHUB



LET'S FAST TRACK ZERO CARBON TOGETHER!

- Adding value to strategic goals in the fields of sustainability and CO_2 neutrality by adding new opportunities for the development, prototyping, and launch of new technologies
- Share visions and insights with internationally recognized partners, and grow their leadership in the sustainability market through quality front-end exposure
- Showcase innovations and business initiatives and collaborate with new partners
- Best practice for FUTURE underground CITIES with Selfsustaining Communities

Workstreams:

- Energy (electric, heat)
- Storage (Li-Ion, Salt, Sand, Eis, H_2, CH_4, ...)
- Grid AC/DC // Loading station

Initiating hub partners:

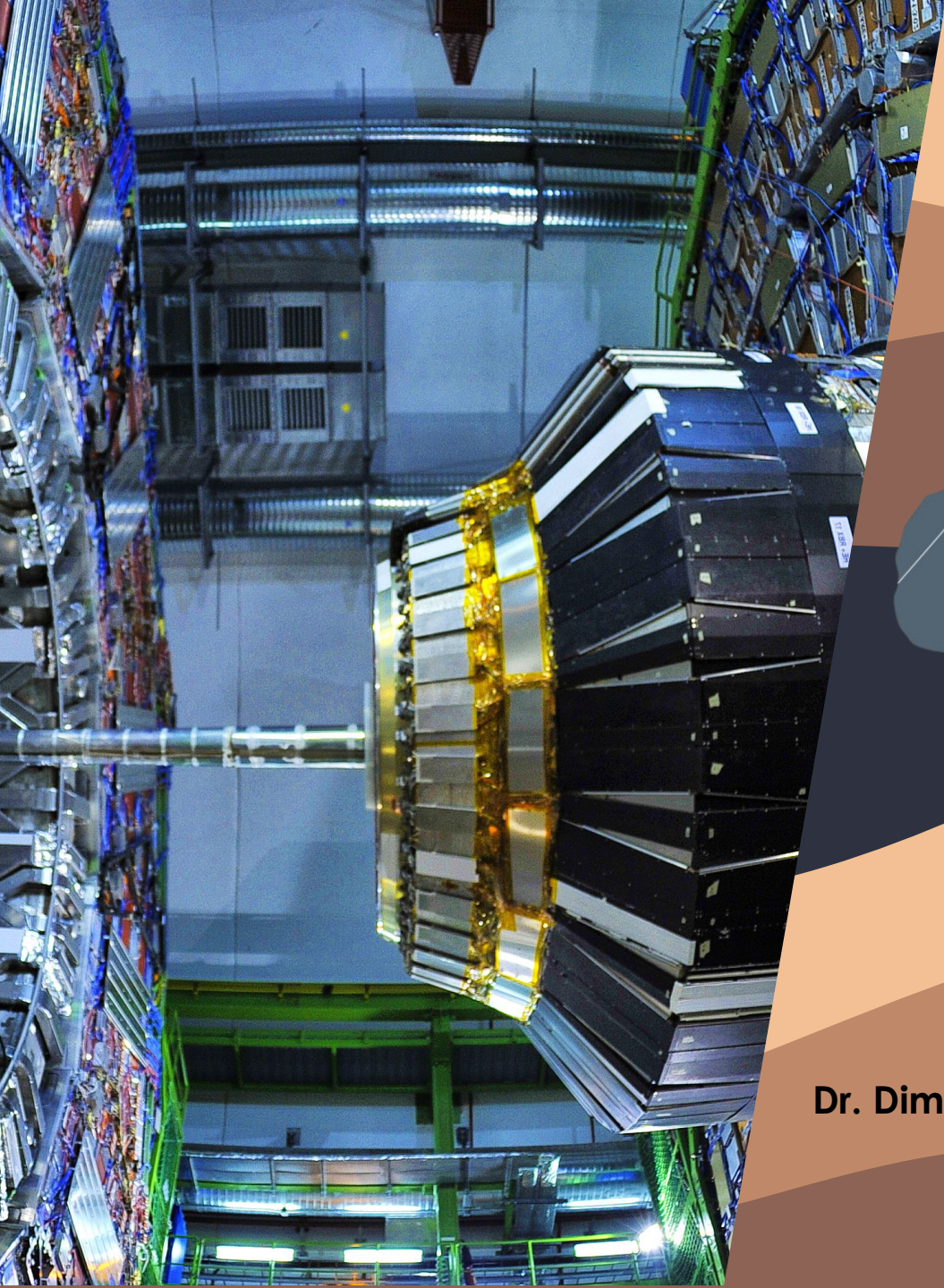
AMBERG GROUP · V-S-H- VersuchsStollen Hagerbach · Xerotech · normet · MOTICS · ALUMINA BATTERY SYSTEMS · FORTESCUE FUTURE INDUSTRIES · SCAUT Swiss Center of Applied Underground Technologies

Steering Board

- Elected — June 2022
- Nomination and election of workstream leaders — June 2022

- Meeting and reporting timeline
  - Steering board meetings: 2x monthly
  - Workstream meeting: tbd
  - Board and WS leaders: 2/y — Nov 21, 2022
  - Hub meetings: tbd

Interested ➔ just let us know!
Thank you for your attention.



FCCIS – Future Circular Collider Innovation Study

(EU – Horizon 2020)

CERN 3 RECYCLE REINVENT REVALORISE

SCAUT Swiss Center of Applied Underground Technologies

Dr. Dimitrios Terzis, CEO MeduSoil SA

dimitrios@medusoil.com

@twiTerzis

FCCIS – Future Circular Collider Innovation Study

(EU – Horizon 2020)

CERN 3 RECYCLE REINVENT REVALORISE

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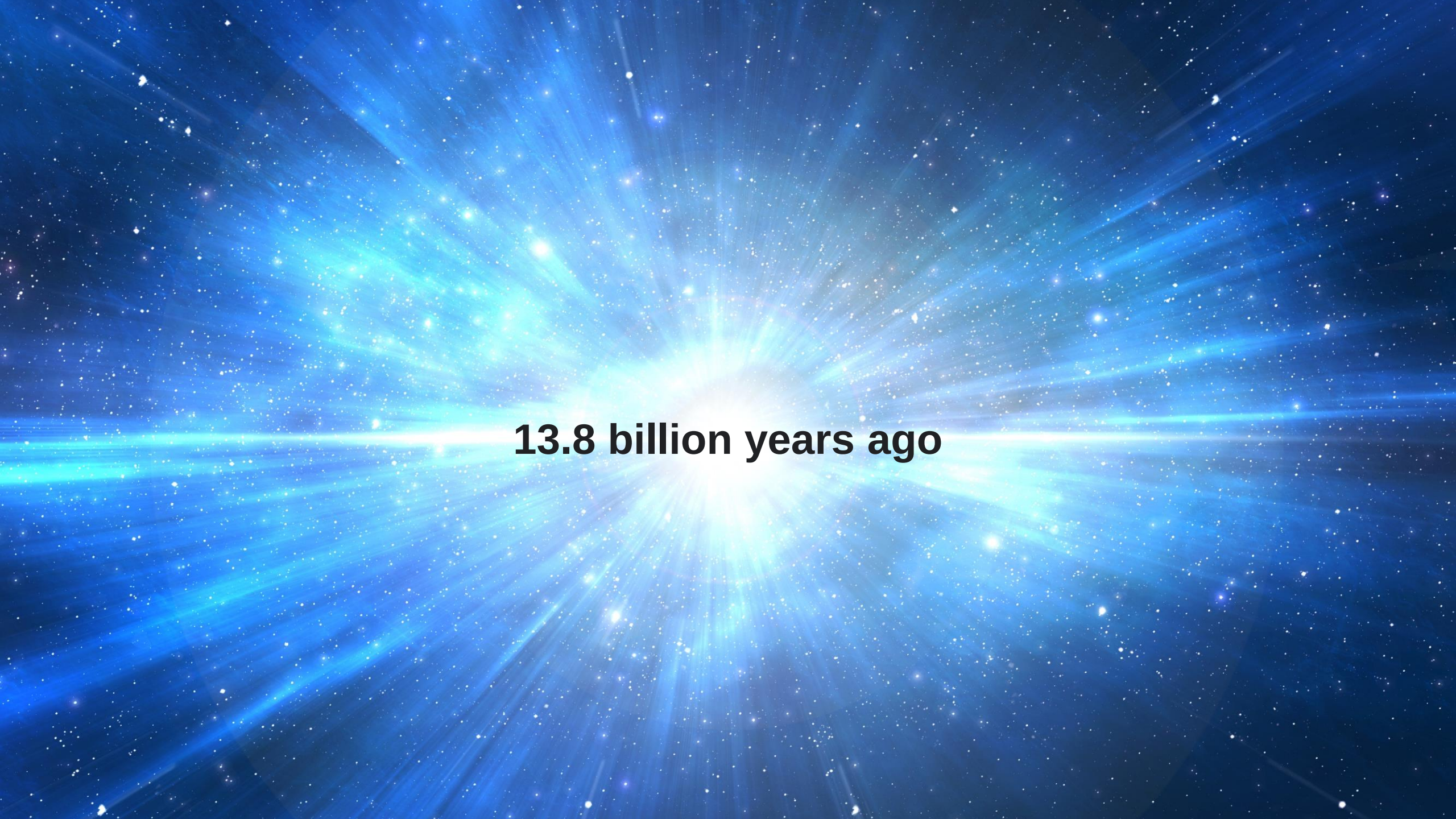
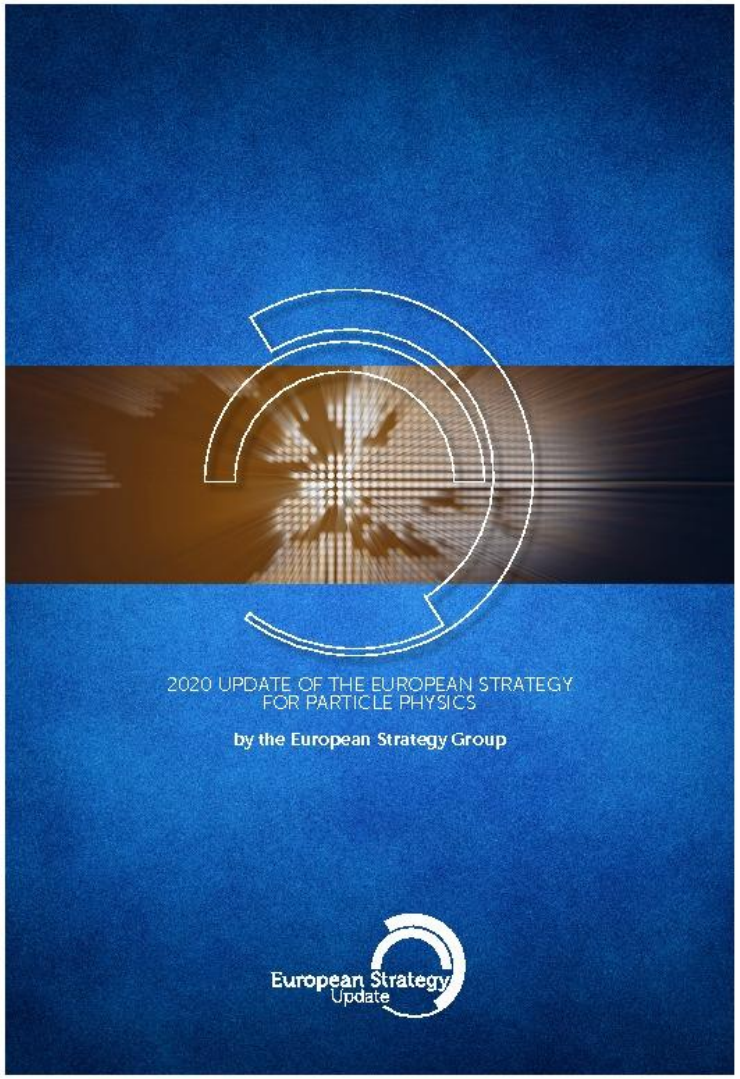
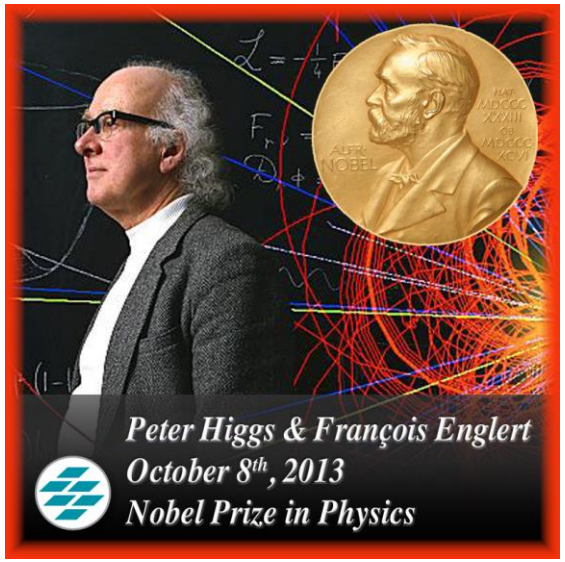

13.8 billion years ago



Today **80%** of the mass of the universe is **unknown**.
What is the rest of the universe made of?

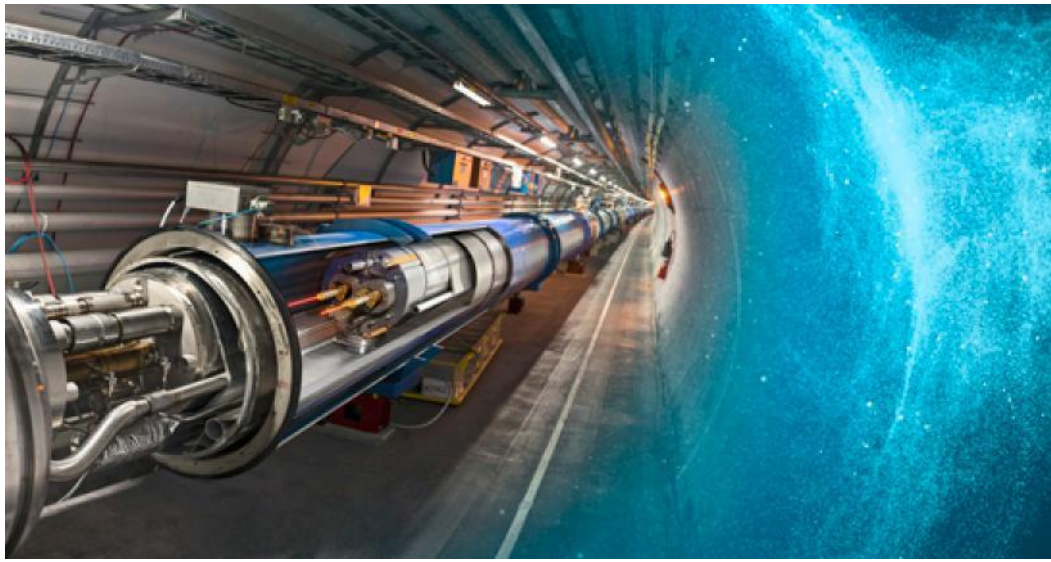
Why is the universe composed only of **matter**? Where has the **anti-matter** gone that was produced simultaneously in the **Big Bang**?

13.8 billion years ago



1964

Theoretical description Peter Higgs



2012

Detection Higgs boson

onwards

Quantification Higgs boson

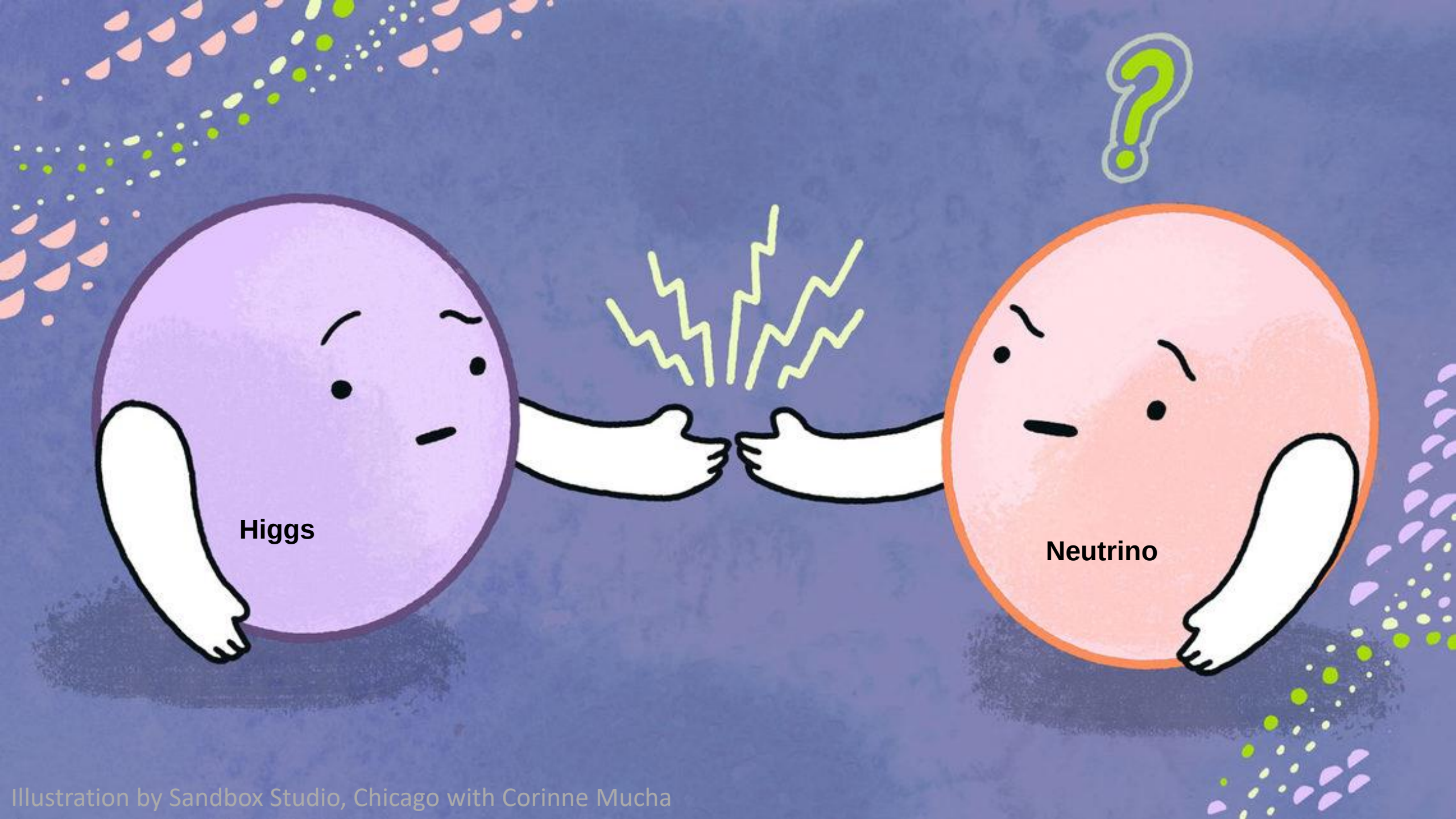
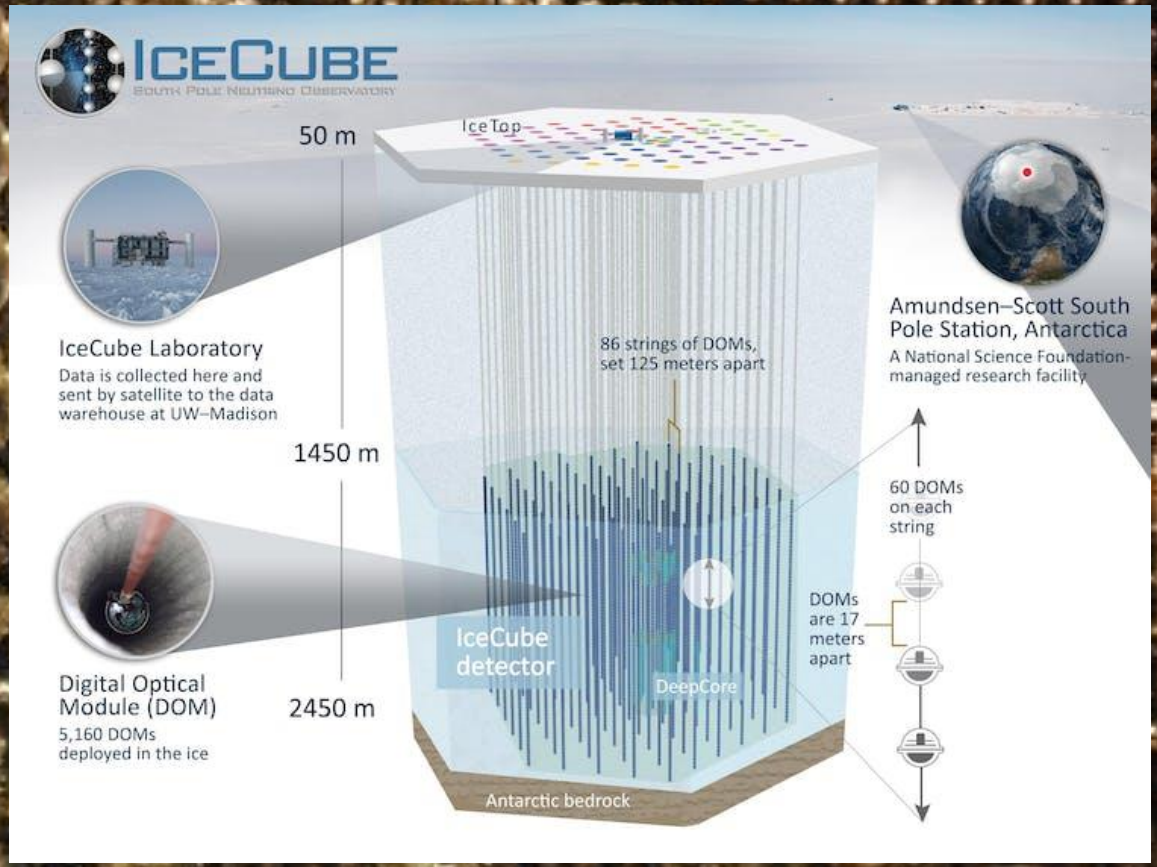


Illustration by Sandbox Studio, Chicago with Corinne Mucha

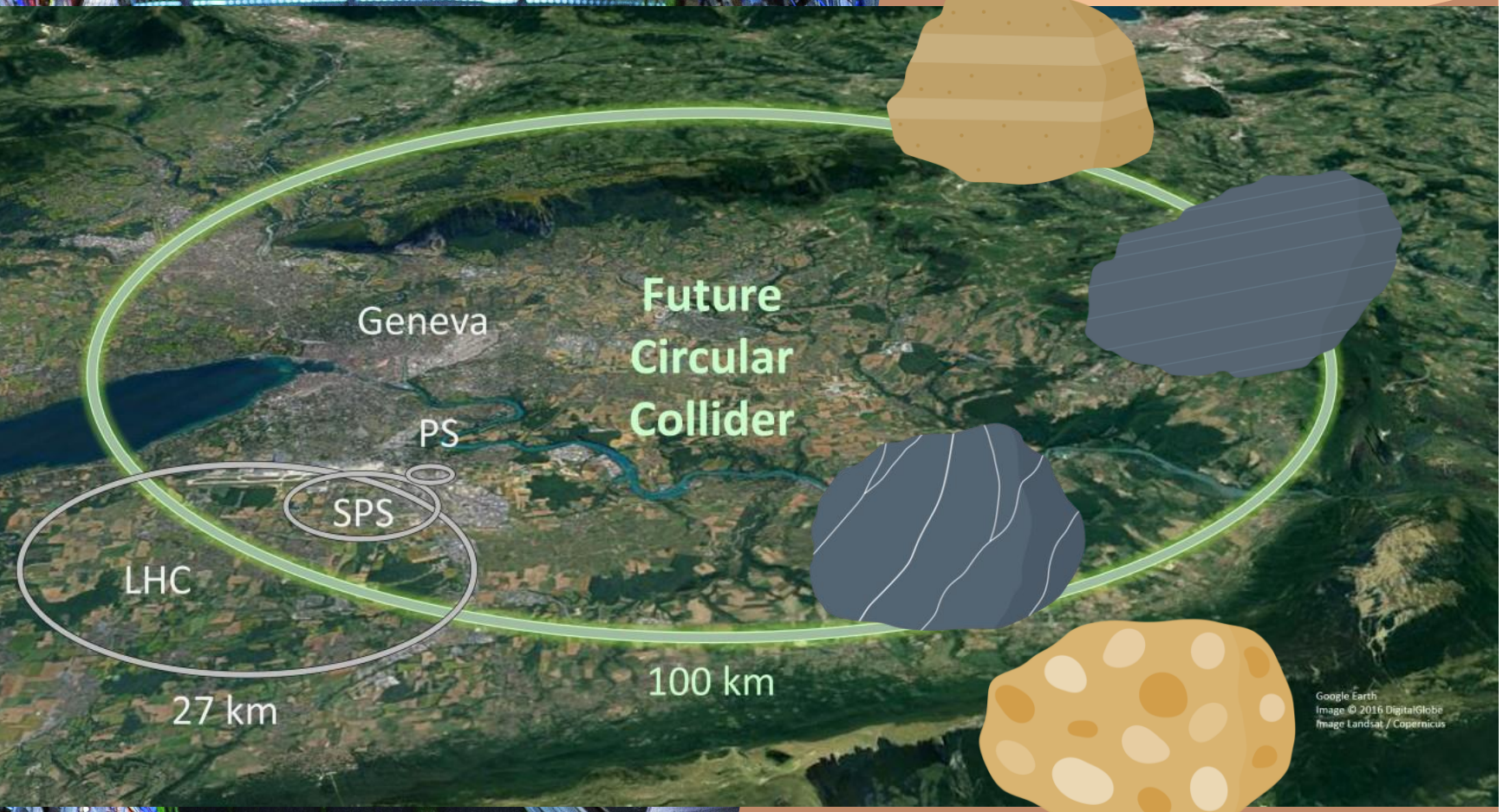
From Higgs boson to neutrinos

From the God Particle to the Ghost particle



WHO YOU
GONNA CALL?


Mining
the
FUTURE®



FUTURE CIRCULAR COLLIDER

CERN

MONTAN UNIVERSITÄT LEOBEN

ZaB ZENTRUM am BERG

FCCIS – Future Circular Collider Innovation Study

(EU – Horizon 2020)

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HOLCIM

bilger+partner

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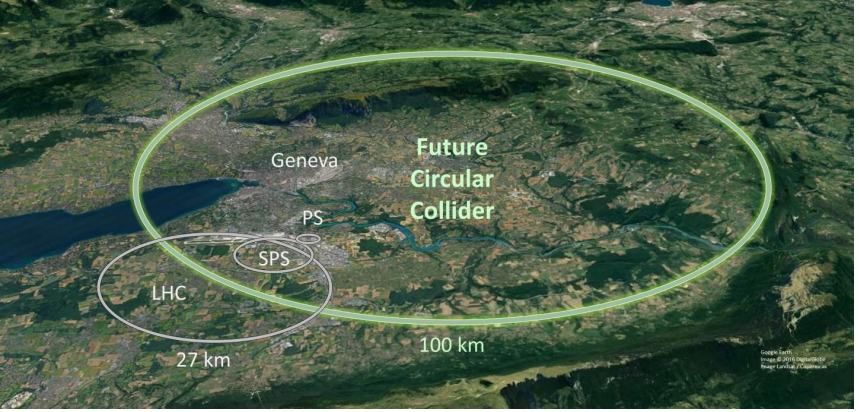
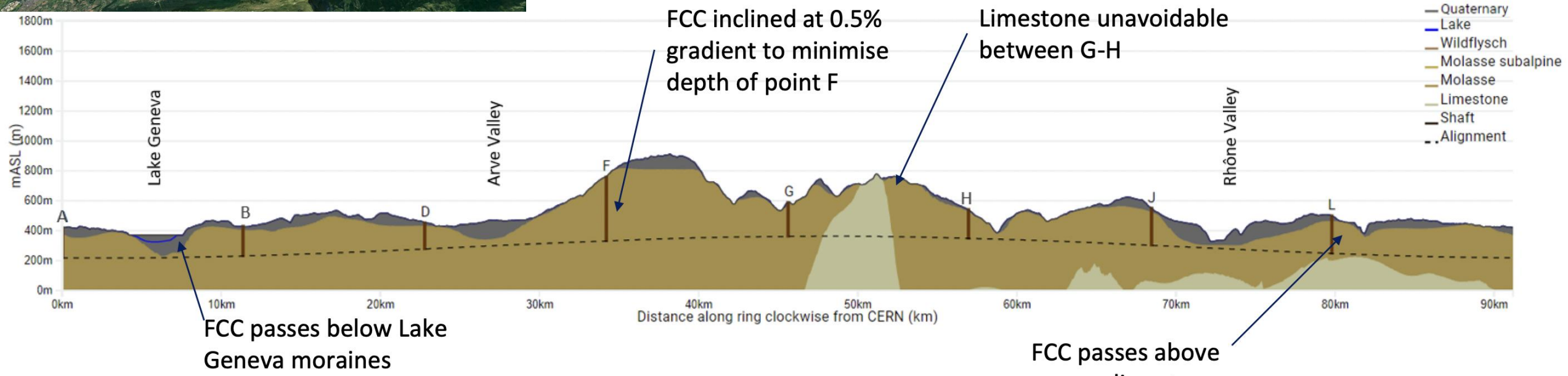


Michael Benedikt
27/09/2022, Mining the Future, CERN

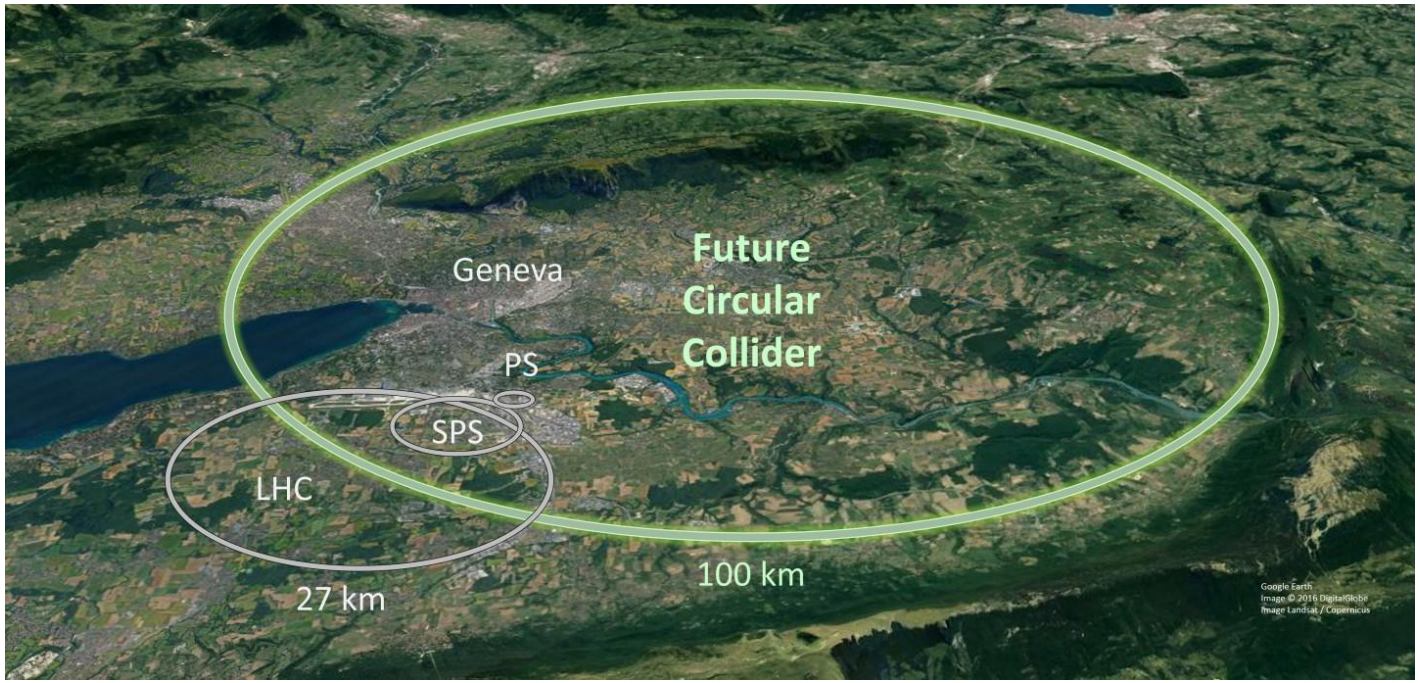


Shaft depth:

A: 202 m B: 200 m D: 177 m F: 399 m G: 228 m H: 139 m J: 251 m L: 253 m

Tunnelling mainly in molasse layer (soft rock), well suited for fast, low-risk TBM construction.

Site investigations campaign planned for 2024 – 2025: ~40-50 drillings, 100 km of seismic lines



2013 ESPPU

2014 FCC study kickoff

2018 FCC CDR

2020 ESPPU

2020 FCCIS kickoff

today

2012 Higgs discovery announced

2011 circular Higgs factory proposal

2025/26 Feasibility proof

2026/7 ESPPU

2028 approval

>2030 start tunnel construction

>2038 machine installation

>2045 first ee collisions

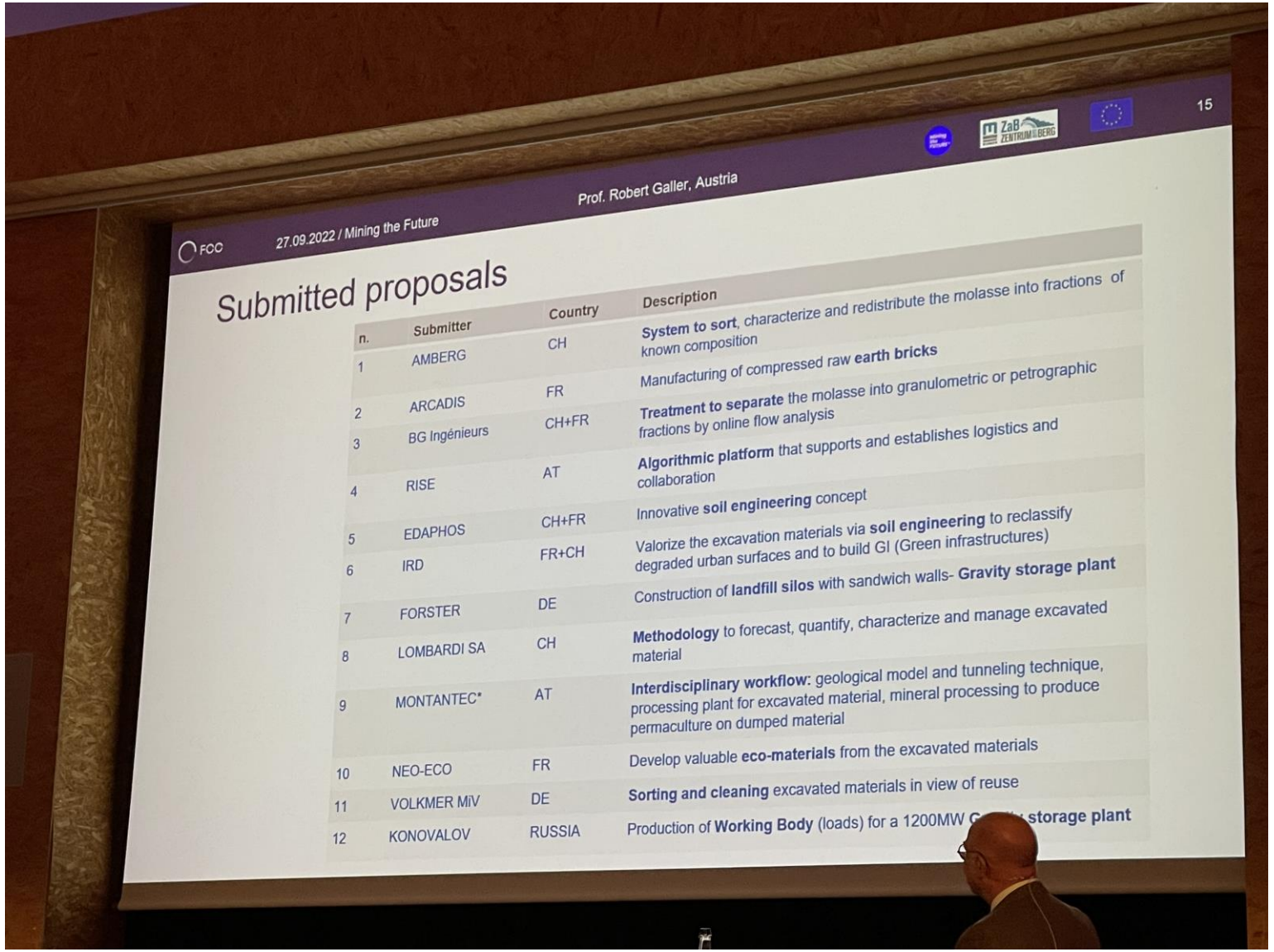
>2030 - 37 element production

>2026 - 30 full technical design

2025/26 Financing model Operation concept

2020-25
FCC Feasibility Study
FCCIS H2020 DS

Michael Benedikt
27/09/2022, Mining the Future, CERN



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	Business as usual	Compared to yearly production in Switzerland
Landfill weight (t)	23 million tons	50%
CO2 due to transport only	104.880 tons CO2 generated	2.6%

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Why this consortium?

CERN³ RECYCLE REINVENT REVALORISE

- **Innovation** in **tradition**
- Systems **&** materials
- From **sorting** to **tailoring material properties** for multiple end building applications

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HOLCIM

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Technical overview

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Four phases

i. The **Obtention** phase
Granulometric separation of the excavated Molasse

ii. The **sorting** phase
Based on the input of the fast and automated analysis the material is directed to its specific sorting plant

iii. The **classification/redistribution phase**
Generate controlled compositions and particle size distribution

iv. The **valorization** phase
Compensate weak mechanical properties with techniques from MeduSoil & Mobbot

Technological readiness

Mobbot digital sprayed concrete

Sprayed concrete technology

- Robotized and automaed concrete spraying process
- Shaping concrete into infrastructure elements or controlled spraying on underground walls
- Allows the use of recycled materials of < 4 mm which are not valorized elsewhere

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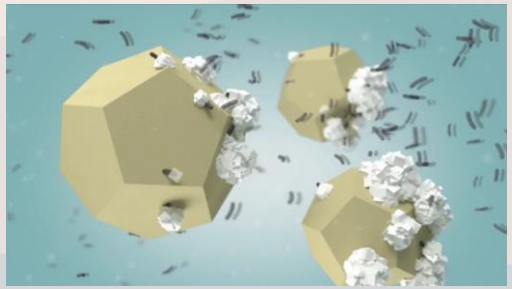
Technological readiness



Bio-binder™ technologies

- Protein-based binders extracted from soil and groundwater microorganisms
- Production in certified bioreactors under controlled environments
- Versatile use depending on soil fraction (from clay to siltuy and granular soils)

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13.8 billion years ago

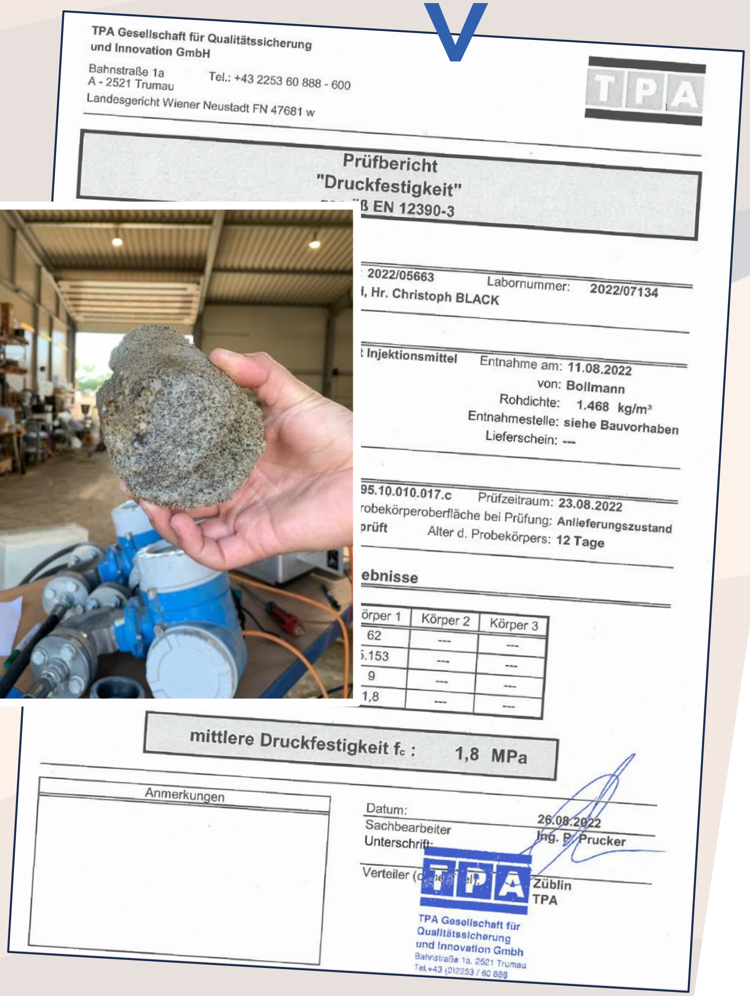
3.8 billion years ago

3.7 billion years ago (panspermia)

Fossil microbialites represent some of the earliest remnants of life on Earth and were common from ~**2.5 billion to 540 million years ago**

Pipeline of developments

Sand reinforcement


TPA Gesellschaft für Qualitätssicherung und Innovation GmbH
Bahnstraße 1a
A - 2521 Trumau
Tel.: +43 2253 60 888 - 600
Landesgericht Wiener Neustadt FN 47681 w

Prüfbericht
"Druckfestigkeit"
...ß EN 12390-3

2022/05663 Labornummer: 2022/07134
..., Hr. Christoph BLACK

...Injektionsmittel Entnahme am: 11.08.2022
von: Bollmann
Rohdichte: 1.468 kg/m³
Entnahmestelle: siehe Bauvorhaben
Lieferschein: ---

95.10.010.017.c Prüfzeitraum: 23.08.2022
...robekörperoberfläche bei Prüfung: Anlieferungszustand
...prüft Alter d. Probekörpers: 12 Tage

...ebnisse

...örper 1	Körper 2	Körper 3
62	---	---
...5.153	---	---
9	---	---
1,8	---	---

mittlere Druckfestigkeit f_c : 1,8 MPa

Anmerkungen

Datum: 26.08.2022
Sachbearbeiter Ing. P. Prucker
Unterschrift:
Verteiler (...): Züblin, TPA

TPA Gesellschaft für Qualitätssicherung und Innovation Gmbh
Bahnstraße 1a, 2521 Trumau
Tel.+43 (0)2253 / 60 888

Clay cracking mitigation

CHF 700k Innosuisse-backed project for 2022-2024

medusoil.com

MeduSoil receives a Swiss Innovation Agency project for boosting its portfolio ...

The teams of MeduSoil, SUPSI and Tibio in MeduSoil's production plant. From left to right: Benoit Pinot, Dr. Dimitrios Terzis, Camilla Perego, Coraline Imsand...

Proof of concept

Preliminary investigations

i. Material composition and properties
   Laboratory sieving, Point load tests & Petrography

ii. Workability of the aggregates
   Sorted Material used as an aggregate for concrete tests

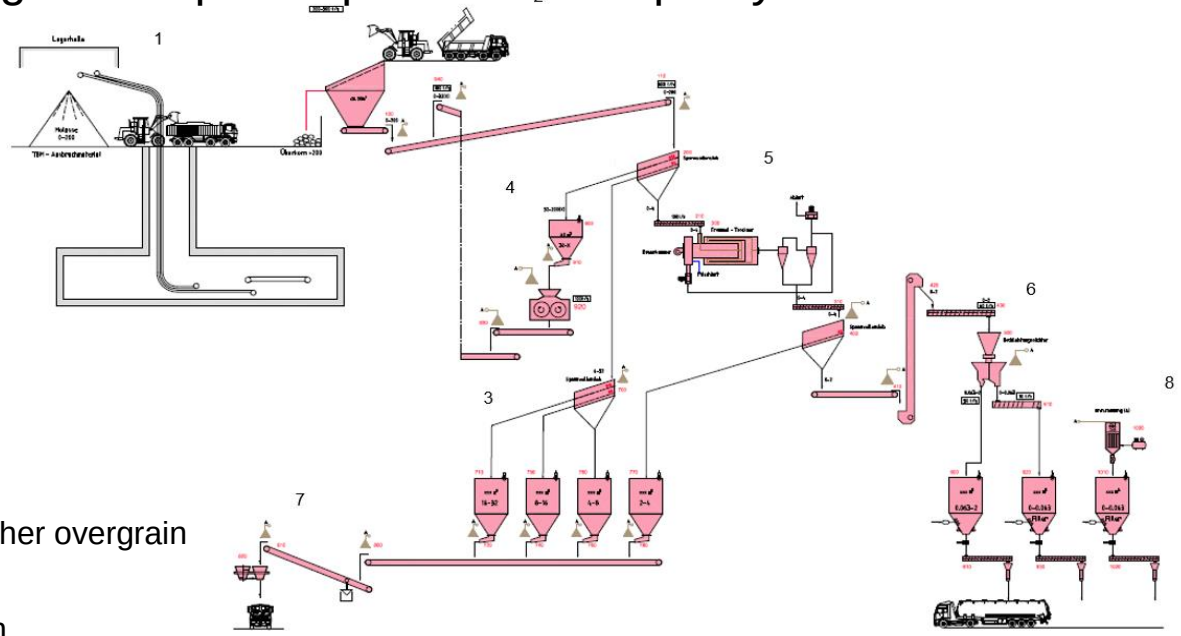
iii. Aggregate handling and Sorting method for industrial Scale
   Plant design for required quantities and quality

Figure 2. Sample of washed molasse from Gubrist Tunnel and iron residues

Proof of concept

Preliminary investigations – Results

iii. Plant design for required quantities and quality



1. Material input
2. Pre-sorting
3. Final sorting
4. Secondary crusher overgrain
5. Material drying
6. Air classification
7. Loading
8. Dedusting

Figure 5. Overview of the overall sorting process

Figure 6. Crossbelt elemental analyser

- Assessing and classifying material on the basis of geochemical composition
- Minute by minute composition analyses

Proof of concept

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Preliminary investigations - Results

i. Laboratory sieving, Point load tests & Petrography

Grain sizes	Zurich Molasse	Geneva Molasse
< 2 mm	63.70%	77.00%
2 - 8 mm	4.10%	4.60%
> 8 mm	32.20%	18.40%

Zurich Molasse	Geneva Molasse
6.3 N/mm^2	2.6 N/mm^2

Zurich Molasse
81% Quartz and Feldspar
18% Agglomerates
1% Schist silicates

Figure 3. Sample of washed molasse (left) and wet molasse material (right) from Gubrist Tunnel

Figure 4. Sample of washed molasse (left) and wet molasse material (right) from Geneva Basin (Cern)

ii. Concrete tests

Cube	Name	Aggregates	Cement	Compressive Strength (7 days) in N/mm^2
Mix 1	Reference	100% of 0/8 mm from gravel pit Holcim in Aigle	330 kg/m^3 Optimo 4 (Holcim)	26.7 (100 %)
Mix 2	Molasse 100	100% of raw molasse from the Gubrist construction site		7.0 (26 %)
Mix 3	Molasse 55	55% of 4/8 mm washed molasse (mainly sandstone)		14.8 (55 %)
		45% of 0/4 mm from gravel pit Holcim in Aigle		

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Proof of concept

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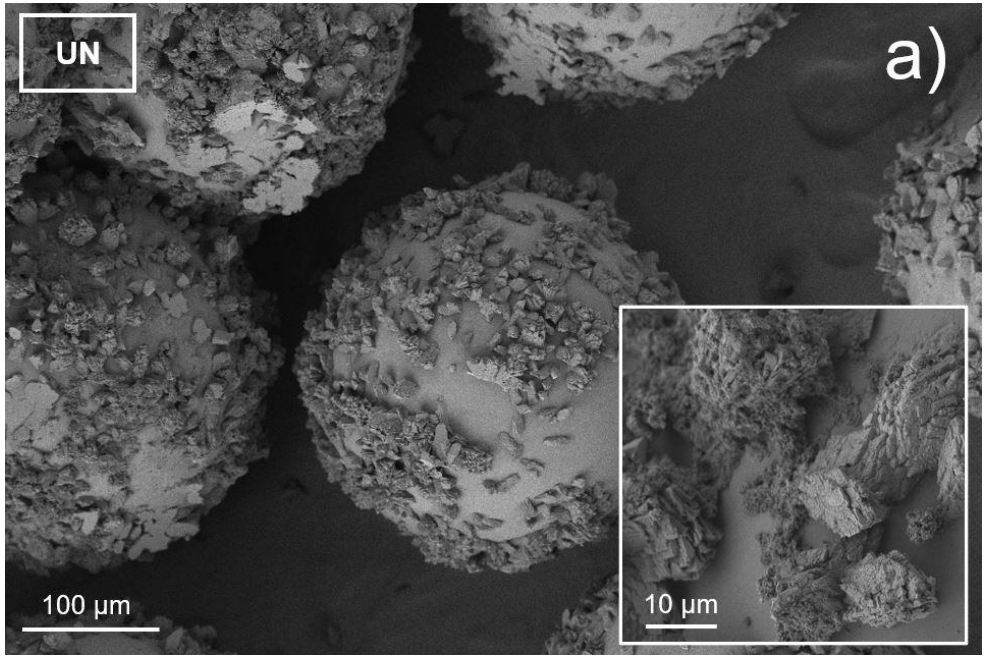

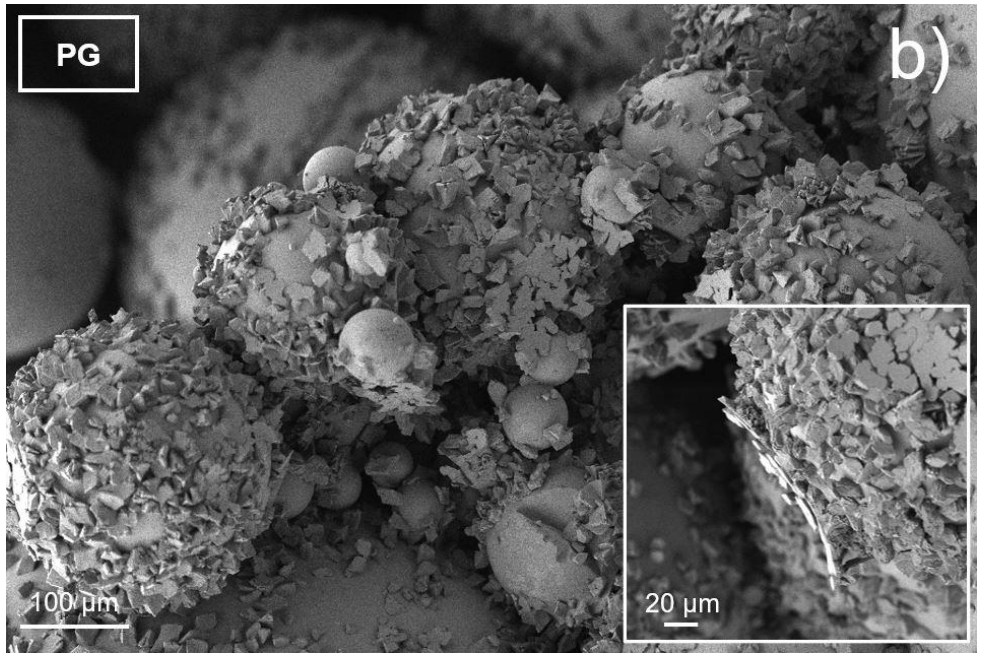

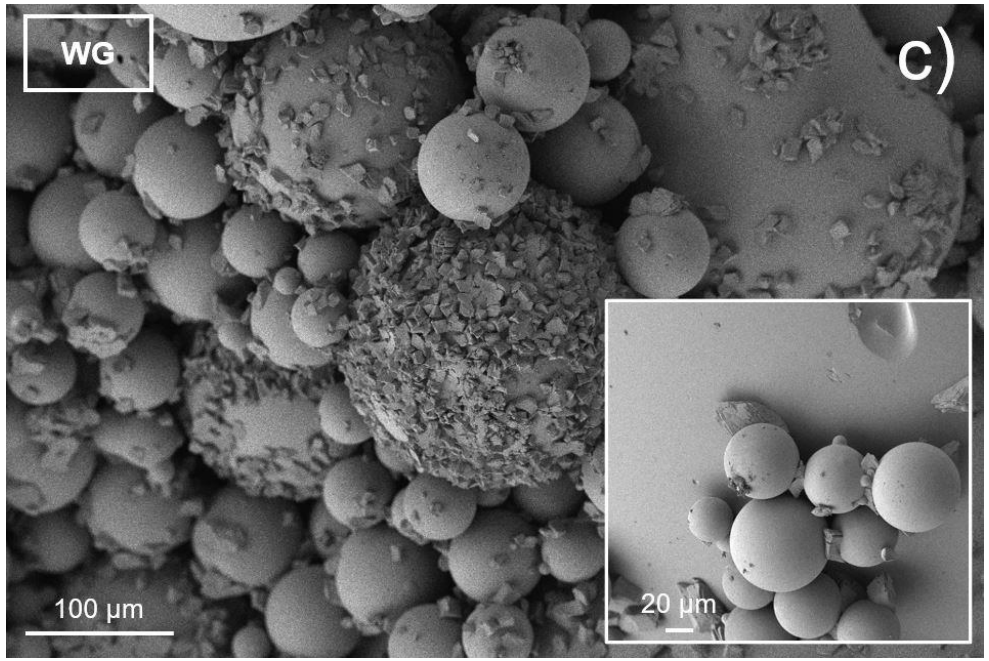

	UN	PG	WG
D_{10} [mm]	0.22	0.23	0.11
D_{90} [mm]	0.29	0.57	1.10
C_u [-]	1.27	1.78	7.50
C_c [-]	0.94	0.95	2.24
n [-]	0.36	0.31	0.22

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Global environmental & societal impact

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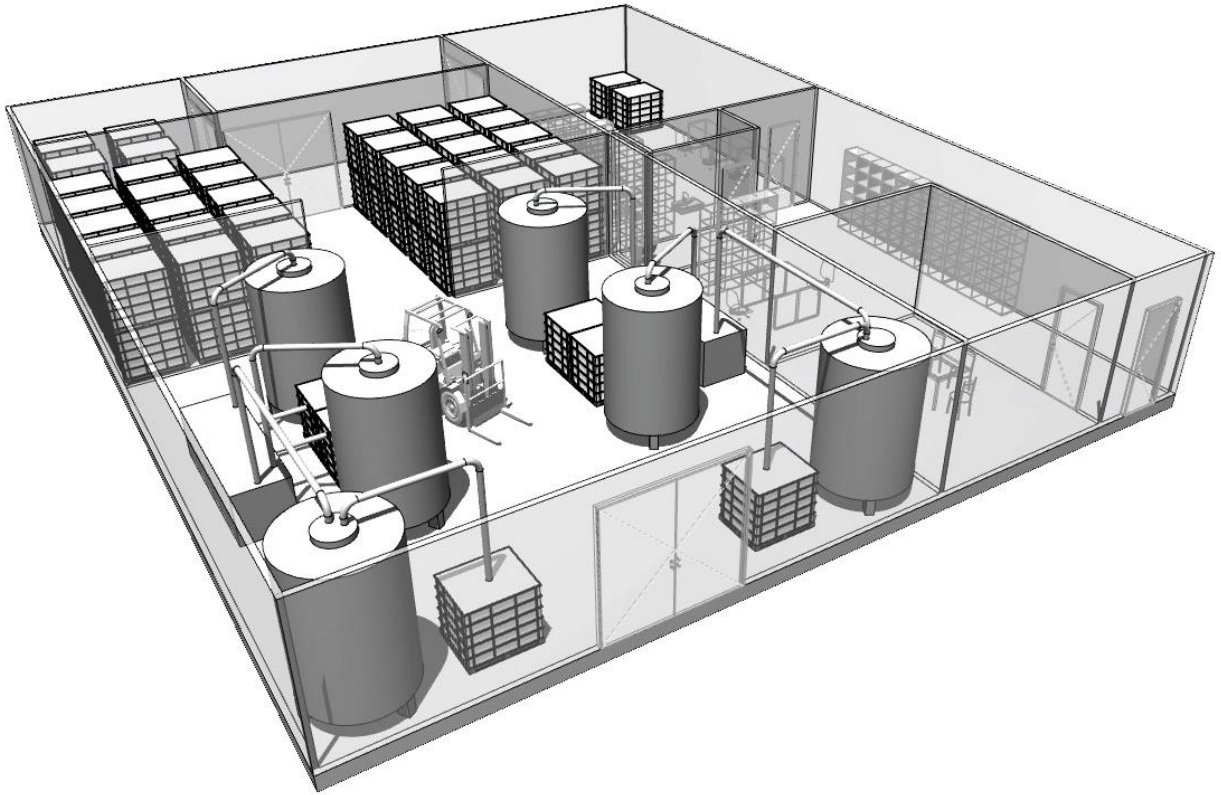
	Business as usual	Compared to yearly production in Switzerland	65% materials reused (CER3N)
Landfill weight (t)	23 million tons	50%	8.05 million tons
CO2 due to transport only	104.880 tons CO2 generated	2.6%	36.88 tons CO2 generated

Feasibility

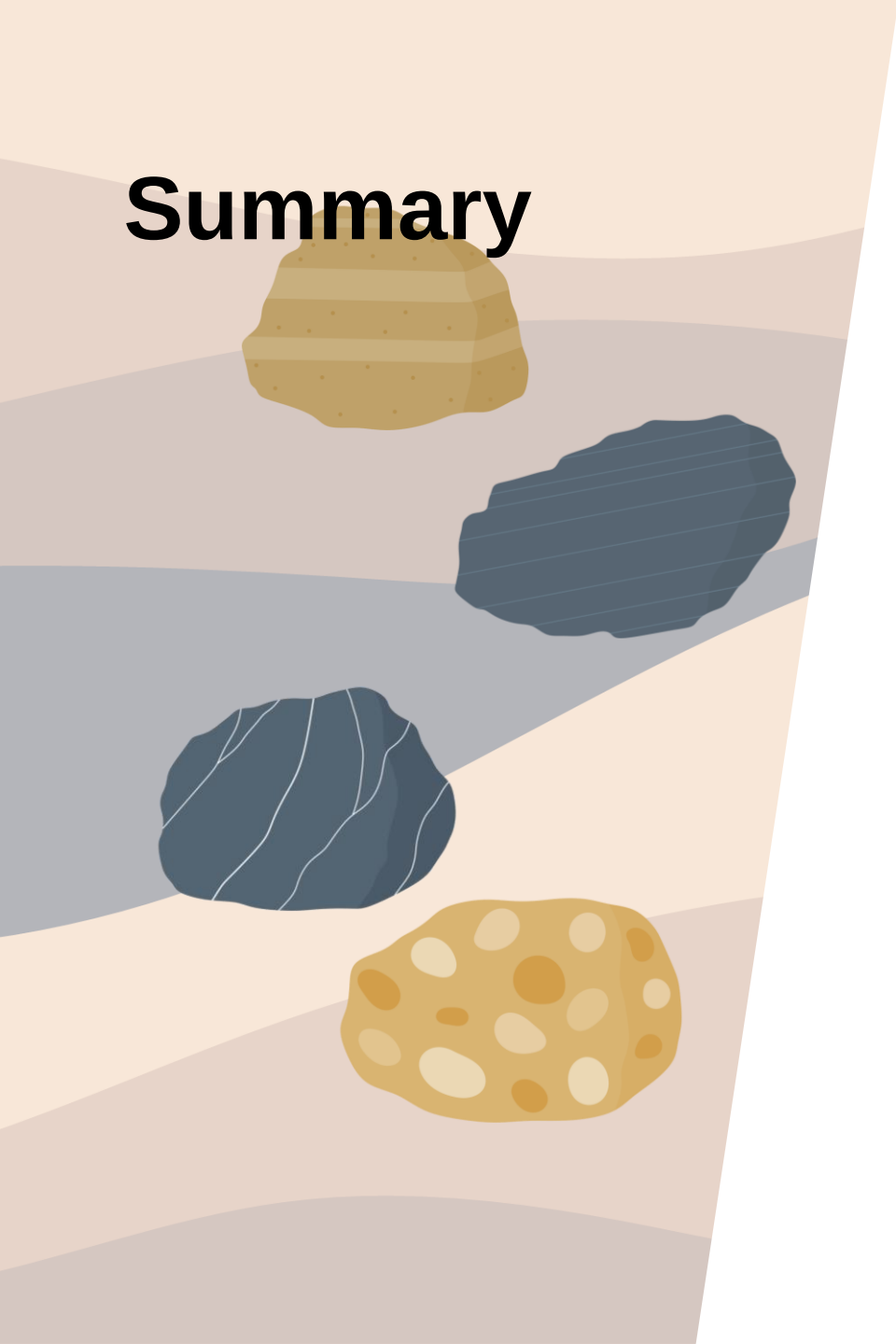


15 million tons in **10** years (2030-2040)
1.5 Million tons / year
175’500 m2
100 times our current production capacity
Fully scalable model
200 Mio CHF investment in production facility
450 Mio CHF in total production costs

Vs

750 Mio CHF if landfilled (2021 Prices)

Summary



CER³N RECYCLE REINVENT REVALORISE

CER³N – Recycle, Reinvent, Revalorize brings:

i. Technical solutions for processing the excavated material at the FCCIS and providing a possibility for partial recycling at large scale

ii. Already reached TRL 3 and TRL 7 in 2023 is within reach

iii. Strong benefits for the environment & society compared to the usual techniques & processing

iv. An important contribution to the underground construction industry to make future projects more sustainable

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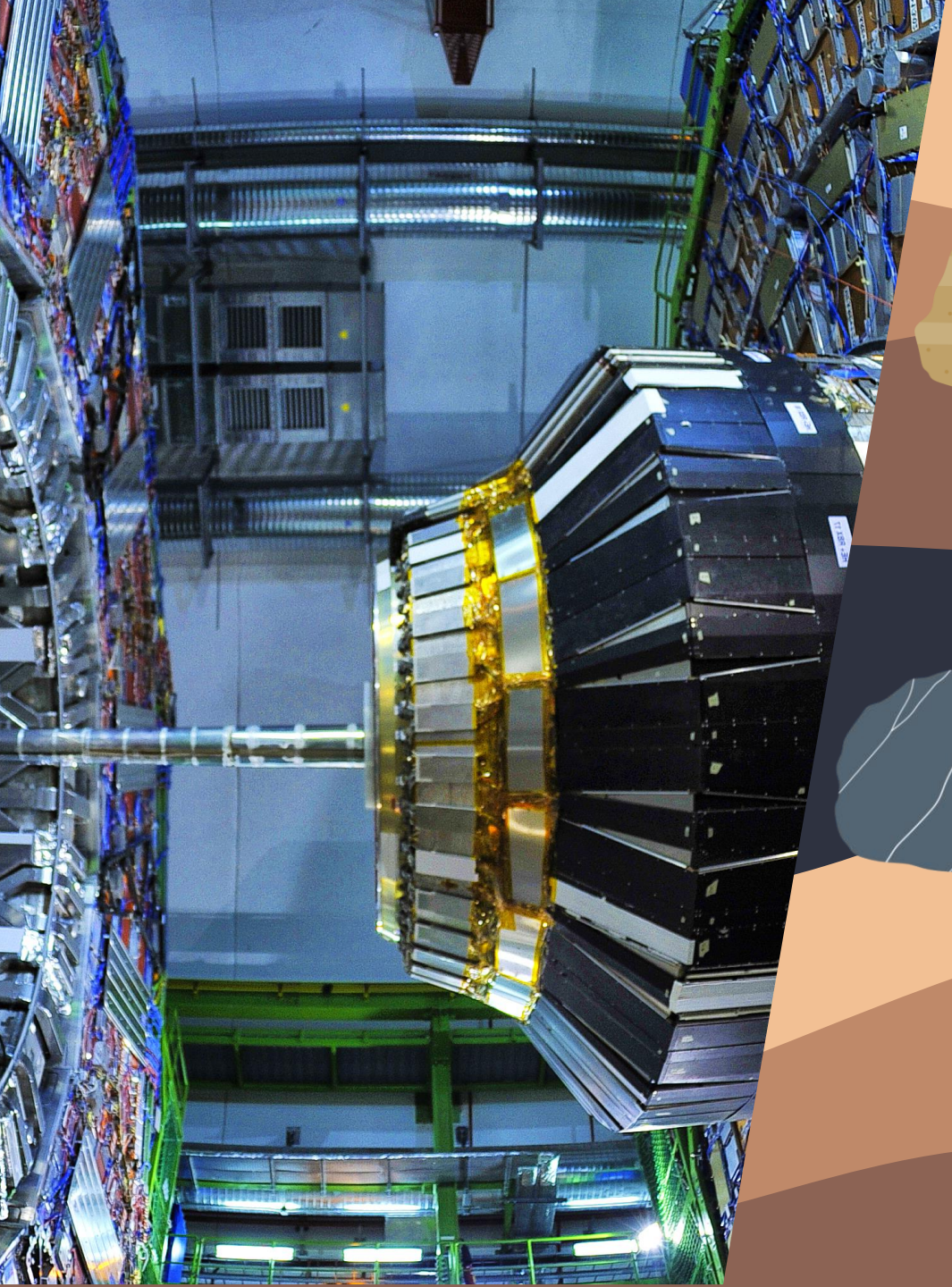

FUTURE CIRCULAR COLLIDER

CERN

MONTAN UNIVERSITÄT LEOBEN

ZaB ZENTRUM am BERG

Thank you for your attention!

CERN³

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Implenia

SUSTAINABILITY AT IMPLENIA

A JOURNEY SINCE 2009

Rolf Wagenbach
Global Head Sustainability

SCAUT Partner Event
13th December 2022

WE DEVELOP AND BUILD WITH AND FOR PEOPLE

CHF 3,765 bn
2021 revenue

7,653
Total workforce
as at 31.12.2021

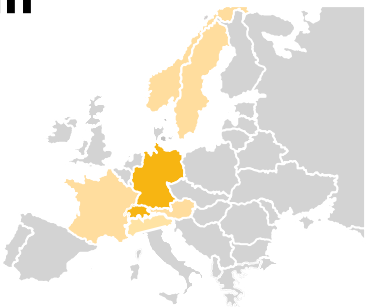
CHF 7,148 bn
Order backlog half year 2022

Sustainability

Industry leader in Sustainalytics rating, AAA rating by MSCI and gold status by EcoVadis

Positive outlook in relevant markets

	CAGR[1] 2022-24
Buildings	**+1.6%**
Civil Engineering	**+2.7%**



1) Compound annual growth rate (Euroconstruct)

4 Divisions

- **Real Estate**
- **Buildings**
- **Civil Engineering**
- **Specialties**

AGENDA

Sustainability at Implenia
- Importance for Implenia

Sustainability Community
- Organisation

Sustainability Goals 2025
- Overview

Sustainability Initiatives
- Focus measures

Q & A

GLOBAL NEWS

- **Federal Council makes climate reporting mandatory for large companies by 1.1.2024**

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Bern, 23.11.2022 - The Federal Council has adopted the executive order on climate reporting for large Swiss companies and brought it into force on 1 January 2024.

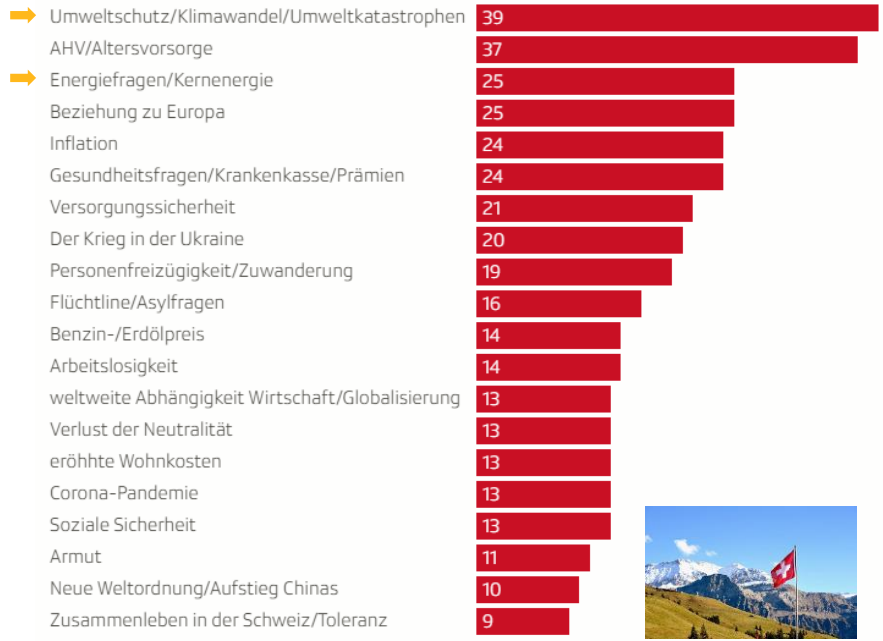
- **UBS: Net Zero by 2050 | UBS Global**

UBS

by 2035 — **Addressing our supply chain**
– Aim for net-zero GHG emissions by our key vendors

by 2050 — **Net zero across all our activities (scope 1, 2, 3)**

- **Swiss Worry Barometer 2022**



in Prozent Stimmberechtigte, Anteil Nennungen
Grafik: mcep • Quelle: Credit Suisse

CURRENT TRENDS AND EVENTS

Global energy crisis
sparked by Russia's war 2022

Adoption of the new **CO_2 law**
Rejected on 13.06.2021

New awarding culture under the **revised procurement law** since 2021

«Konzernverant-wortungsinitiative»
Rejected on 29.11.2020

«Building Green 2021»
Big sustainable construction event in Hamburg

«Fossil Free Sweden»
Sweden as a fossil free nation till 2045

Fossilfritt Sverige

«Climate strategy Oslo»
Minus 95% CO_2 by 2030, compared with 1990

New reporting guidelines under the **EU-Taxonomy** from 2022

CLIMATE CHANGE MITIGATION
CLIMATE CHANGE ADAPTATION
POLLUTION PREVENTION
CIRCULAR ECONOMY
SUSTAINABLE USE OF WATER AND MARINE RESOURCES
HEALTHY ECOSYSTEM

SUSTAINABILITY AT IMPLENIA

MEDIA REVIEW

IN KOOPERATION MIT DEM BUNDESAMT FÜR ENERGIE

Maximal nachhaltig – optimal zertifiziert

Die Schweizer Immobilienbranche baut vermehrt ökologisch und gesund: Bereits 14 Projekte sind nach dem Standard Nachhaltiges Bauen Schweiz SNBS Hochbau erstellt und zertifiziert worden – 70 sind in der Pipeline.

«Gold» für das neue UVEK-Gebäude

SNBS und Co.

MAXIMUM SUSTAINABILITY, PERFECTLY CERTIFIED

EVERYTHING IS GOLD

Implenia
58.995 Followerinnen
2 Wochen • Bearbeitet •

HIER IST ALLES GOLD

LEED Gold zertifizierter Büroneubau auf dem Gelände der «Macherei» im Münchner Osten: Für eine Projektgesellschaft der Art-Invest Real Estate und der Accumulata Immobilien Development hat Implenia die fünfgeschossige Büroimmobilie schlüsselfertig errichtet. Das Baufeld 30 ist Teil der Quartiersentwicklung, die als neuer „Kreativhub" in mehreren Baulosen realisiert wurde.

Der Neubau nach Plänen von OSA Ochs Schmidhuber Architekten erforderte ein hohes technisches Know-how und aufwändige statische Massnahmen. Die Erfahrung in der Umsetzung von Grossprojekten, die eigene Fachplanung und die reibungslose Abstimmung der ausführenden Teams haben den Auftraggeber erneut überzeugt.

Das Gebäude ist Teil des ersten LEED Gold zertifizierten Quartiers in Deutschland.

ACCUMULATA Real Estate Group, O S A Ochs Schmidhuber Architekten

Matthias Jacob, Simon Kaiser, Stefanie Kratsch, Isabel Kiefer, Robert Bschlagengaul

#Implenia #ImpleniaDeutschland #Buildings #Architecture #Design #LEED #Construction #Germany #Munich #Sustainability #RealEstate

217 • 6 Kommentare

SUSTAINABLE INFRASTRUCTURE

50 | Infrastrukturbau

So werden Infrastrukturen nachhaltig

Text: Joe Lutfiger, Geschäftsführer NNBS, Zürich | Fotos/Grafik: zvg.

Im Hochbau wird der unabhängige Standard Nachhaltiges Bauen Schweiz seit vielen Jahren mit Erfolg angewendet und stösst dabei auf zunehmende Beachtung. Nun folgte im Oktober 2020 sein Pendant für den Tiefbau, das es möglich macht, auch Infrastrukturbauten nachhaltig zu planen und zu erstellen.

Nachhaltiges Bauen begrenzte sich bisher auf den Hochbau und betraf dort vor allem die Energieeffizienz. So entstanden diverse Labels und Standards in diesem Bereich. Auch belegen unterschiedliche Fördermassnahmen und Subventionen die Anstrengungen, den Energieverbrauch und die daraus resultierenden CO_2-Emissionen des Gebäudeparks zu reduzieren. Von nachhaltigen Betrachtungen dagegen weitgehend ausgeklammert blieben unsere unzähligen Bauten im Infrastrukturbereich für Mobilität, Wasser, Schutz, Energie oder Kommunikation. Die bundesrätliche Strategie «Nachhaltige Entwicklung» verfolgt bezüglich unserer gebauten Umwelt jedoch das klar formulierte Ziel, neben Hochbauten auch Tiefbauten nach anerkannten Standards der Nachhaltigkeit zu planen, zu erstellen, zu betreiben und weiterzuentwickeln.

Neu entwickelte und unabhängige Standards

Aufgrund dieser Strategie entstand das Netzwerk Nachhaltiges Bauen Schweiz (NNBS), das von mehreren Bundesämtern sowie privaten Partnern getragen wird. Es hat während der letzten Jahre Grundlagen definiert, die bestehenden Vorgaben zusammengetragen und neue Beurteilungskriterien erarbeitet. Ziel dieser Arbeiten war das Schaffen eines

SNBS Infrastruktur – Nutzen und Mehrwerte

- Macht Nachhaltigkeit greifbar und Projekte beurteilbar
- Zeigt Stärken und Schwächen von Projekten
- Erlaubt gezieltes Setzen von Prioritäten
- Bauf auf Bestehendem (Norm SIA 112/2) auf
- Praxisorientierte, projektbegleitende Checkliste
- Unterstützt bei der Kommunikation gegenüber Politik und Bevölkerung
- Mögliches Instrument zur Beschaffung von Finanzmitteln
- Neues Zuschlagskriterium in der öffentlichen Beschaffung, BöB

www.nnbs.ch

FACHTHEMEN

QUANTIFYING SUSTAINABILITY

SNBS Hochbau und Infrastruktur

Die Nachhaltigkeit quantifizieren

A GREEN VILLAGE IN GENEVA

Implenia
58.995 Followerinnen
2 Wochen • Bearbeitet •

A GREEN VILLAGE IN GENEVA

Geneva, on the River Rhône, is truly a world city, playing host to around 200 governmental and non-governmental organisations. One of these, the World Council of Churches (WCC), which represents more than 500 million Christians, has its headquarters in the city's international quarter. The WCC complex includes an assembly building, four annexes and a library, all set in a small area of parkland.

Implenia was given the job of making this ecumenical centre fit for the future. The resulting "Green Village" project includes the renovation of the listed central building, while six new buildings, providing offices, apartments and a hotel, are being built in the surrounding gardens. The first two new buildings are scheduled for completion by the end of 2022.

Green Village is one of the first projects to put the "One Planet Living" philosophy into practice. This philosophy is based on ten principles for sustainable neighbourhoods, which Implenia formulated together with the WWF. The primary aim is to reduce CO_2 emissions during both construction and the building's operational phase by, among other things, selecting the right materials and using renewable energy. A large solar energy system, for example, is being installed on the roofs.

"One Planet Living" also includes other environmental measures, such as reducing and recycling waste, green mobility solutions and promoting biodiversity. Emphasis is also placed on social issues, such as encouraging neighbourliness, using regional resources, involving local businesses and promoting community well-being.

Our Real Estate Division: https://lnkd.in/dF9Wb6bN

Our Sustainability Report: https://lnkd.in/dKzzfb8

Adrian Wyss, Marc Lyon MRICS, Camille Sainte-rose, Stephan Meierhofer, Fritz Lobeck

#Implenia #RealEstate #Sustainability #GreenVillage #Construction #Buildings #Architecture #Design #Geneva #RenewableEnergy #Recycling #GreenPlanet #SolarEnergy #GreenMobily #WasteManagement #C02Reduction

Übersetzung anzeigen

ANIMATION «SUSTAINABILITY AT IMPLENIA»

3:09 min

OUR FOCUS IN LINE WITH VISION, MISSION AND VALUES

Vision

Our vision is to be a multinational leader in construction services.

Mission

Our mission is to sustainably develop properties and construct buildings as well as infrastructure with and for people to fit their modern living, working and mobility needs.

Values

Excellence

Agility

Collaboration

Integrity

Sustainability
We generate results that endure and we protect our fellow human beings and the environment. We live up to Sustainability by working together to create a future worth living for everyone.

Sustainability Priorities

Sustainable products and services

Respect for the environment

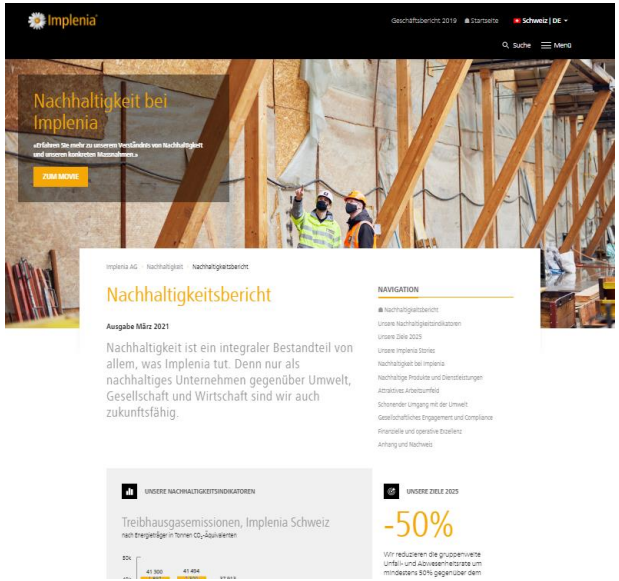
Attractive working environment

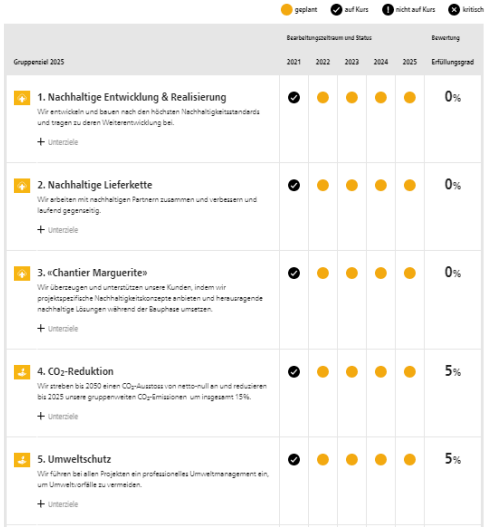
Social commitment and compliance

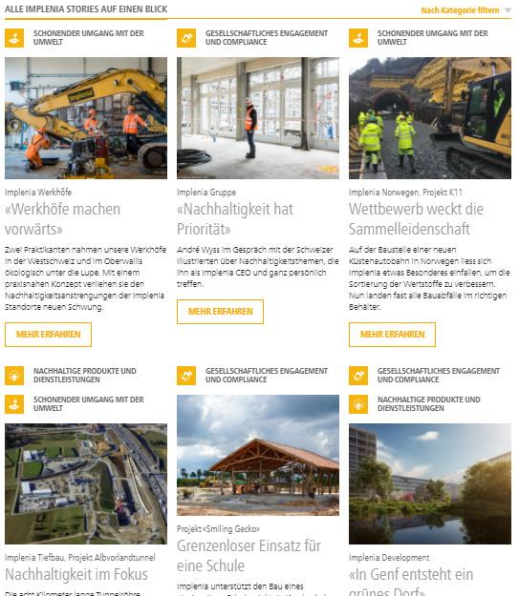
Financial and operational excellence

SUSTAINABILITY AT IMPLENIA

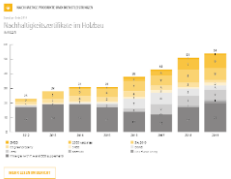
SUSTAINABILITY REPORTING SINCE 2012







sustainability.implenia.com



- Sustainability report newly integrated on website www.implenia.com
- Includes new features: Goal cockpit, interactive graphics and movies
- 6th Sustainability Report will be published on 01.03.2023


Organisation
SUSTAINABILITY
COMMUNITY

SUSTAINABILITY COMMUNITY

ORGANISATION

Sustainability Committee
11 members (Divisions & Functions)

Global Sustainability Team
6 Global Sustainability Specialists

Sustainability at Implenia

«Values & Goals»

- Sustainability **strategy**, goals, group-wide communication and reporting
- Group-wide **initiatives** for ongoing improvement towards more sustainability at Implenia

Respect for the environment

«Safeguard»

- **Environmental protection** on construction sites
- Fundamentals for operational teams, creation of awareness campaigns, CO2 footprint assessment and **CO2 reduction** measures
- Planning and implementation of project-specific **environmental initiatives** by country units and construction projects

Sustainable products and services

«Competence Center»

- **Support** in planning, acquisition and realization
- Multiple years of experience in achieving **sustainability certifications** in building construction

Sustainability Specialists in Divisions
Members in all Divisions and Countries with focus to implement on construction sites

SUSTAINABILITY GOALS 2025

SUSTAINABILITY GOALS 2025

OUR 12 SUSTAINABILITY GOALS

Sustainable Products and Services | Respect for the Environment | Attractive working environment | Social commitment and compliance | Financial and operational excellence

Sustainable Development & Construction

[1] «We develop and build according to the highest **sustainability standards** and contribute to their further development»

CO_2-Reduction

[4] «We **aim for net zero CO_2-emissions by 2050** and a **reduction** in our group-wide **CO_2-emissions by 15%** by 2025»

Sustainability in our DNA

[7] «We live up to sustainability in our daily actions and **transparently communicate** our learning and our results»

Ethical Governance

[10] «We **live a zero-tolerance policy** towards compliance violations, always do **business in a responsible and ethical manner** and demand the same behavior from our partners»

Sustainable Supply Chain

[2] «We work with **sustainable partners** and continuously improve together»

Environmental Protection

[5] «We carry out professional **environmental management** in all projects to **prevent environmental incidents**»

Engaged Employees

[8] «We **aim for zero accidents**, unconditionally stand for safety at work, modern working conditions, **high employee satisfaction** and a low fluctuation rate»

Sustainable Finance

[11] «We integrate **ESG-criteria** in our **business** and **investment decisions** for clients, investors and society at large»

Eco Construction Site

[3] «We convince and support our clients by offering project-specific **sustainability concepts** and implementing outstanding **sustainable solutions** during construction»

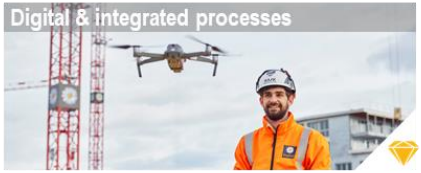
Circular Economy

[6] «We develop new **circular business models** and promote the **closing of material cycles**»

Implenia without borders

[9] «We engage in **social partnerships** and collaborate with our **stakeholders** beyond the construction site»

Digital & integrated processes



[12] «We consolidate our reputation for **operational excellence** and **high-quality standards**»

SUSTAINABILITY INITIATIVES

SUSTAINABLE DEVELOPMENT & CONSTRUCTION

#1 «We develop and build according to the highest **sustainability standards** and contribute to their further development»

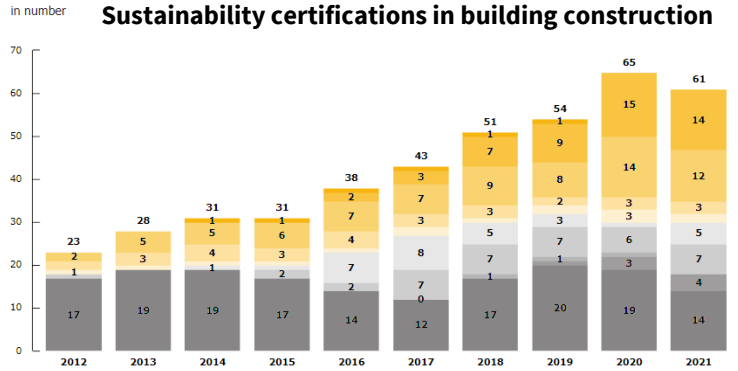
Sub-Goals	KPI
1.1 We certify all our development projects according to established **sustainability labels** and strive to achieve the highest certification requirements. (e.g. SNBS, DGNB, SEED)	% Projects
1.2 We reduce the **grey energy** of our development projects and consistently promote **timber construction.**	# Projects
1.3 We systematically increase the share of **renewable energies** (e.g. by installing PV systems) and minimize the **consumption of energy** (including CO_2 emissions), water and waste in our own development projects.	# kWh/a

REFERENCE PROJECTS IN BUILDING CONSTRUCTION

Buildings	Label
Implenia Connect	WELL Platin
UBS Para, Zürich*	LEED Platin
Andreasturm, Zürich	DGNB Platin
Giessenplatz, Dübendorf	greenproperty
Quai Zurich, Zürich	LEED Platin, Minergie-P-Eco, 2000-Watt-Areal
Neugrüen, Mellingen	Minergie-A-P-Eco
UBS HGHG, Zürich	LEED Platin
Cilag, Schaffhausen	LEED Gold
WHO, Genf	Minergie
Pont Rouge, Genf	DGNB Gold
Rue de Lausanne, Genf	SNBS Gold

Real Estate	Label
Lokstadt, Winterthur*	2000-Watt-Areal, Minergie-P-Eco, Minergie-Eco, SNBS, SIA 2040
Tivoli, Neuenburg*	SEED
sue&til, Winterthur	Minergie, SIA 2040
Green Village, Genf*	SEED, SNBS
schorenstadt, Basel	Minergie-P-Eco, SNBS

*Ongoing project



SUSTAINABLE DEVELOPMENT AND CONSTRUCTION

SNBS INFRASTRUCTURE

NNBS - Network Sustainable Construction Switzerland
Implenia is executive board and founding member since 2012

SNBS Infrastructure

- Offers overarching concept for sustainable construction in Switzerland.
- To plan, construct, operate and further develop infrastructure projects
- Core topics: mobility, water, protective structures, energy and communication
- Holistic sustainability label
- Version 1.0: 75 indicators in 29 criteria
- Further information on the SNBS Infrastructure can be found online

Link

Our experience

- Education with NNBS done
- Project-work done with ETH Zurich
- Criteria catalogue used for acquisition

Transversale Themen	Bereich	Thema	Kriterium	
T1.1 Zielkonflikte und Synergien T1.3.1 Zielkonflikte T1.3.2 Synergien	Gesellschaft	Raumentwicklung und Siedlung	G 1.1	Raumplanung, Landschaften, Ortsbilder und Kulturraum
			G 1.2	Wohnqualität und Zusammenleben
			G 1.3	Zugang zur Infrastruktur und Aufenthaltsqualität
		Gemeinschaft	G 2.1	Kommunikation und Partizipation
			G 2.2	Sozialverträgliches Verhalten
			G 2.3	Rechtssicherheit
			G 2.4	Solidarität, Gerechtigkeit, Verteilungseffekte
		Gesundheit und Sicherheit	G 3.1	Arbeitssicherheit, Unfallvermeidung, Rettung und Gesundheit
			G 3.2	Schutz vor Gewalt und Kriminalität
T1.2 Zielsetzung und Systemabgrenzung T1.2.1 Zielsetzung des Projekts T1.2.2 Ziele der SNBS-Bewertung T1.2.3 Systemabgrenzung	Wirtschaft	Betriebswirtschaft	W 1.1	Betriebswirtschaftliches Kosten-Nutzen-Verhältnis
			W 1.2	Nutzungsflexibilität, Anpassungsfähigkeit und Rückbau
		Volkswirtschaft	W 2.1	Volkswirtschaftliches Kosten-Nutzen-Verhältnis
			W 2.2	Regionalwirtschaftliche Aspekte
			W 2.3	Ökonomische Nutzung vorhandener Infrastrukturen
		Finanzierung	W 3.1	Geeignete Finanzierung
T1.1 Projektbegleitende Nachhaltigkeitsbeurteilung T1.1.1 Prüfung der Anwendbarkeit T1.1.2 Nachhaltigkeitsbewertung T1.1.3 Projektorganisation	Umwelt	Rohstoffe, Energie und Bodennutzung	U 1.1	Energieverbrauch
			U 1.2	Flächennutzung, -recycling und Boden
			U 1.3	Belastete Standorte
			U 1.4	Verwertung von unbelasteten und belasteten Aushub-, Ausbruch- und Rückbaumaterialien (Abfall)
			U 1.5	Umwelt- und Ressourcenschonender Materialeinsatz
		Natur und Umwelt	U 2.1	Beeinträchtigung des Klimas
			U 2.2	Umweltbelastungen
			U 2.3	Oberflächengewässer und Grundwasser
			U 2.4	Natur und Landschaft
		Gefahrenprävention	U 3.1	Naturgefahren
			U 3.2	Störfälle

SUSTAINABILITY GOALS 2025

CO2-REDUCTION

#4 «We aim for **net zero CO_2-emissions by 2050** and a **reduction** in our group-wide **CO_2-emissions by 15%** by 2025»

Sub-Goals	KPI
4.1 We consistently pursue our decarbonization strategy, reduce our annual **sales-related CO_2-emissions** of the entire group by **3%** and our footprint by 15% by 2025. In doing so, we **annually collect our CO_2-footprint** from each country in which we operate, increase our CO_2-offsetting by 10% annually and define country-specific CO_2-reduction paths.	% Reduction # CO_2 emissions
4.2 We examine all of Implenia's suitable roofs and façades for the use of **solar panels** with the aim of tripling internal solar power production to 3 GWh.	# kWh/a of solar energy
4.3 We improve the **energy efficiency** of all our production facilities and properties.	% Locations
4.4 We define a group-wide **mobility concept** with fossil-free cars and implement specific concepts at each location with 50 or more employees.	% Locations
4.5 We are continuously increasing the proportion of renewable energy in our electricity purchases and are aiming for **100% renewable energy** in our properties and production facilities.	% Locations

CO2-REDUCTION

DATA COLLECTION SINCE 2012

Data recording matrix
This is the benchmark data currently recorded by Implenia:

Category	Type	Key data recorded
Group	General information	
Production facilities		
Properties		
Building sites		
Mechanical and transportation		
Business trips		

- Surfacing works, concrete works, gravel works
- Office buildings
- Workshops
- Construction sites
- Lorries and machinery
- Delivery trucks
- Cars
- Flights
- Revenue
- Employees
- Paper
- Heating
- Electricity
- Fuel
- Water
- New materials
- Recycled materials
- Kilometres
- Destinations

Official first data publication

- 2012/13: Switzerland
- 2019: Germany, Sweden, Norway, Austria
- 2020: France

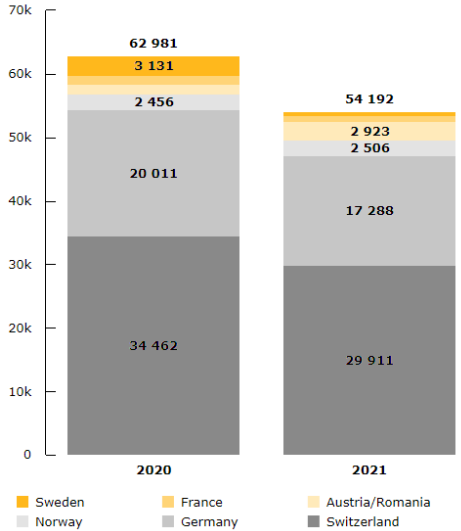
CO2-REDUCTION

CO2-FOOTPRINT, GLOBAL

Status: end 2021

Base year 2020: Greenhouse gas emissions, Implenia Global (Scopes 1 + 2)

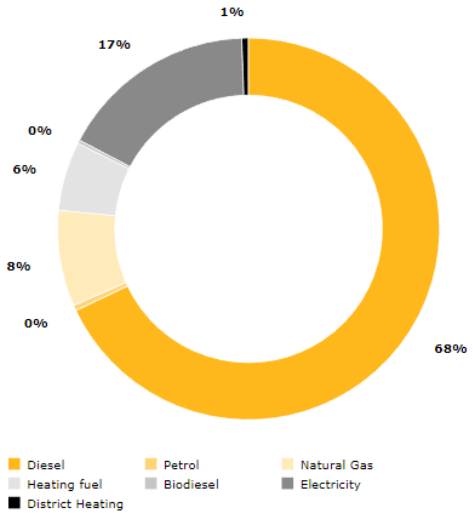
in tonnes of CO_2 equivalents



Status: end 2021

Base year 2020: Greenhouse gas emissions, Implenia Global (Scopes 1 + 2)

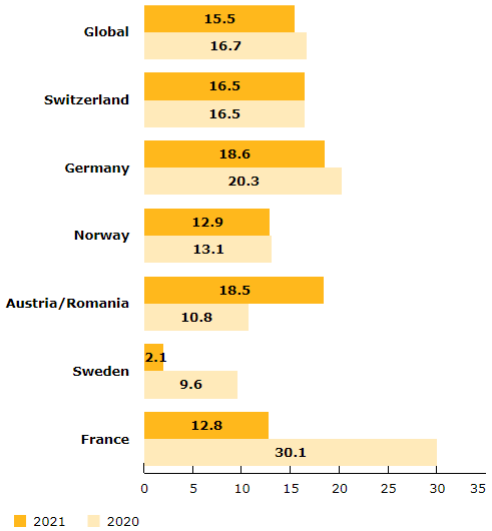
by energy source and in %



Status: end 2021

Base year 2020: Revenue-adjusted greenhouse gas emissions, Implenia Global (Scopes 1+2)

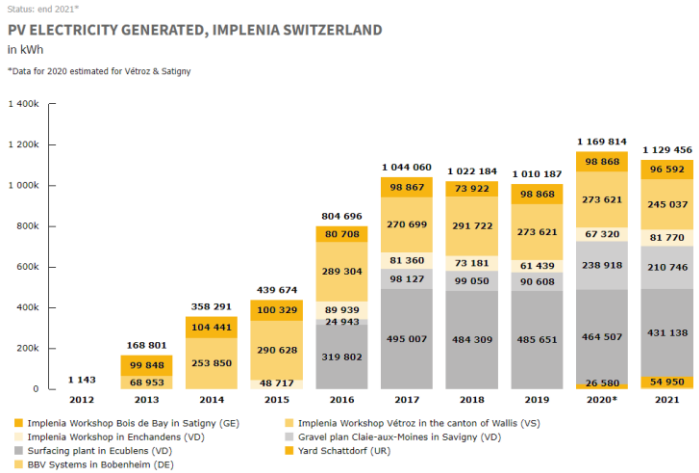
in tCO_2/Mio. CHF



CO2-REDUCTION MEASURES EXAMPLES PRODUCTION SITES & YARDS

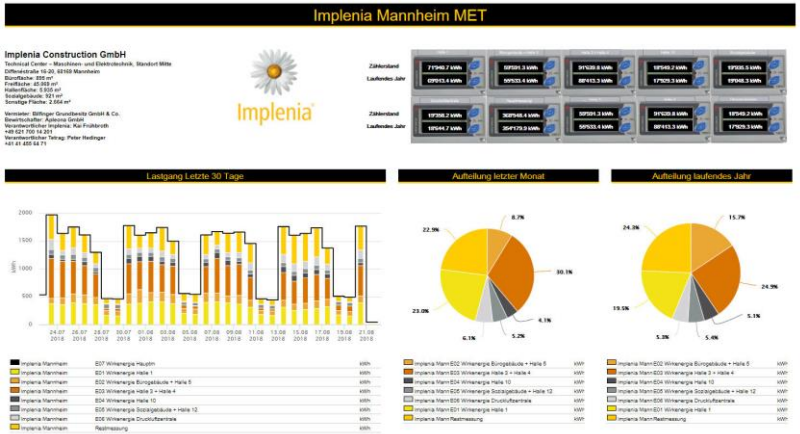
Photovoltaic Power Plants

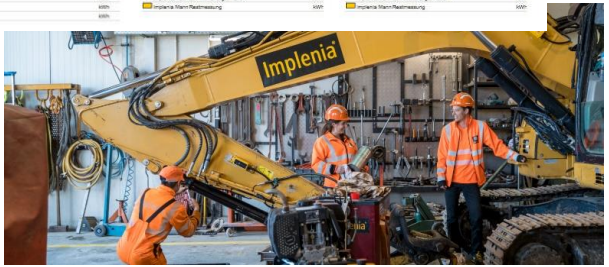
7 photovoltaic power plants produces 1.1 GWh/a



Energy Monitoring

8 energy monitoring systems are installed





CO2-REDUCTION MEASURES EXAMPLES CONSTRUCTION SITE: CO2-FOOTPRINT

Raderhochbrücke: DE - 2022

59% steel, 29% concrete

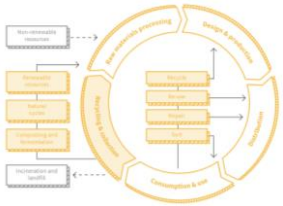
SiSto Mositunnel Brunnen: CH - 2014

74% concrete, 11% electricity

CO2-REDUCTION MEASURES EXAMPLES CONSTRUCTION SITES

Circular Economy

Several pilot-projects initiated



Civil Engineering measures:

- Onsite production: Mobile gravel & concrete plants
- Re-using of material on a close by construction site
- Recycling of excavation material
- Reduction of transport emissions and costs

Implenia believes that the **potential** in this area of business is particularly **good** because of the **large volume of excavated material** it produces.

Further CO2-reduction measures

Find more initiatives under: Sustainability Stories

CO2-reduction measures:

- Sustainable Concrete
- Logistic concepts
- Pellet heating
- Electrified machinery
- Eco-Drive
- Green electricity
- Bio-Diesel
- LED-Lightning

SUSTAINABLE PRODUCTS AND SERVICES

Implenia Civil Engineering

A bridge joins the circular economy

SUSTAINABLE PRODUCTS AND SERVICES

Implenia Civil Engineering

Closing material cycles on site

SUSTAINABLE PRODUCTS AND SERVICES

Implenia Production sites

Setting the standard for asphalt recycling

RESPECT FOR THE ENVIRONMENT

Implenia depots

“Depots move forward”

SOCIAL COMMITMENT AND COMPLIANCE

Implenia Group

“Sustainability is a priority”

SUSTAINABILITY GOALS 2025

ENVIRONMENTAL PROTECTION

[5] «We carry out professional **environmental management** in all projects to **prevent environmental incidents**»

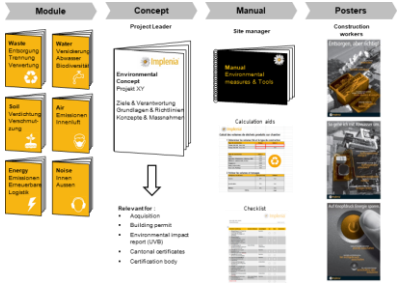
Sub-Goals	KPI
5.1 We consistently report our **environmental incidents** categorized by severity and continuously reduce through corrective actions our annual environmental incidents to zero serious incidents.	# Incidents
5.2 We reduce **construction waste**, introduce waste separation systems on all our construction sites and increase the **recycling rate to 100%** for materials that can be separated in a technically sensible manner.	100%
5.3 We establish our **environmental organisation** so that all our personnel have competent contact persons for environmental protection and are **trained** by them three times a year on an environmental topic.	% educated employees

ENVIRONMENTAL PROTECTION PRODUCTS

Environmental Standard
Global standard

Global environmental **standard** with **6 environmental topics** (construction waste, noise, air, water, soil and energy) for all divisions and countries

Environmental Concept
Modular tool

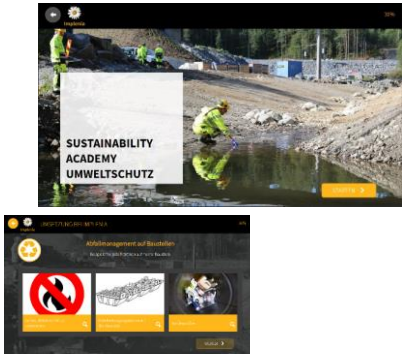


Modular concept for the individual description and implementation of environmental aspects on construction sites

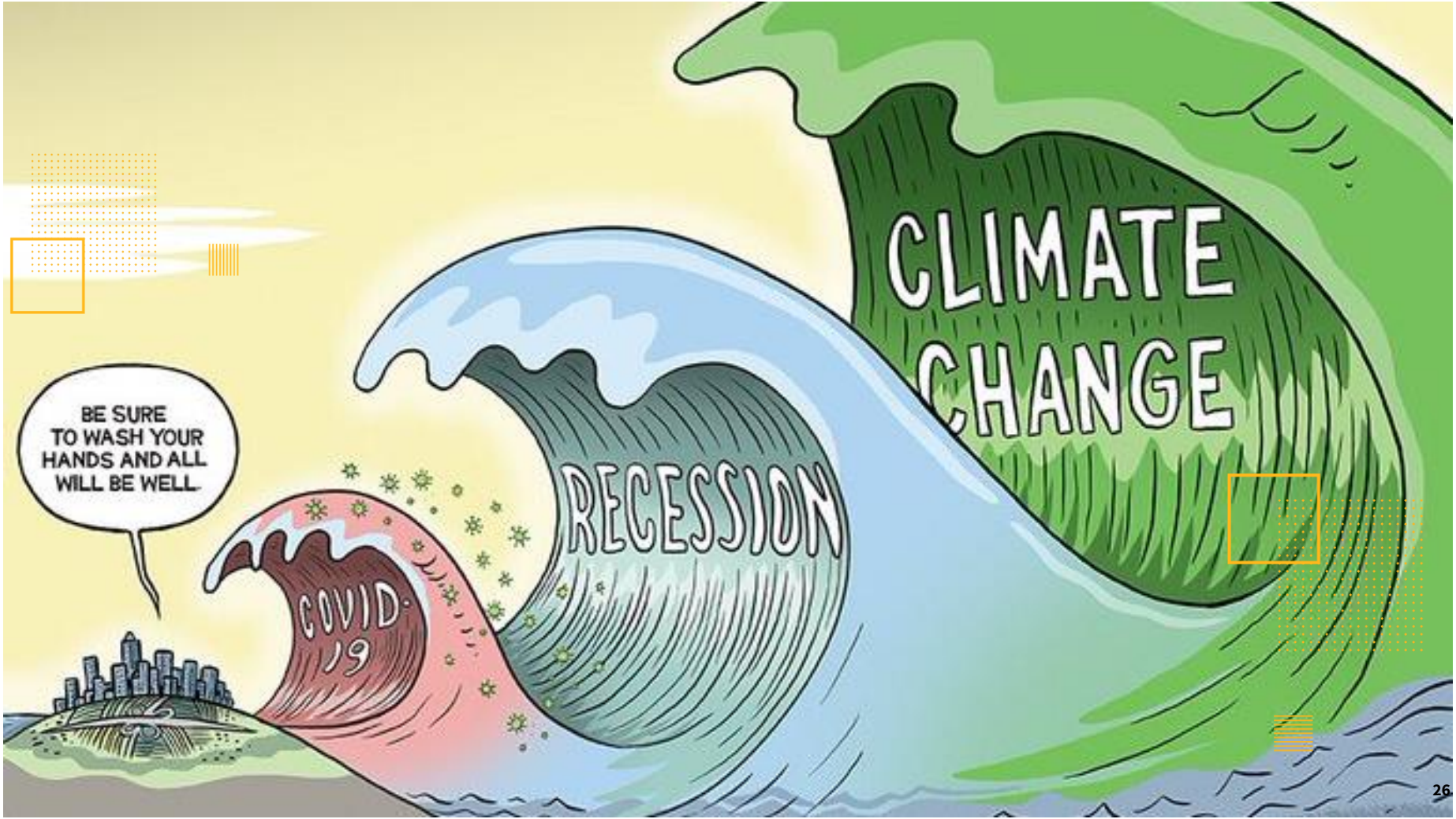
Environmental Posters
11 sensitization campaigns

Sensitisation Campaigns **for blue collars**: Posters, presentations and info-material

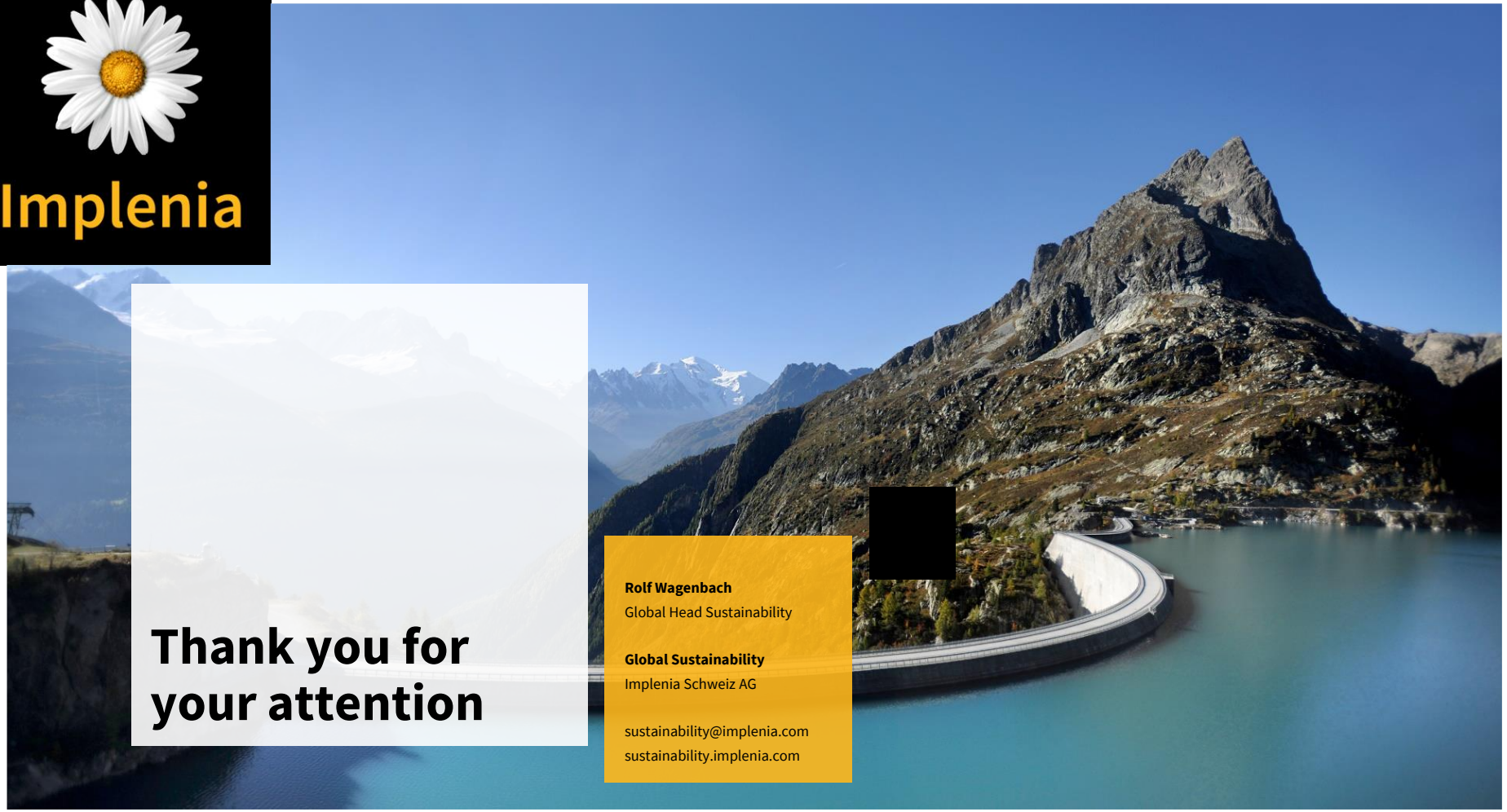
Sustainability Academy
E-learnings



E-learnings **for white collars**: Environmental protection, CO2-reduction, Sustainable development & construction, Circular economy, Sustainable procurement


BE SURE TO WASH YOUR HANDS AND ALL WILL BE WELL
COVID-19
RECESSION
CLIMATE CHANGE

Implenia



Thank you for your attention

Rolf Wagenbach
Global Head Sustainability

Global Sustainability
Implenia Schweiz AG

sustainability@implenia.com
sustainability.implenia.com

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SUSTAINABILITIY IN THE PRODUCTION OF INFRASTRUCTURE-CONCRETE ELEMENTS

ADRIAN FORRER | MÜLLER-STEINAG GROUP

WHO WE ARE

ADRIAN FORRER | DIRECTOR MÜLLER-STEINAG UMWELT AG

MÜLLER-STEINAG GROUP

>1150

Employees

>145

Years active in the construction industry

16

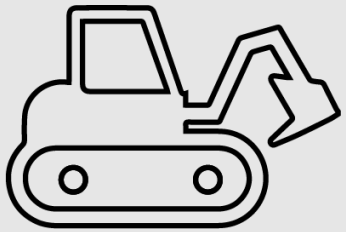
Production Sites

9001

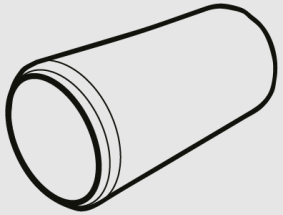
14001

Certified companies

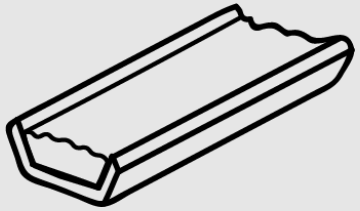
TARGET CONSTRUCTION SEGMENTS



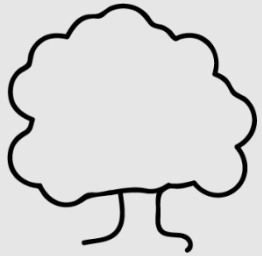
Civil Engineering



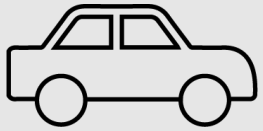
Sewerage Construction



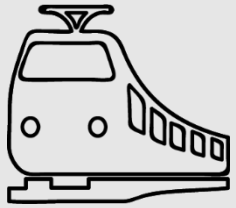
Hydraulic Engineering



Gardening & Landscaping

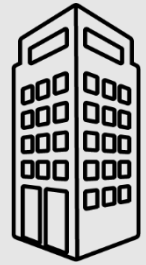


Road Construction



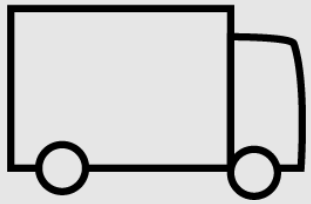
Railroad Construction

Surface & Path Construction



Building Construction

SERVICES



Logistics

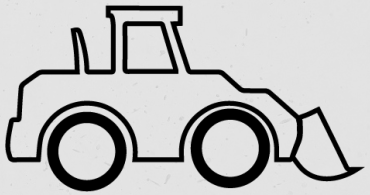
Engineering

Concept Proposals

Structural Analysis

Setting and Installation Tools

Assembly



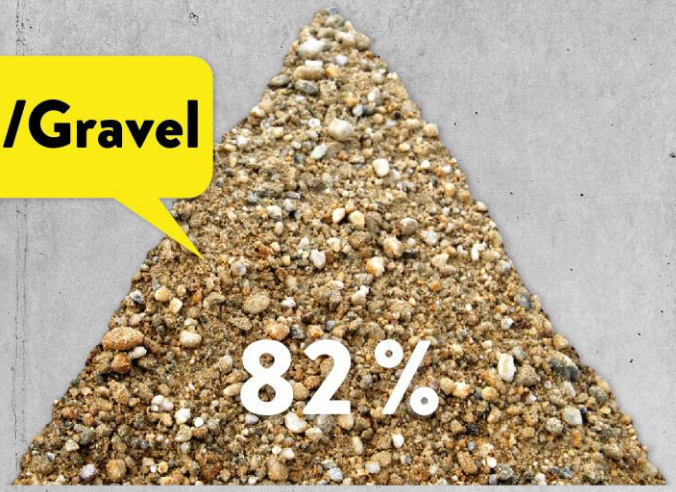
Disposal

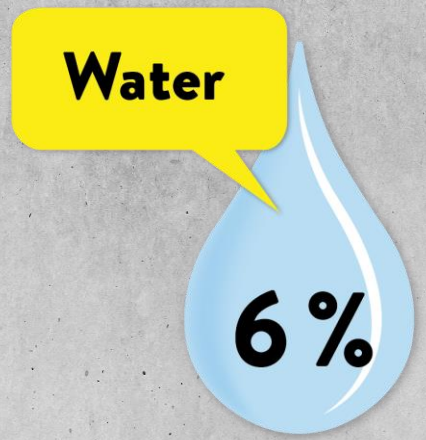
Sales Documents

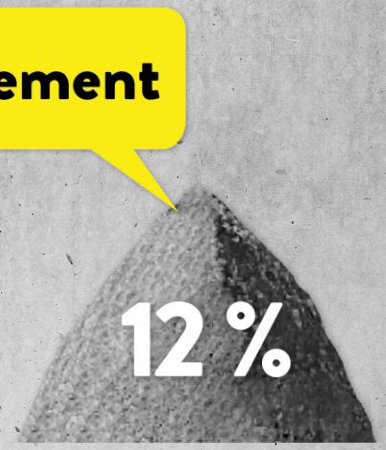
MÜLLER-STEINAG Gruppe

MATERIAL

CONCRETE







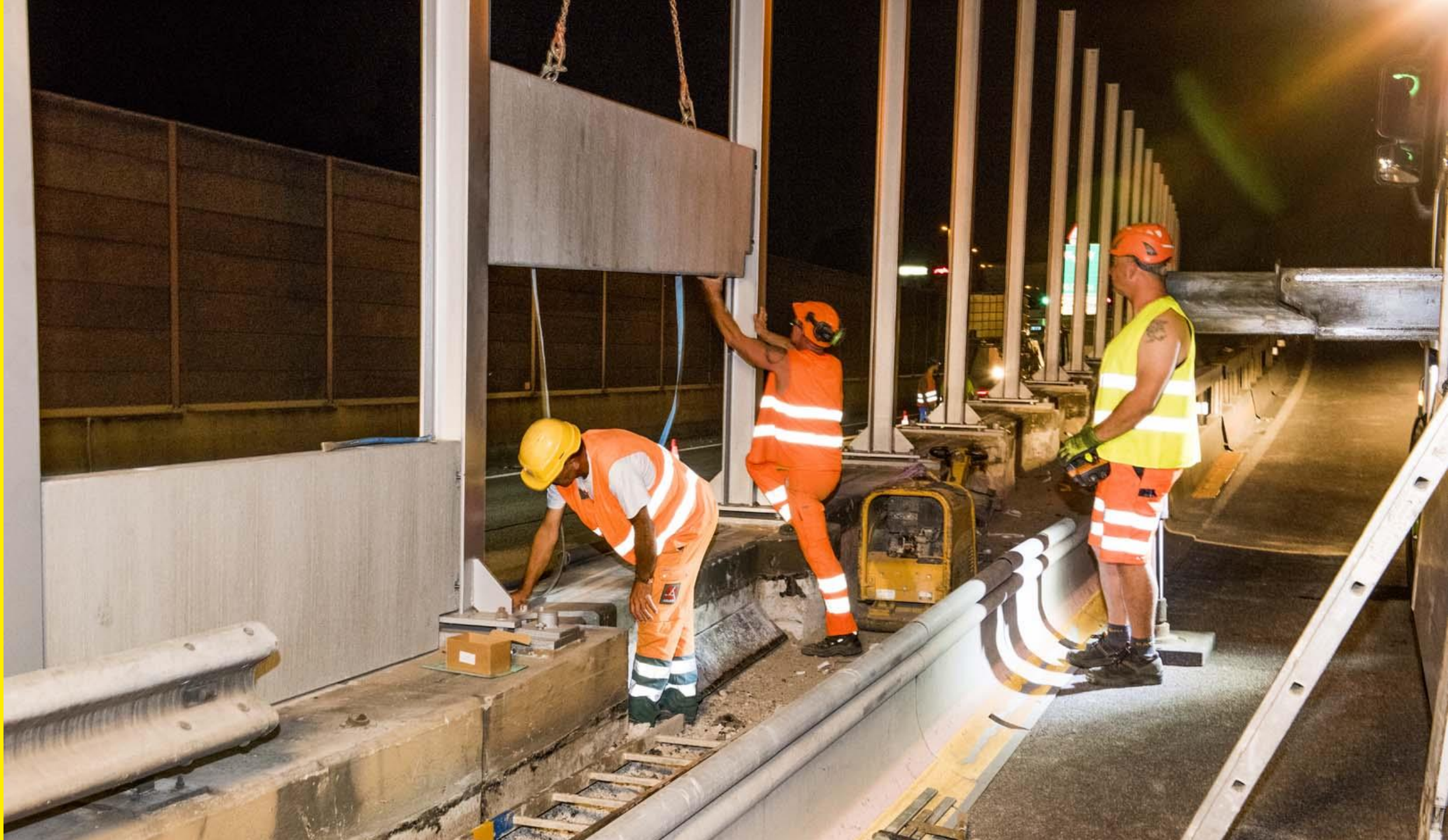
100 %

MÜLLER-STEINAG Gruppe

PRECAST CONCRETE PRODUCTS FOR INFRASTRUCTURE


TUNNEL
RATHAUSEN


KIBAG
WALO
36




Meier+Jäggi
MÜLLER-STEINAG ELEMENT AG

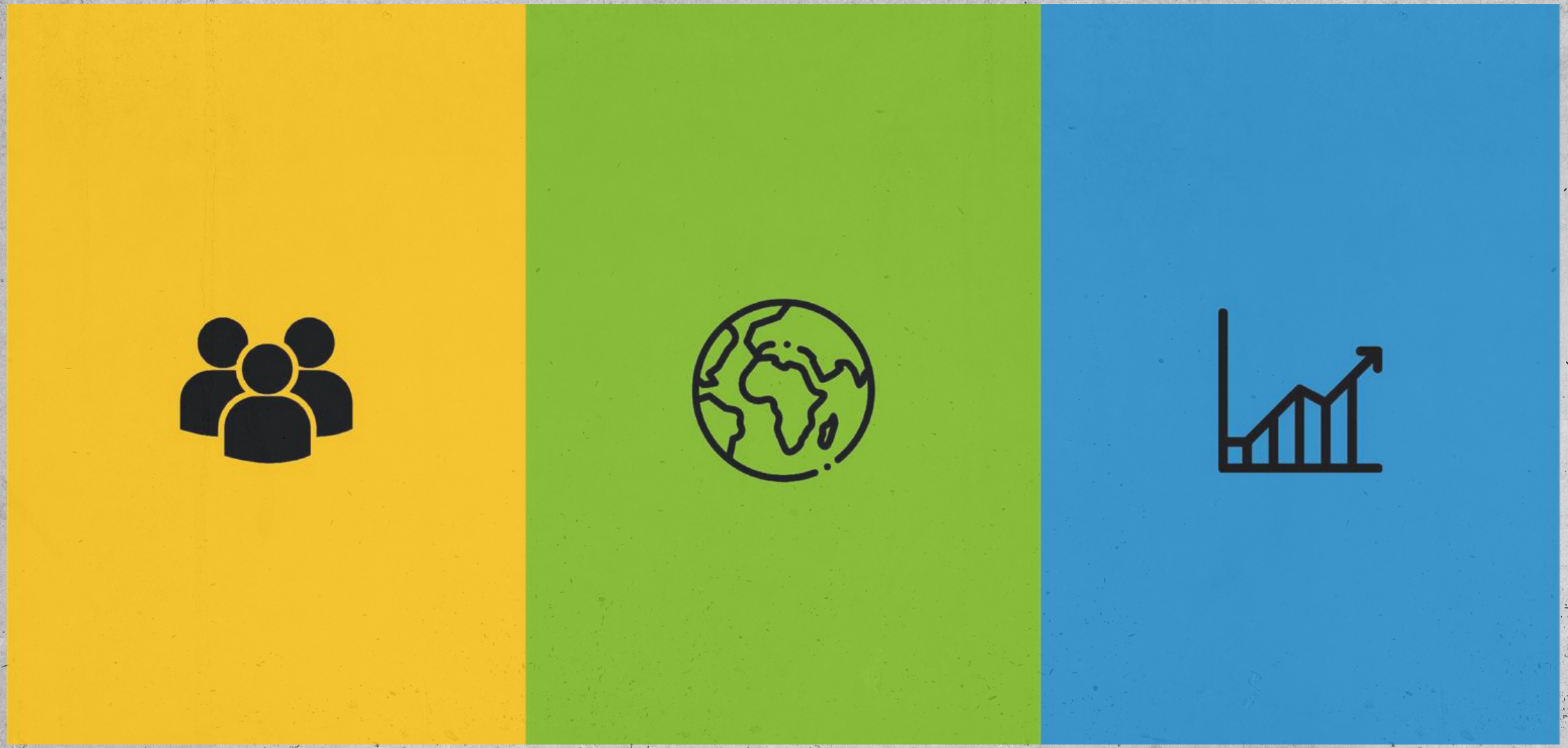

LEISER
CONFISERIE
VALSER
LEISER
VALSER
KIBAG


CONVOI-EXCEPTIONNEL
FR-NA 10
SCANIA
Toppenburger
GROVE

MÜLLER-STEINAG Gruppe

SUSTAINABILITY

THE 3 P’S



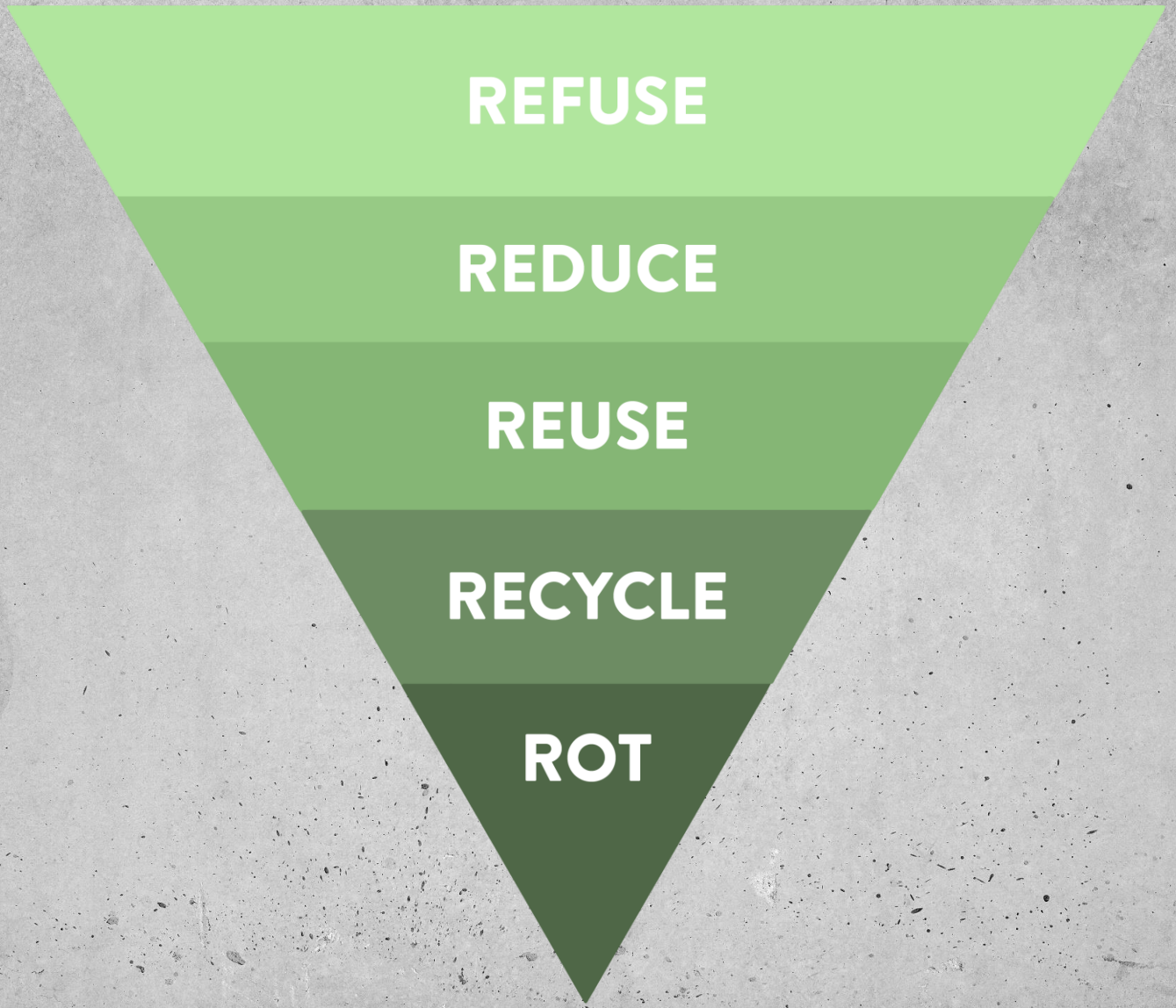
MÜLLER-STEINAG Gruppe

FOCUS PLANET

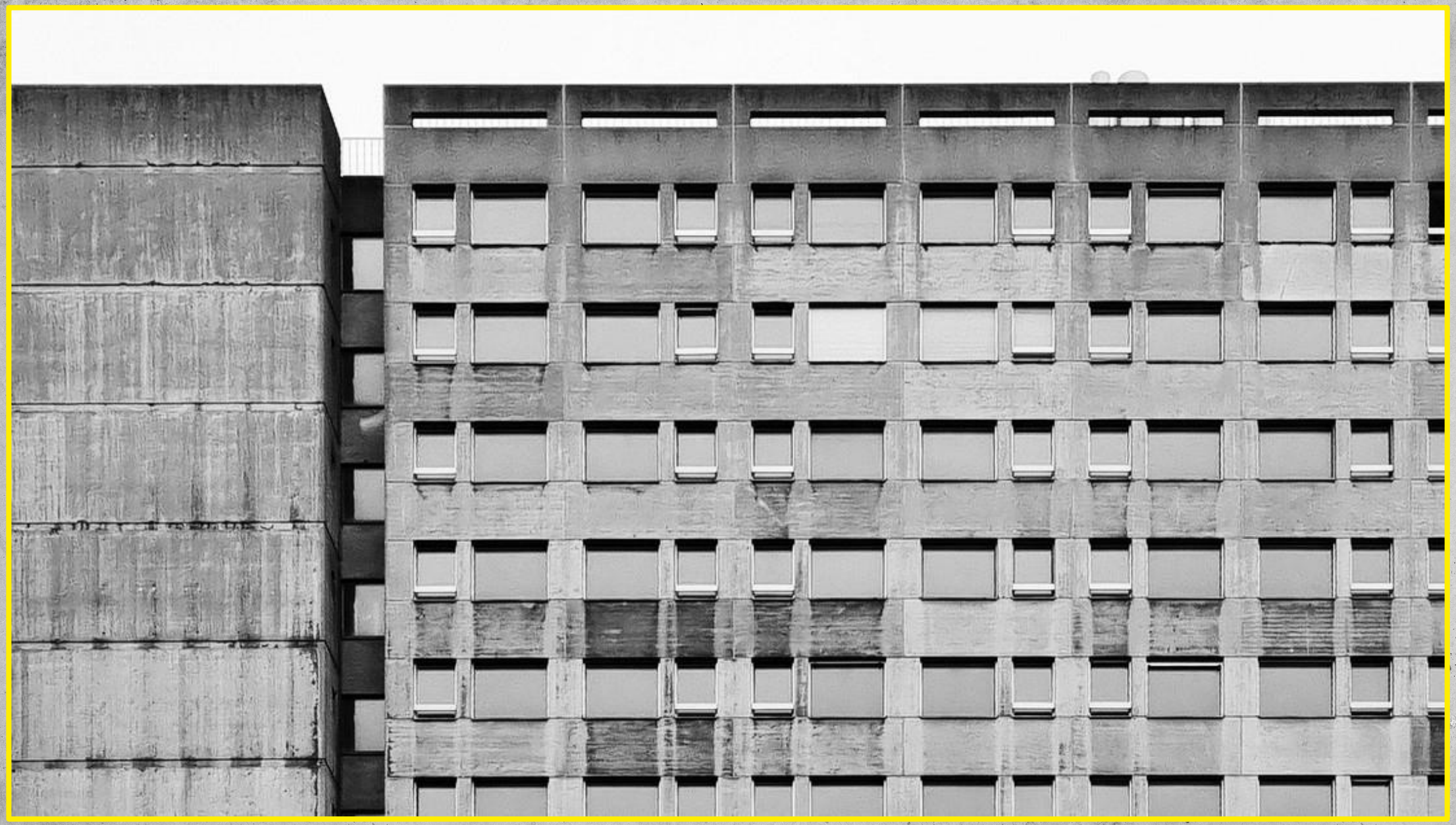
VISION

The MÜLLER-STEINAG Group wants to become climate-neutral by **2050**. This means that the company-wide carbon footprint should have a net zero balance.

THE 5R METHODOLOGY APPROACH



REUSE EXISTING ELEMENTS



MÜLLER-STEINAG Gruppe

CO2-REDUCTION

REDUCE DIMENSIONS OF PRODUCTS (THINNER)

REDUCE PROCESS ENERGY

Solar energy

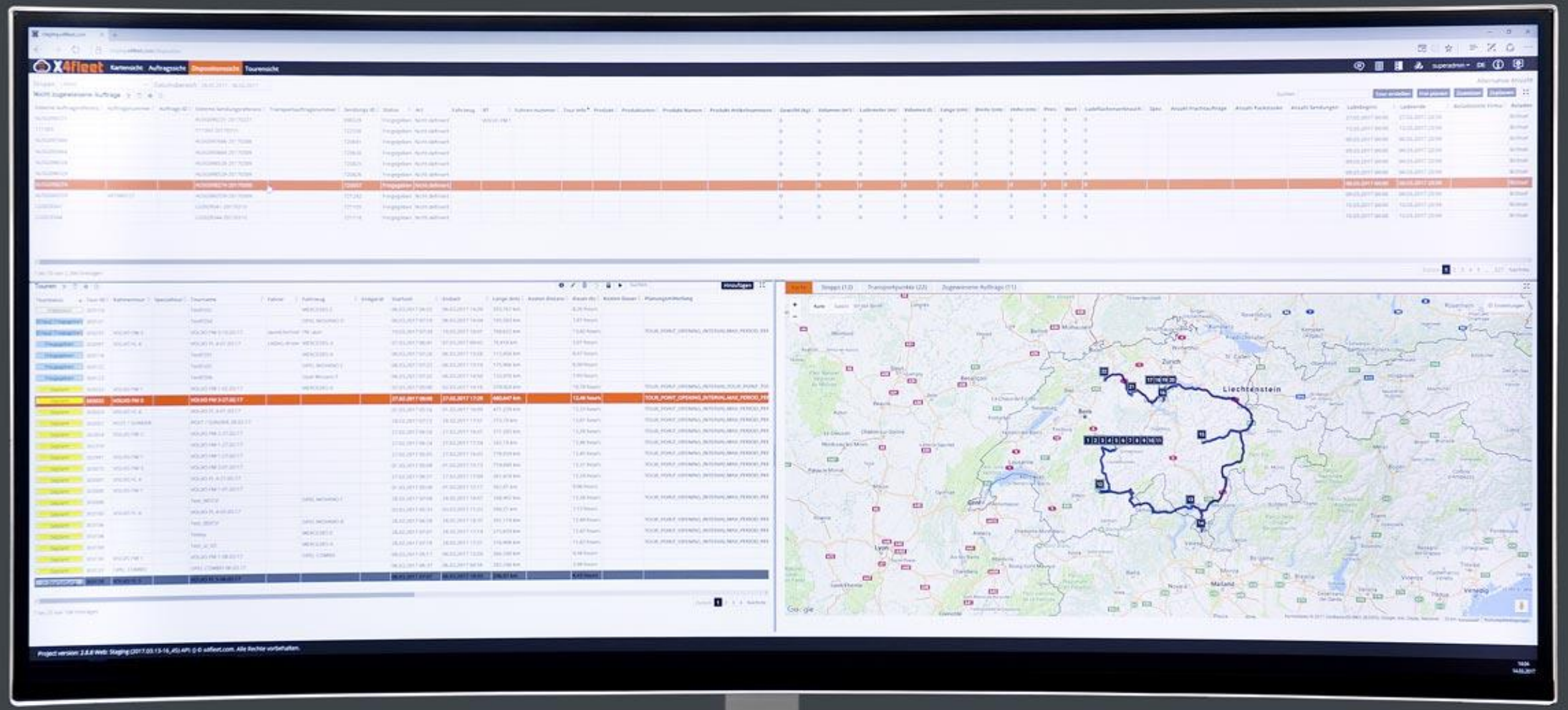
Reuse process water

REDUCE CEMENT IN CONCRETE MIX

REDUCE CLINCER (CEM I TO CEM II)

RECARBONISATION OF RECYCLED CONCRETE AGGREGATES

REDUCE TRANSPORTS (DISPATCH)



MÜLLER-STEINAG Gruppe

CIRCULAR ECONOMY

CLOSING THE CYCLE OF MATERIALS

4 Concrete production and new construction

1 Selective dismantling

3 Cement production: grinding with clinker

2 Processing to concrete and mixed granulate

…THAT MEANS: YOU HAVE TO CHALLENGE THE EXISTING REGULATIONS

c r b

NPK

Merkblätter zum Devisieren

Nr. 14 D/17

Beton – nach den Normen SN EN 206:2013 (2. Auflage) und SIA 262:2013

Hochbau
Tiefbau
Kunstbau
Untertagbau

1 Ausgangslage

Für den Betonbau gilt in der Schweiz die Norm SIA 262 «Betonbau». Die Ausgabe 2013 (gültig seit 1.1.2013) hat die Fassung von 2003 abgelöst. Die Norm SIA 262 stützt sich beim Beton auf die zwei folgenden Normen:

- SIA 262/1 «Betonbau – Ergänzende Festlegungen»
- SN EN 206:2013 (2. Auflage) «Beton – Teil 1: Festlegung, Eigenschaften, Herstellung und Konformität», hier als SN EN 206 bezeichnet.

Tiefbauamt des Kantons Bern **Bautechnische Details Kantons- und Nationalstrassen**

Kunstbauten	**Referenz:**
Tiefbaubetone	**6.10-01**
Vorgaben Tiefbaubetone für Kunstbauten des Kantons Bern	

Das Dokument ist wie folgt strukturiert:

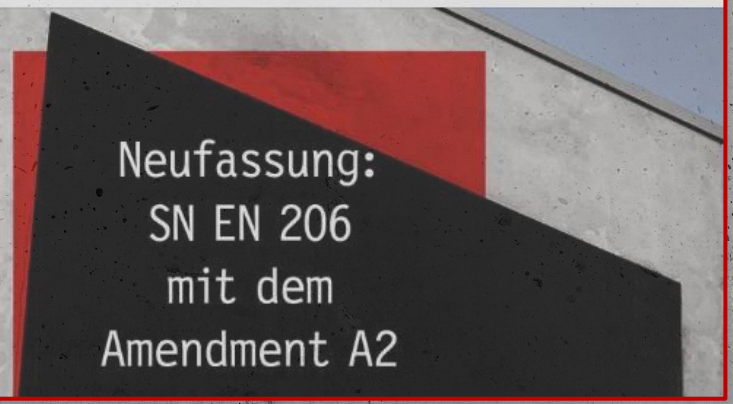
1. Anforderungen

Tiefbaubetone für Kunstbauten (Beilage zur Ausschreibung)	siehe Anhang 1A
Anforderungen an die Betone nach Eigenschaften	siehe Anhang 1B

sia SIA Schweizerischer Ingenieur- und Architektenverein

25. Mai ·

n der Neuausgabe der SN EN 206:2013+A2:2021 «Beton – Festlegung, Eigenschaften, Herstellung nd Konformität» wurden die zugehörigen nationalen Elemente aktualisiert. Dabei wurde das Corrigendum C1:2019 zur SN EN 206:2013+A1 integriert und die Verweise angepasst -- unter nderem infolge der Revisionen der Merkblätter SIA 2030 und SIA 2042. Weiter wurde die Tabelle NA.1 infolge Freigabe eines Zements aktualisiert und die Tabelle NA.2a eingefügt:
ttps://bit.ly/3PDLUIZ



…..ENSURE ACCES TO RC-MATERIALS, …..

…TESTING RC-CONCRETE PRODUCTS, ….

…& SELLING RC-CONCRETE PRODUCTS AS ALTERNATIVE

MÜLLER-STEINAG Gruppe

TODAYS MARKET FOR ENVIRONMENTAL OPTIMIZED PRODUCTS

WHICH PRODUCTS OR SOLUTIONS CAN I ALREADY GET TODAY?

- Concrete with resource-saving cement
- Concrete with recycled aggregate (recycled concrete)
- Concrete with stored CO2
- CO2 neutral concrete
- Concrete elements from prefabrication (BIM)
- Concrete solutions with component activation
- Reuse of supporting structures and components
- Hybrid constructions (composite ceilings or combinations in the structure Reduced masses for ceilings (hollow, ribbed or coffered ceilings

WHICH PRODUCTS OR SOLUTIONS CAN I ALREADY GET TODAY?

That's not enough for us! What is being researched, written on...

– 3D concrete printing

– Mixed demolition granulated concrete

– Recycled concrete with a high resistance class

– Alternative concrete reinforcement systems for textile or carbon concrete

MÜLLER-STEINAG Gruppe

FOCUS PEOPLE

VISION

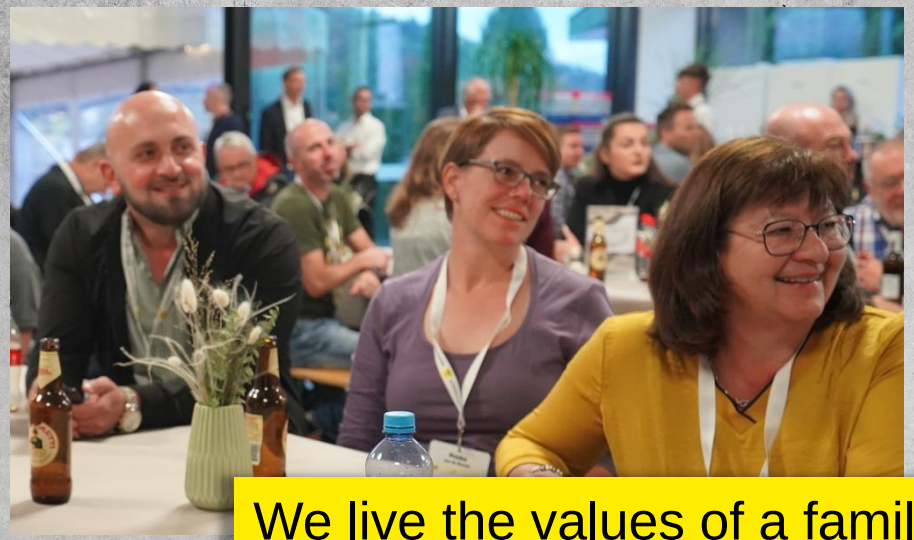
«We attract and retain an above-average number of qualified and motivated employees compared to the industry.»

THE MÜLLER STEINAG GROUP

MOTIVATION & RECRUITMENT

With enthusiasm for our business, we attract the best professionals.

MOTIVATION AND COHESION

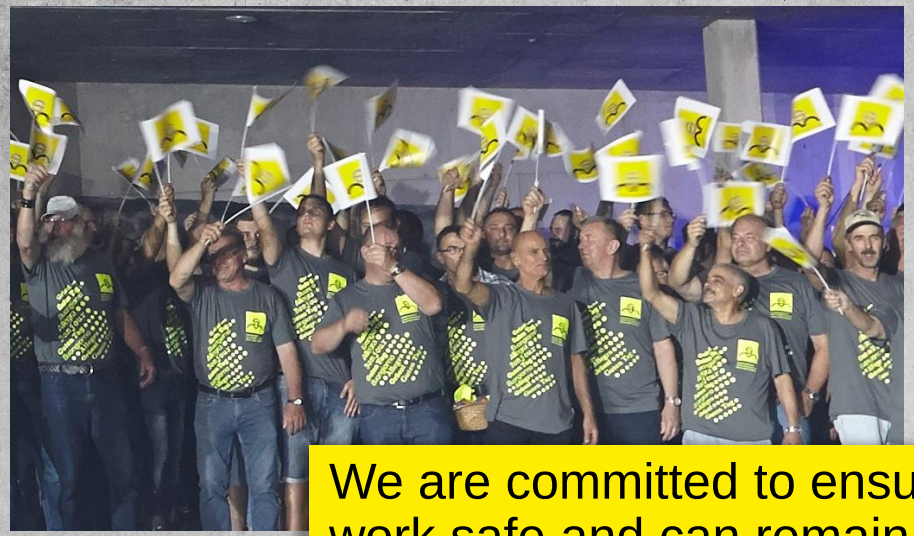


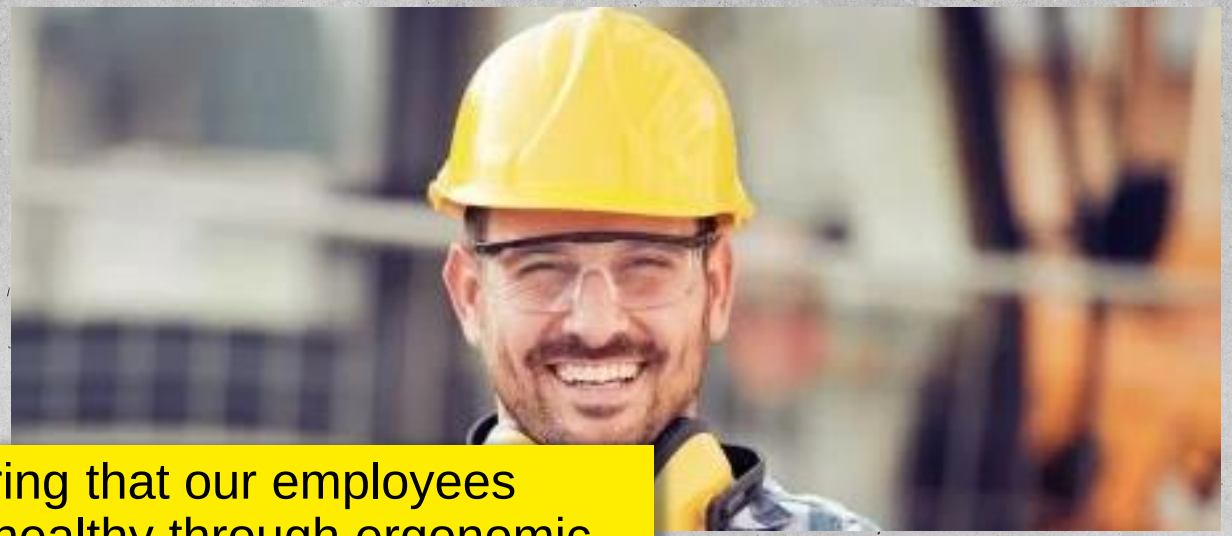
We live the values of a family business and actively promote social togetherness.

PROSPECTS

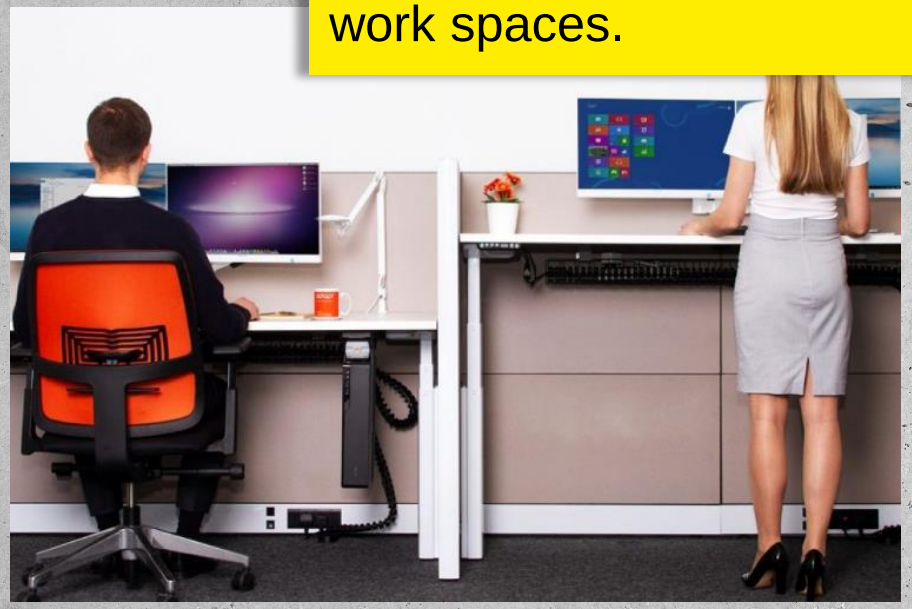
The MÜLLER-STEINAG Group supports employees in their ongoing training and actively promotes young talent.

HEALTH & SAFETY





We are committed to ensuring that our employees work safe and can remain healthy through ergonomic work spaces.



GENDER & SALARY EQUALITY

Gender equality is monitored, measured and the proportion of women is increased where possible.

FOCUS PROFIT (ECONOMY)

MÜLLER-STEINAG Gruppe

VISION

Sustainability commitment increases the company longevity potential, enables growth, while balancing cost and turnover.

INVESTMENTS

- Low risk and long-term pay back investments
- Assuring business for the next generations

RESSOURCES

- Saving existing resources
- RC instead of fluvio glacial gravel

COSTS

- Cost Cutting
- Saving cement consumption
- Saving Energy

PROCESSES

- Research & Development
  in sustainable added value processes
- Saving moulds

PRODUCTS

Research & Development
in new sustainable products (e.g. pesticide separator)

THANK YOU FOR THE LONG LASTING CONCRETE CHOICE

MÜLLER-STEINAG Gruppe

The sales companies of the MÜLLER-STEINAG Group:

CREABETON AG

MÜLLER-STEINAG BAUSTOFF AG

MÜLLER-STEINAG ELEMENT AG

End-of-the-Year Event **Sustainability in Underground Construction**

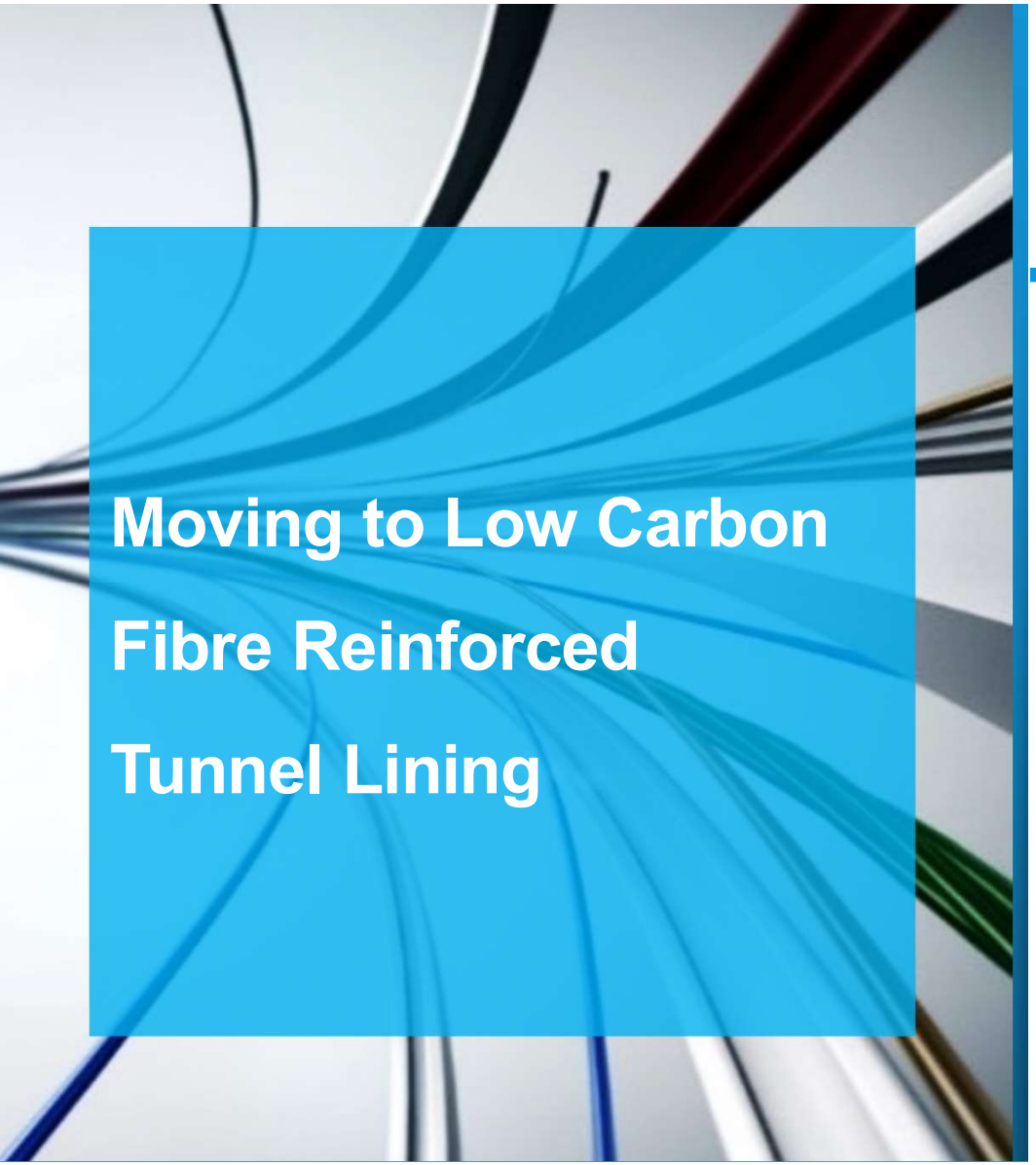
SCAUT
Swiss Center of Applied Underground Technologies

BEKAERT
better together

Build Sustainable Precast Segment Lining with Fibre Reinforced *Concrete*

Benoit de Rivaz

HADERBARCH 13/12/2022



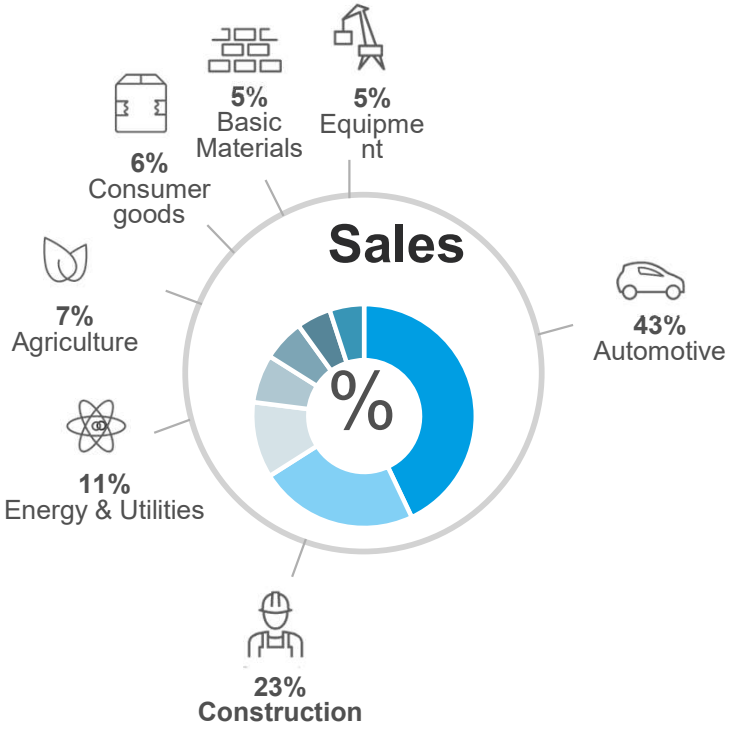
Moving to Low Carbon Fibre Reinforced Tunnel Lining

BEKAERT
better together

Bekaert in brief

- Founded in 1880 by Leo Leander Bekaert
- The world's largest independent producer of steel wire products and solutions
- Serving customers from a very wide range of industry sectors in 120 countries and operating a global manufacturing platform with 29 000 employees worldwide
- Combined sales of € 5.1 billion and consolidated sales of € 4.3 billion (2018)
- Listed on Euronext® Brussels

Bekaert has a strong presence in diverse industry sectors

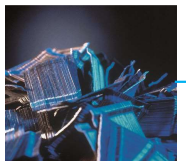


Often hidden or unknown… but always there…

About 30% of all tires around the world are reinforced with Bekaert tire cord

Every year over 1 billion bottles of sparkling wines are opened via the *muselet* made of Bekaert steel wire

Bekaert's customers annually use 3.5 million kilometer of bookbinding wire



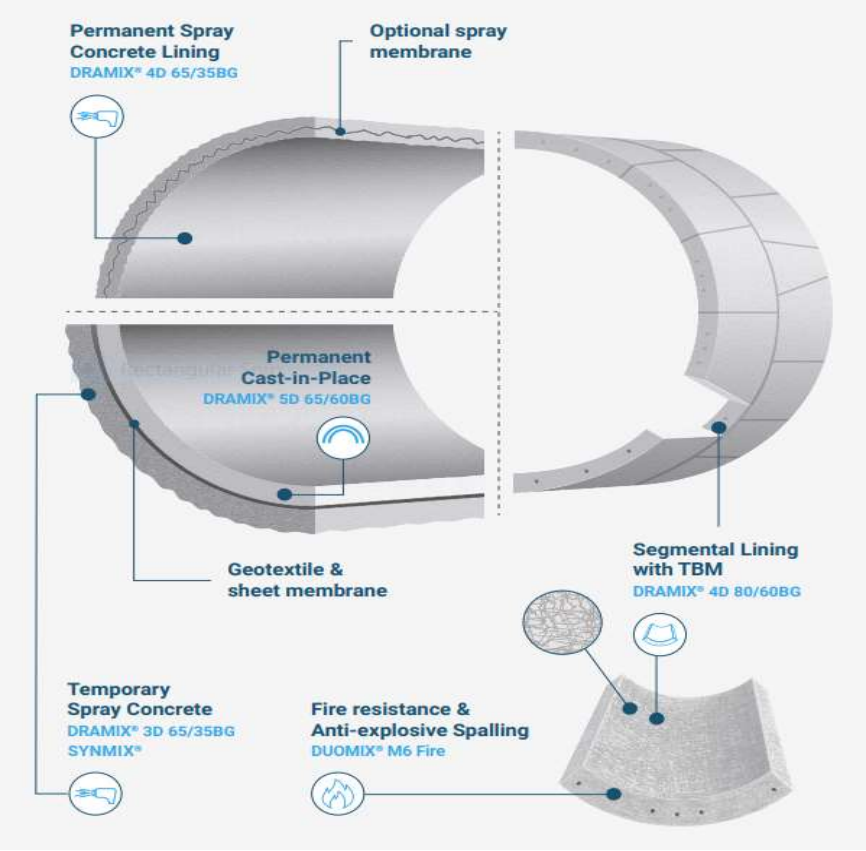
Every year, 10 million m³ of concrete is being reinforced with Dramix® steel fibers invented by Bekaert

A SMART&SUSTAINABLE FIBRE REINFORCED SOLUTION FOR EVERY NEED

BEKAERT
better together

- **EASY DOSING**
- **EASY MIXING**
- **HI PERFORMANCE**
- **EXTREME NETWORK**
- **GREEN DURABILITY**

MAIN TUNNELING APPLICATION



MAIN PRODUCT

BEKAERT
better together

Dramix®3D

The reference fibre for spray concrete for first lining.

Dramix®4D

High strength concrete + extra high tensile strength + small diameter optimized 4D hook gives exceptional post crack behavior.

Dramix®5D

Combined perfect anchorage + ultrahigh tensile strength + high ductile wire and provide flexural hardening at modest dosage.

Synthetic fibres

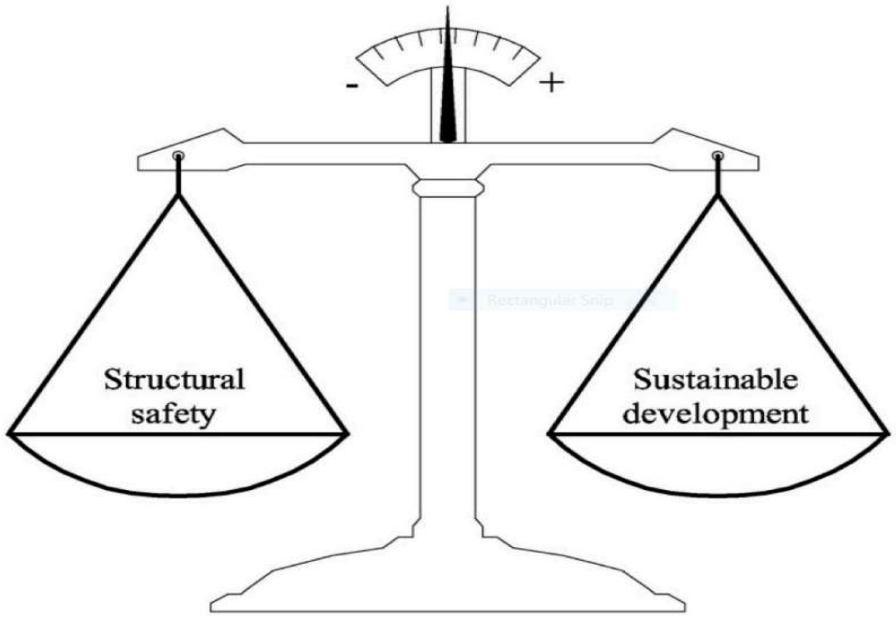
Synmix®

For temporary support and mining.

Duomix® M6 Fire

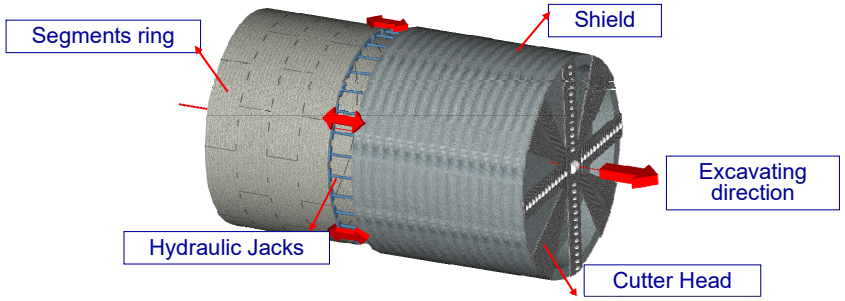
For anti-explosive spalling.

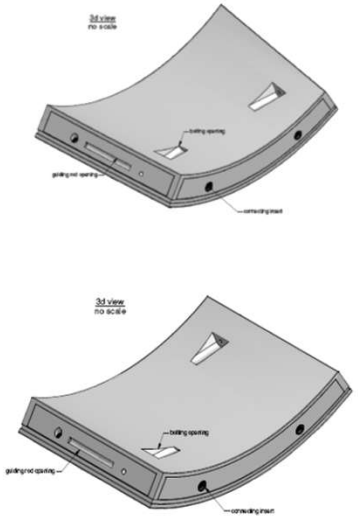
The assessment of concrete linings requires the definition of both the **Sustainability Index and Mechanical Index**



Contemporarily, a low environmental impact guarantees a sustainable development, which is in accordance with the Brundtland Commission of the United Nations (March 20, 1987), the "development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

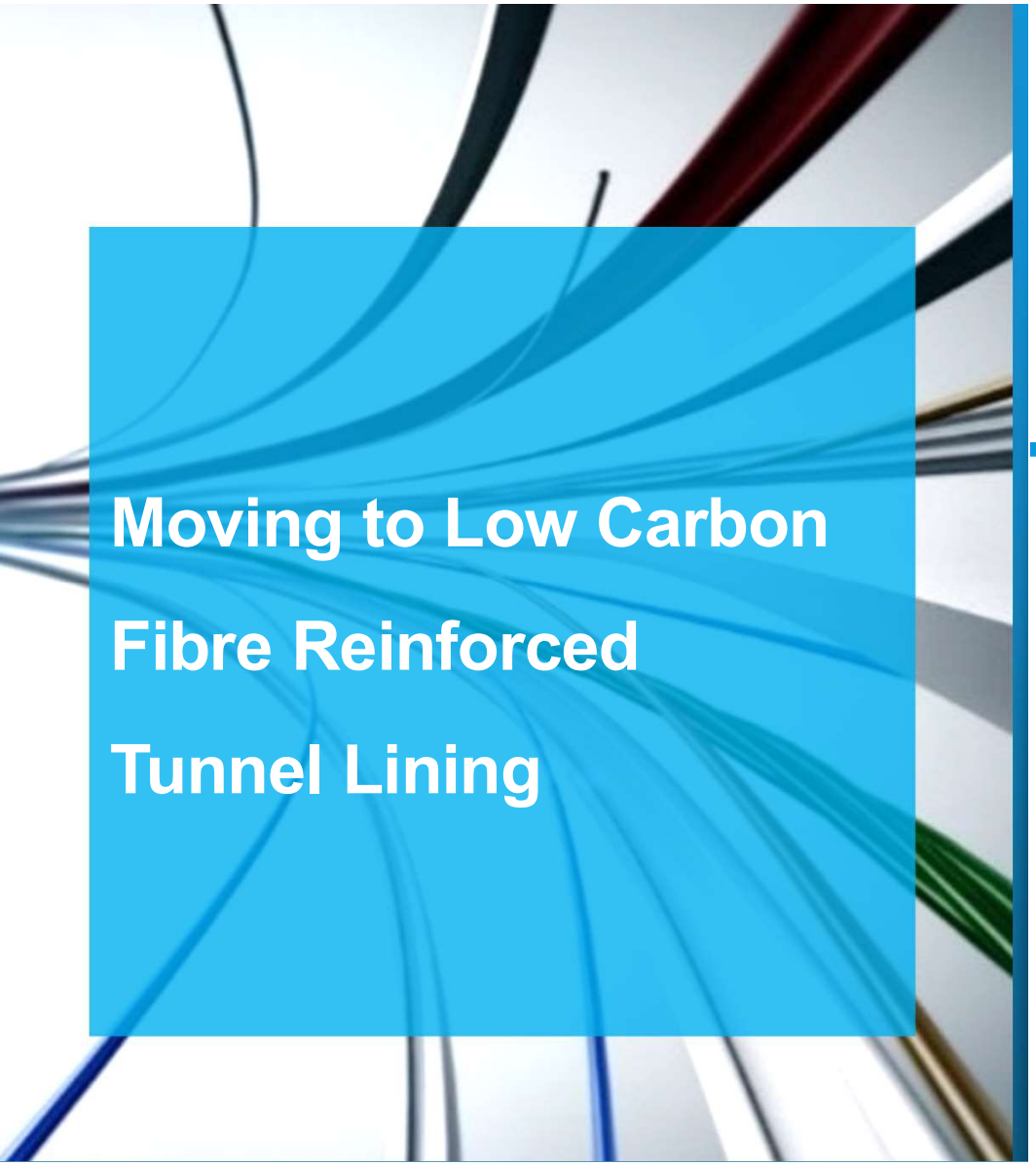
MORE AND MORE MECHANIZED EXCAVATION USING TBM





MORE AND MORE FIBRE REINFORCED CONCRETE PRECAST SEGMENT

State of the art summarized by fib bulletin 83



Moving to Low Carbon Fibre Reinforced Tunnel Lining

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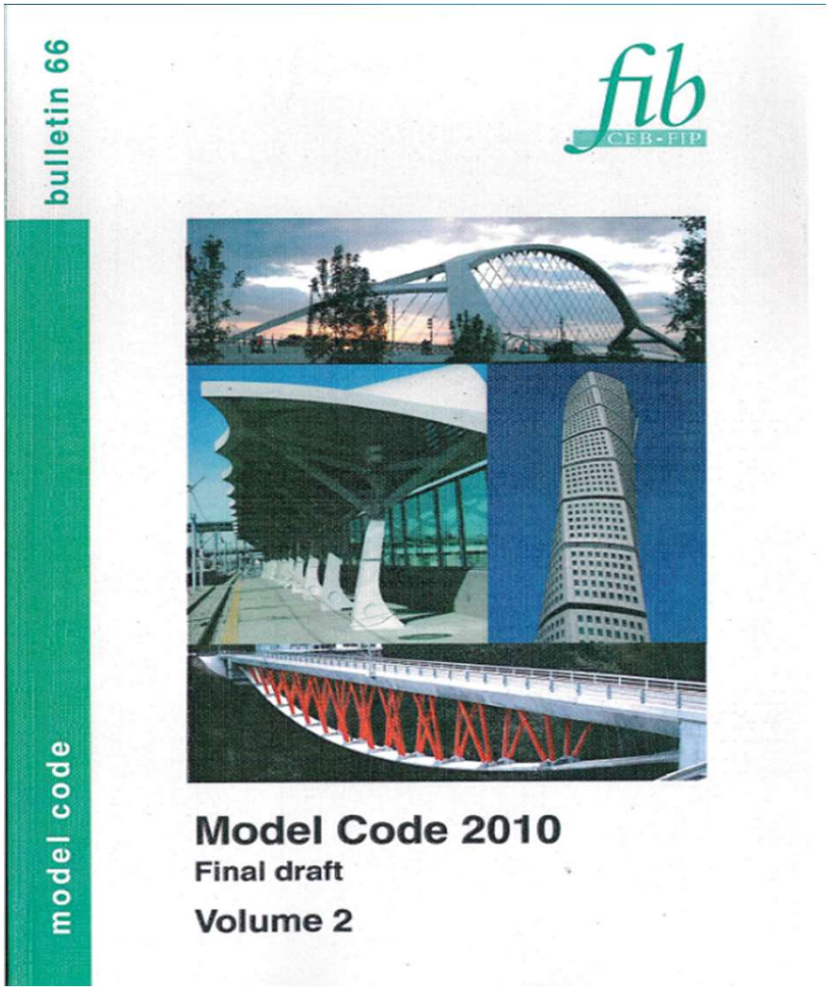
FRC PRECAST SEGMENT INTERNATIONAL GUIDELINE JOURNEY

2012	2013	2016	2017	2018	2019
Model Code 2010	AFTES	ITA TECH Volume 1 ITA WG2 Lesson learn	ACI 544 Fib Bulletin 83	ITA TECH Volume 2	ITA WG2 Design



International (2010/2012)

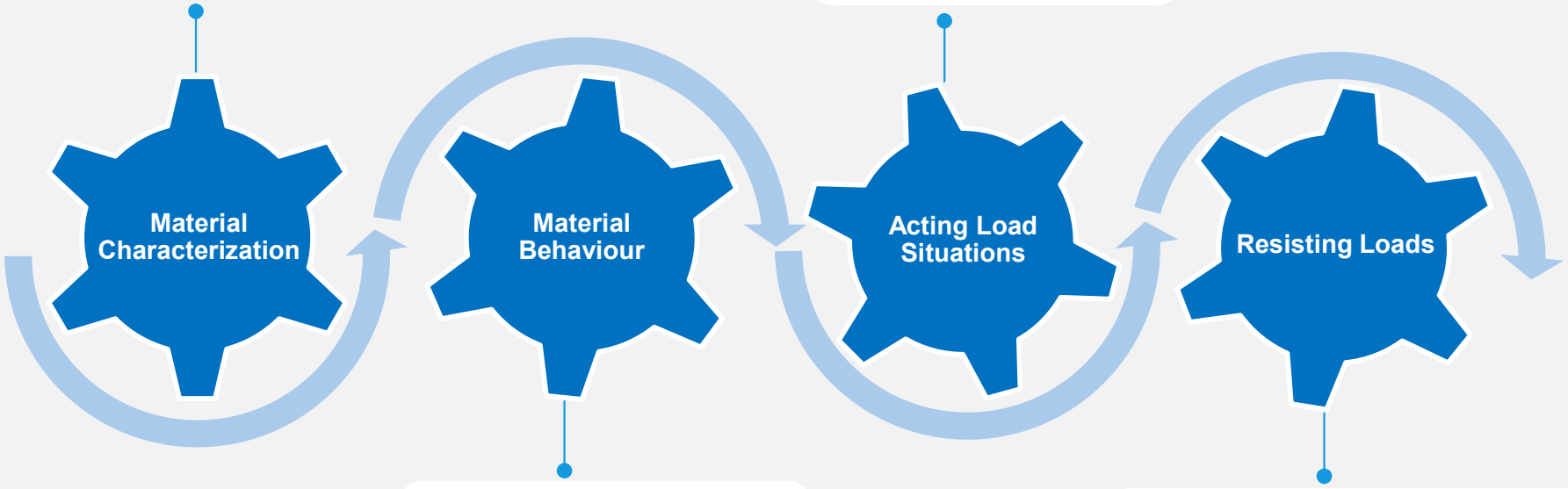
- Published 2012
- Pre-normative (e.g. future Eurocode)
- Proposed by fib as operational document
- Fibres are included in MC2010 which is the base for the future EuroCode (2023?)

NEW PUBLICATION 2018

Precast tunnel segments in fibre-reinforced concrete

Contents

Design Flow



- Beam tests according to EN14651
- Performance classes
- Material requirements

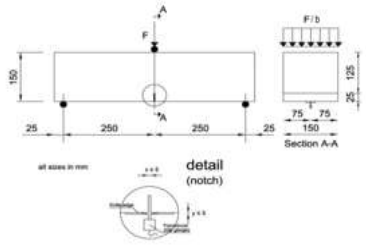
- Constitutive laws
- Material safety factors and other impact factors

- Demolding
- Stacking
- Transport & Placing
- Service

- Bending moment capacity
- Shear capacity
- Resistance against spalling/bursting
- Resistance against impact

Material Characterization

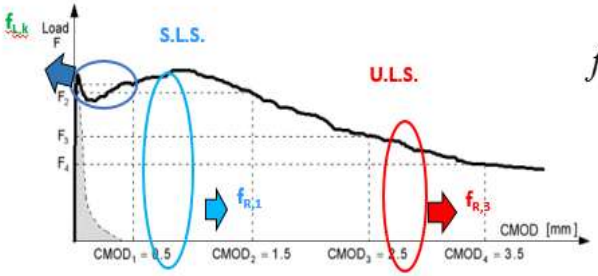
- **Beam test according to EN14651**



EN 14651

h_{sp} = 125 mm

b = 150 mm



$$f_{R,j} = \frac{3 F_j l}{2 b h_{sp}^2}$$

- **Classification according to MC2010**

4

C

f_{R1k}	f_{R3k}/f_{R1k}
1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0	a: if $0.5 \le f_{R3k}/f_{R1k} < 0.7$ b: if $0.7 \le f_{R3k}/f_{R1k} < 0.9$ c: if $0.9 \le f_{R3k}/f_{R1k} < 1.1$ d: if $1.1 \le f_{R3k}/f_{R1k} < 1.3$ e: if $1.3 \le f_{R3k}/f_{R1k}$

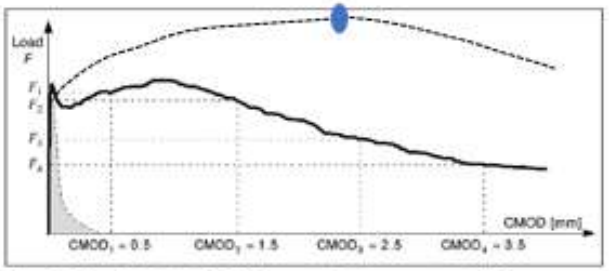
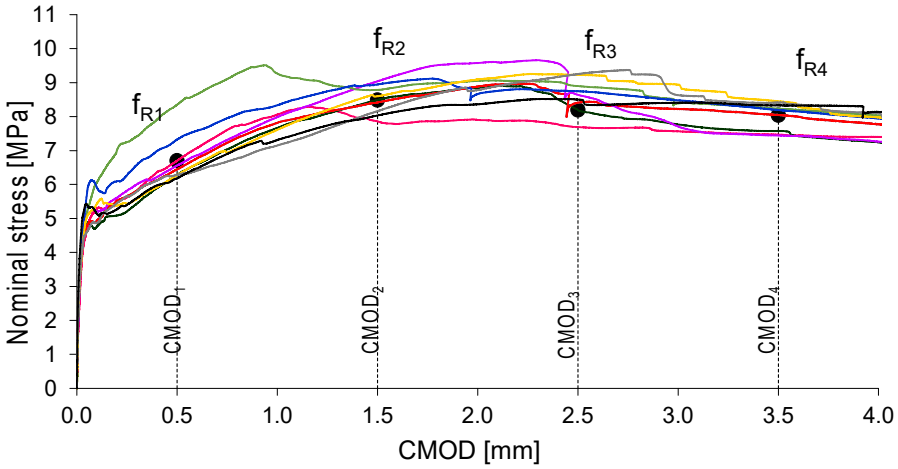


Figure 5.6-6: Typical load F–CMOD curve for plain concrete and FRC

- **Requirements according to MC2010**

$f_{R1k} / f_{Lk} > 0.4$ $f_{R3k} / f_{R1k} > 0.5$	If fulfilled ➔ fibres can substitute conventional reinforcement at ULS

Material Example 40kg/m3 Dramix 4D 80/60BG



	f_L [Mpa]	f_{R1} [MPa]	f_{R2} [MPa]	f_{R3} [MPa]	f_{R4} [MPa]
Beam_01	4.68	6.70	7.86	7.69	7.47
Beam_02	4.90	6.28	8.49	8.20	7.58
Beam_03	4.78	6.45	8.41	8.42	8.04
Beam_04	5.15	6.56	9.04	8.64	7.44
Beam_05	5.72	7.33	8.95	8.75	8.19
Beam_06	5.03	6.27	8.60	9.23	8.45
Beam_07	5.63	7.75	10.2	8.99	8.54
Beam_08	4.60	6.28	8.16	9.25	8.40
Beam_09	5.43	6.18	8.03	8.50	8.33
Average	5.10	6.64	8.64	8.63	8.05
Characteristic	4.30	5.58	7.26	7.65	7.19

Hardening behavior in bending (at sectional level) allows immediately:

- Structural ductility (ULS)
- Cracking control (SLS)

Mix design example Tor Vergata TESTS

CEM II/A 42.5	480 kg/m^3
Natural sand 0/4	422 kg/m^3
Crushed sand 0/4	423 kg/m^3
Crushed aggregate 4/16	519 kg/m^3
Crushed aggregate 16/25	350 kg/m^3
Water	170
Steel fibre 4D80/60BG 40 kg/m	40 kg/m^3

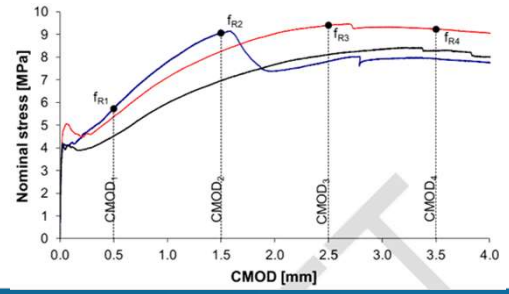
Performance class type
5e according to MC2010

Alternatively: design by testing

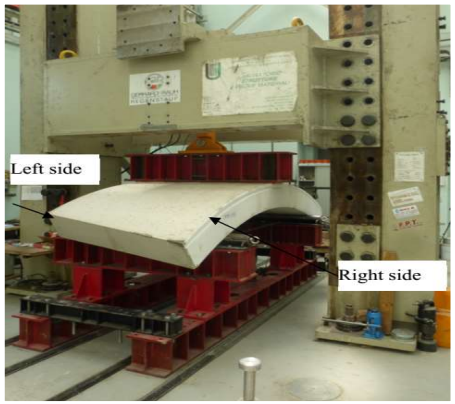
Dramix® 4D 80/60BG - Tests led by Prof. Meda

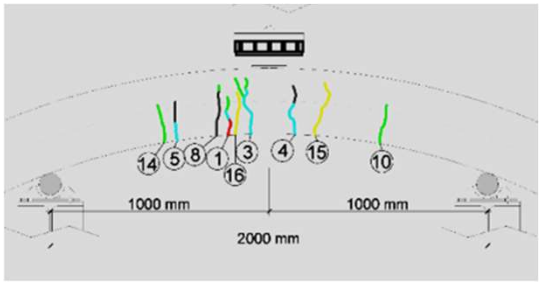
Università degli Studi di Roma "Tor Vergata"
CIVIL ENGINEERING AND COMPUTER SCIENCE DEPARTMENT
TERC – TUNNELLING ENGINEERING RESEARCH CENTRE

Material Characterization

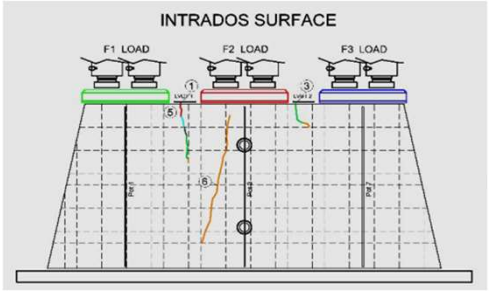


Bending Test





Point Load Test



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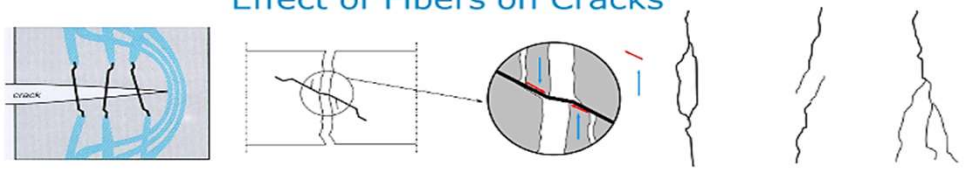
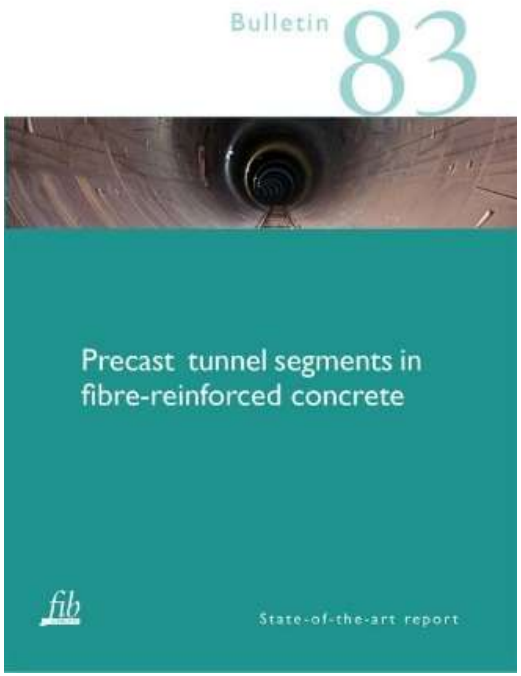
Durability and Steel Fibres

Solution: Segments reinforced with steel fibers, *having a bending hardening behavior*, contain cracks much thinner Effect of Fibers on Cracks segment reinforced with steel rebar.

Effect of Fibers on Cracks



- "Comparing crack width in RC segments with FRC segments indicate a better performance in favor of fibers by as much as an average value of 43%"

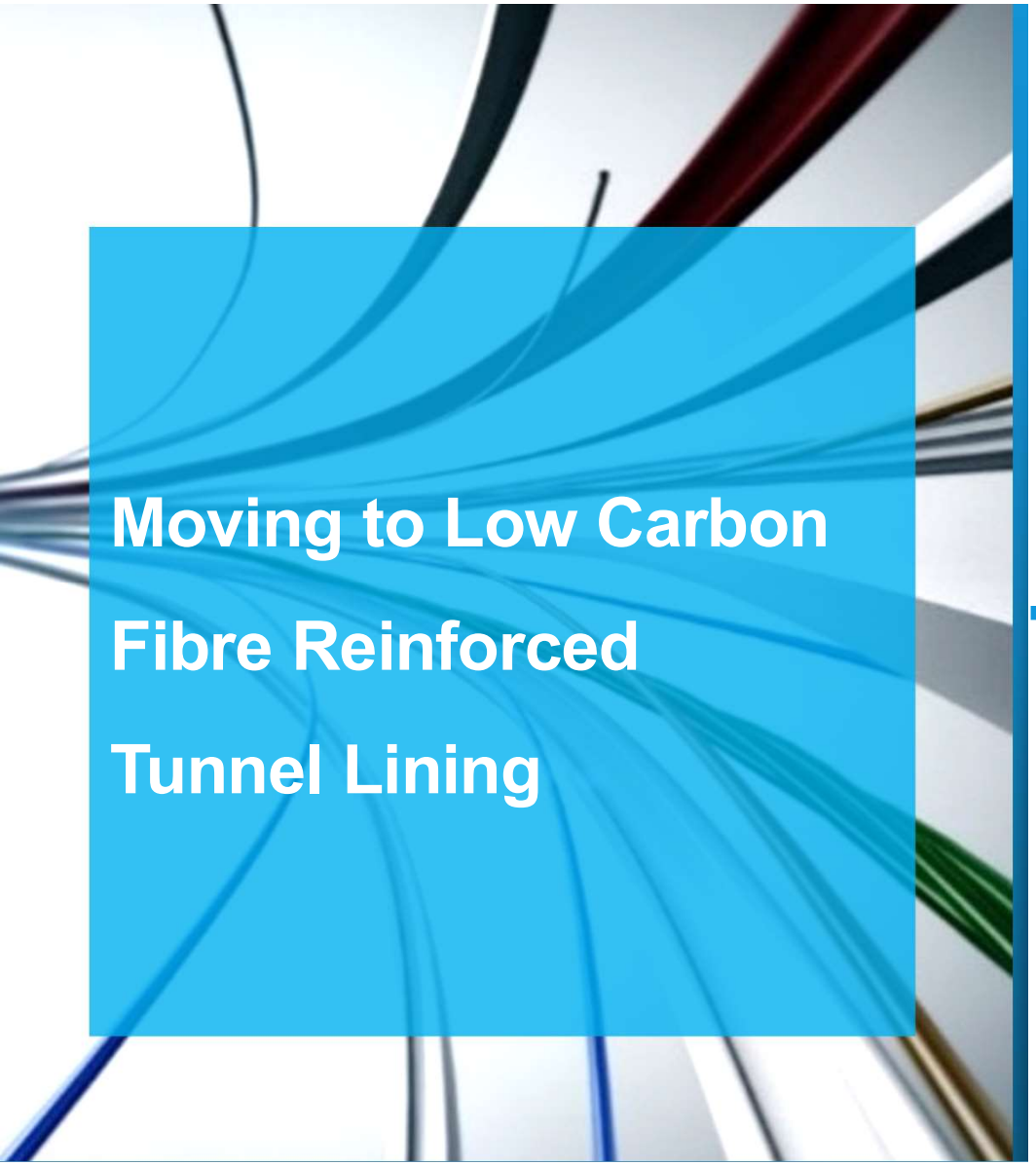


fib Bulletin 83 – Precast tunnel segments in fibre-reinforced concrete
§8 Durability – Literature study

Conclusions

- Uncracked concrete:
  SFRC durability ➤ RC durability
- Cracked concrete:
  SFRC durability ➤ RC durability
- Stray Current induced
  SFRC durability ➤ RC durability

Discussion remain about the max crack width according to exposure class . AFTES recommandation < 0,2mm



Moving to Low Carbon Fibre Reinforced Tunnel Lining

Tunneling Tomorrow

Bye, bye concrete ?

"Concrete is recognized as the second most widely consumed commodity on the planet after water. It also contributes approximately 8% of global carbon emissions; the main source of these emissions is the manufacture of Ordinary Portland Cement (CEM I)

In a tunnelling project, **it is generally considered that 60% to 70% of embodied carbon is contained in the concrete linings of the shafts and tunnels**. It is paramount, therefore that the tunnelling industry does its utmost to significantly reduce or eliminate its use of cement in all applications – segmental linings, in-situ linings, sprayed concrete and annulus grouts." C.A

When it comes to crimes against the environment, one of the tunneling's most often –used materials is one of the biggest offenders: cement. Expert says that the cement industry produces 5 percent of the global warming gases. " I believe that in 10 years we will see concrete replaced by others materials, such as geopolymer"

Tom Melbey
ITA Workshop

Breakthrough in the Middle East - Timeline

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Achievements made without sacrificing durability:

Very high chloride content: 10,000-50,000 mg/l
High sulphate content: 100 – 5,500 mg/l

Design life 100 years

Design according to MC2010 USING FRC to
Increased resistance to chloride-induced corrosion
- Eliminated risk of stray current-induced corrosion
- Easier production/handling
- Simplified segment precasting process

A paper by consultant COWI Denmark entitled **'The consultant's view on service life design Carola Edwarsen**

2009
STEP, ABU DHABI,
80 YEARS

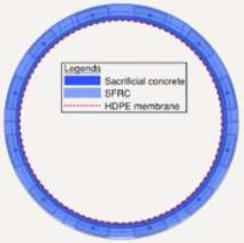
ABU HAMOUR TUNNEL,
QATAR
100 YEARS
2013

2013
DOHA METRO RED LINE NORTH
UNDERGROUND, QATAR, 120 YEARS

DOHA METRO GREEN LINE
UNDERGROUND, QATAR
120 YEARS
2014

2014
RIYADH METRO RED
LINE, SAUDI ARABIA
100 YEARS

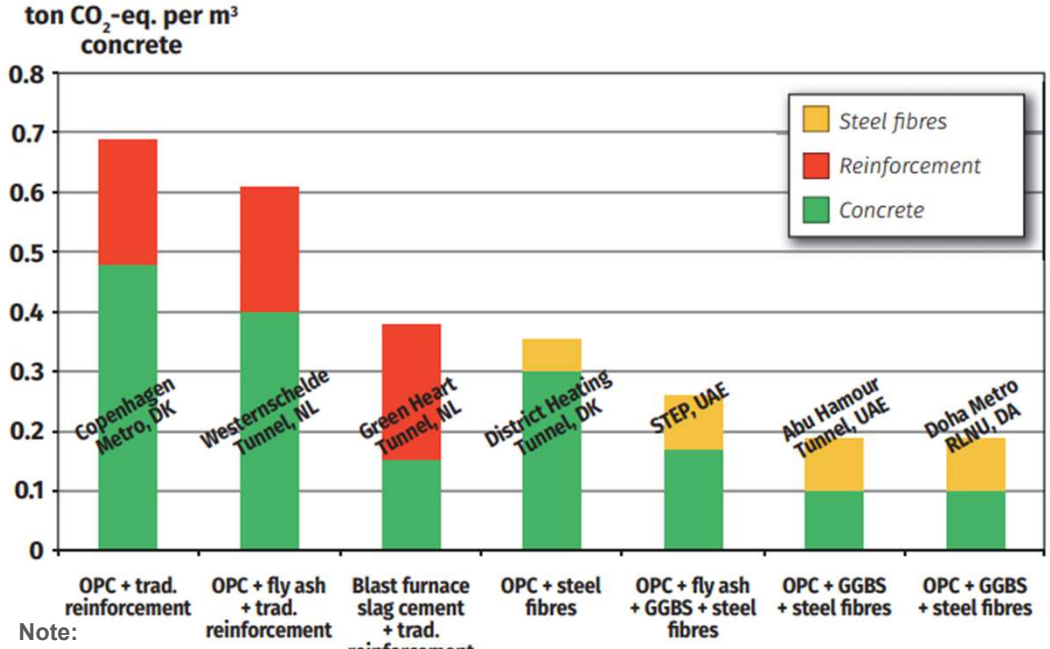
IDRIS MTS,
QATAR
100 YEARS
2016



2017
DS233/02 - JEBAL ALI STORMWATER
AND GROUNDWATER TUNNEL, DUBAI
100 YEARS

Low Carbon Concrete Lining for tunnels - voice of the customers

- **Steel fibre: Reduced CO2 emmission**
- Concrete mix design: High content of sup. Cementitious materials **(GGBS & FA) → Reduced CO2 emission**



Comparison of embodied CO2 for different types of binder and steel reinforcement used for various major infrastructure projects

A paper by consultant COWI Denmark entitled **'The consultant's view on service life design"** provides this example how much CO2 emission saving was reached by replacing traditional concrete and steel-reinforced with steelfiber reinforcement and adding GBBS/FA to the concrete mix.

- **Use of GGBS & FA: > 75% CO_2 reduction**
- **Use of steel fibres: > 50% CO_2 reduction**

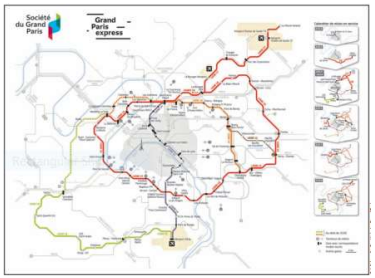
- **Doha Metro have just 0,2to vs 0,7to of CO2 emission which Copenhagen Metro had.**

- **If Doha Metro would be built "traditional"… = 400.000 tons more CO2 emission**

Note:
GGBS (Ground Granulated Blast-furnace Slag) is a cementitious material whose main use is in concrete and is a by-product from the blast-furnaces used to make iron.

FA (Fly ash) is a particulate material produced from the combustion of coal in thermal power plants. It´s also a by product The fine powder does resemble Portland Cement but it is chemically different. Fly ash chemically reacts with the byproduct calcium hydroxide released by the chemical reaction between cement and water to form additional cementitious products that improve many required properties of concrete.

GRAND PARIS LINEA 16.1



200 km of Automatic Subway Line to Provide New Travel Options

- ✓ 200 km, equivalent to the existing Metro Network
- ✓ Automatic subway lines, almost entirely underground
- ✓ Estimated cost :42 billions euros

68 future stations
Expected to handle 2 Mio. Passengers / day
This new system is going to transform Greater Paris

2016	2018	2030
Civil Engineering work started in April	First lot with FRC Precast segment 16.1 awarded	Project finished

VOICE OF THE OWNER SGP

"

"The Grand Paris Express is set to be a cradle for innovation that will drive the transport and development projects forward

- *"This is why we are orienting many of our projects towards sustainable design and construction, such as reducing concrete, choosing materials or even operating solutions for the metro that consume less energy.*
- *Innovations have already given significant results….*
- ***The use of fiber-reinforced concrete for the construction of the segments of part of line 16.1** This is a first in France in underground work. Compared to reinforced concrete, fiber-reinforced concrete notably represents **savings of around 5,000 tonnes of steel for 10 kilometers of tunnels***

GRAND PARIS LINEA 16.1

Partners

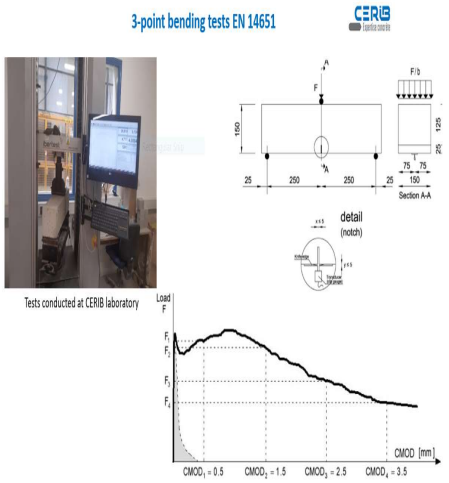
- Owner Société du Grand Paris (SGP)
- Designer Egis
- Contractor Eiffage Génie Civil
- Precast plant Bonna Sabla
- Steel fibre Bekaert

Tunnel parameters

- Year of construction 2020 – 2021
- Designed lifetime 100 years
- Total length (excavated) 19 km
- Diameter 8,70m

Segmental lining parameters

- Nbr of segments (incl. key) 7 per ring
- Size of segments x T 0,40m L 2m x W 4m
- Concrete quality C50/40
- Fiber type Dramix® 3D 80/60 BGP
- Dosage : 40kg/m3



In terms of results, according to the Model Code 2010, a 4,5d FRC mini is required, with the understanding that the minimum characteristic values to be achieved for design purpose are:

Fr1k = 4.4 Mpa

Fr3k = 5.7 Mpa

GRAND PARIS LINEA 16.1

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Suitability tests preliminary studies

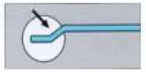
- Mix: around 90 between 100 and 300 l
- Bending tests:
  - Around 750 preliminary study and study phases
  - 150 to determine K coefficient
  - 100 for suitability test
- Tests conducted at CERIB (concrete laboratory)
- Around 64 tons of materials

Choice of structural fibers

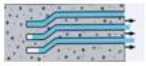
- 2 geometries tested (single and double hooks)
- 2 fiber diameters tested (0.75 and 0.9 mm)
- Multiple yield strengths for the steel
- Choice: DRAMIX 3D 80/60 BGP,
  - 0.75 mm Glued, 1,800 Mpa, L60 mm
  - 4,584 fibers/kg
    (network of 11.6 km fibers/m3)

The quality of Dramix® is due to a combination of factors…

- **Wire strength** — A **high length-diameter ratio** (L/D ratio)
- **Wire elongation** — **Hooked ends**



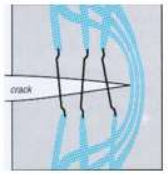
- **Shape** — **Controlled pull-out** (due to deformation of the hook)



- **Length** — **High tensile strength steel**

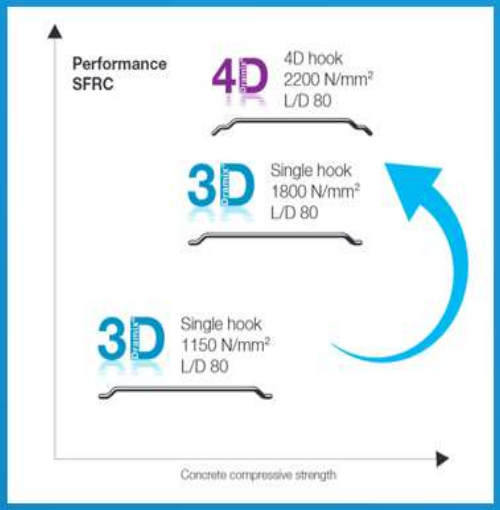
- **Diameter** — A system of glued fibre bundles enables fibres with a high L/D ratio to be mixed easily and uniformly throughout the concrete

- **L/D ratio**



The tensile strength of a steel fibre has to increase in parallel with the strength of its anchorage. Only in this way can the fibre resist the forces acting upon it.

4D 80/60/BGP = 4 644 fibre/kg
40kg/m3 4D 80/60BGP > 11 000 lm lm/m3



l/D	80/60	65/60	45/50
Length (mm)	60	60	50
Diameter (mm)	0.75	0.90	1.05
Aspect Ratio	80	65	45
Network (m/kg)	276	200	147

GRAND PARIS LINEA 16.1

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Mechanical behavior

Studies conducted at the University of Rome (Department of professor Alberto Meda):

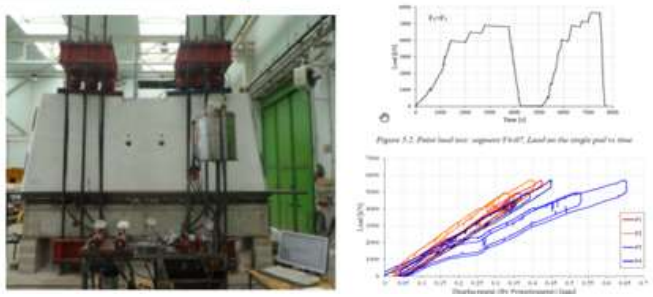
- Bending tests on the lining segments
- TBM cylinder thrust tests
- Connector pull-out test

Suitability and control plan:
Tests on around 40 lining segments

TOR VERGATA

Bending tests

TBM cylinder thrust tests



Connector pull-out test

Eifage work with Herrencknnecht TBM with a maximum trust of 5200KN

GRAND PARIS LINEA 16.1

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Environmental sustainability benefits of steel fibre compared with steel rebar

- SFRC segments have more than 50% less steel than rebar reinforced segments saving more than 5,000 tonne of steel production carbon for 10km of tunnel
- One truck can transport 24.2 tonne of fibre per load compared with 17.85 tonne per truck load for reinforcing rebar.
- The concrete chosen for the Line 16 Lot 1 fibre reinforced segments has a low carbon footprint of 170kg CO_2 equivalent/m^3 and reduces the carbon weight of the steel in the segments by 90kg equivalent CO2/m^3 **or nearly 11,000 tonne equivalent CO_2 per 10km**

SOURCE TUNNELTALK APRIL 2022

Why and How FRC PSCL is Developing?

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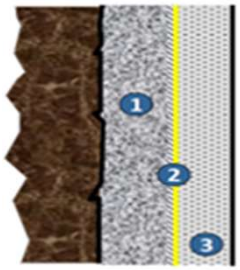
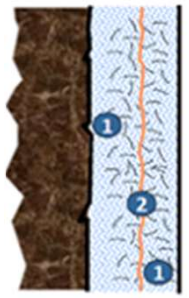
FROM DUCTILITY TO DURABILITY TO SUSTAINABILITY

Design Change Drivers



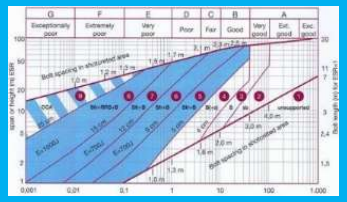
1. Temporary sprayed concrete
2. Geotextile & sheet membrane
3. Permanent cast-in-situ concrete

- Automated, mechanized construction
- Safety culture-limited man access
- Spray waterproof membranes
- **Surveying technology fibres**
- Higher skilled operatives
- **Testing method- FRC material property**
- **Quality control device**
- **Improved design techniques and standards**
- Architectural solution?
- **CO2 SAVING by less concrete consumption**

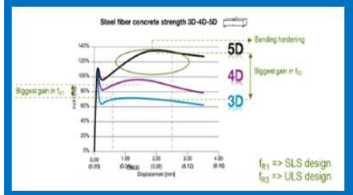


1. Permanent sprayed concrete
2. Optional spray applied membrane

Energy Absorption



(Steel & Synthetic fibers)



Residual Strength - Hardening

(High Performance Steel Fibers)

Low Carbon Concrete Lining - Shotcrete

West Connex M4 – M5 Link Tunnels, Sydney

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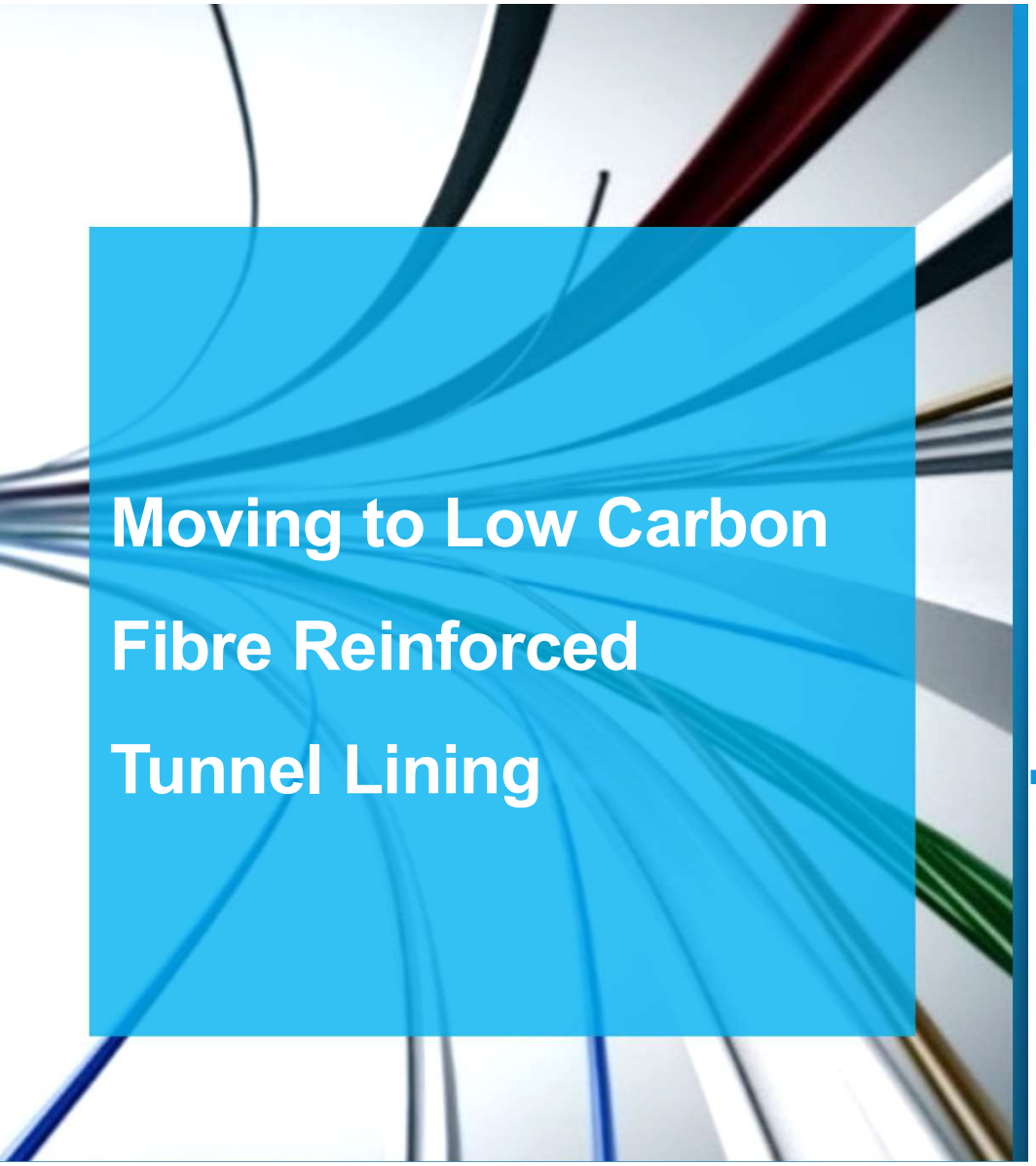
Built by: JV Bouygues, Acciona and Samsung
Consultant: Jacobs/US
Concrete supply by: Hansson (Heidelberger Group)

Our solution: High-performing Dramix 4D 65/35BG (better anchorage and high tensile strength) to achieve the performance required with just 35 kg/m3

Saving 20% of concrete (60,000m3)´- which leads to 40000 tons CO2 saving,

Benefits to project from use of Dramix 4D in shotcrete:

- Allowance for the use of high values of residual flexural tensile strength in the design of Permanent Sprayed Concrete Linings (PSCL - 100-year design life tunnel support) with fr1 = 3.5 MPa and fr4 = 3 Mpa
- Approximate reduction in tunnel support (lining) thickness in the order of 20% with a final volume of approximately 250,000 m3 of shotcrete applied with production testing every 100m3.
- Statistically consistent production test results over the 250,000m3 applied with 95% confidence characteristic values compliant throughout construction. Only 1.5% results below target characteristic values for fr4 and 5% for fr1 with between batches coefficient of variation below 20%.
- Overall increased confidence in shotcrete quality and easy Quality Control



Moving to Low Carbon Fibre Reinforced Tunnel Lining

EPD certification for Bekaert Dramix® production plant Petrovice

- **Transparently** communicates the **key environmental performance indicators** of Dramix® over its lifetime
- Validated by an official independent third party (ITB)
- Already implemented in One Click LCA's tool
- **Achieve certifications easier** thanks to their compliance tool
- We chose a leading reference in construction **to reduce our carbon footprint:** One Click LCA
- They provide a **free carbon tool** for fast and effective automated LCA assessments
- Import your building materials manually or automatically from Excel, Revit, IFC, IESVE, energy models (gbXML), and other tools
- Largest database of its kind with over 100K datapoints
- **Achieve certifications easier** thanks to their compliance tool

Interrogation of the LCA results show that the cradle-to-gate carbon (Global Warming Potential) impact of 1 kg of fibre production is 0.88kg CO2eq. For comparison, ton of steel produced worldwide in 2019 emitted on average 1.85 tons of carbon dioxide.

We are part of sustainable networks

BEKAERT better together + One Click LCA

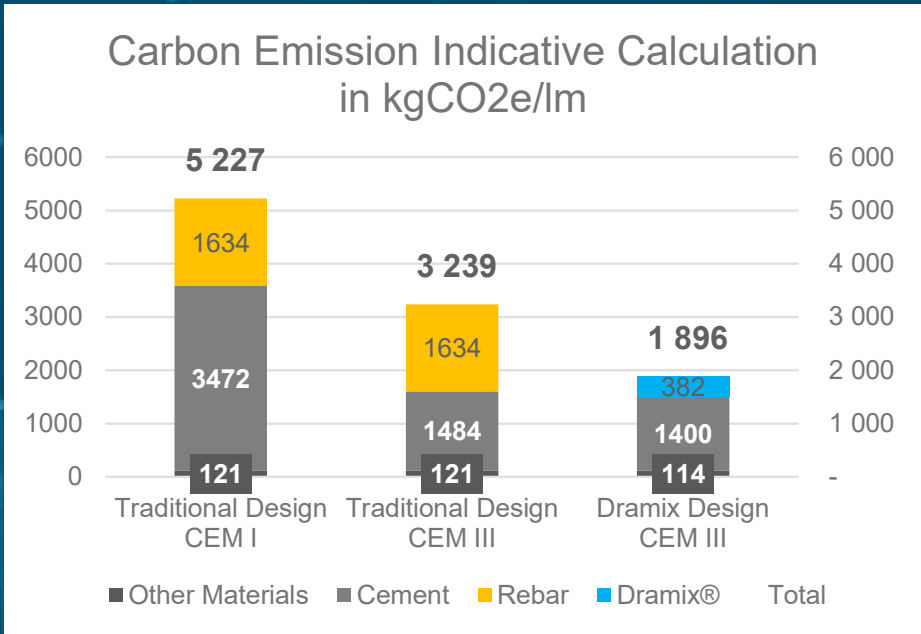
Free carbon tool

Free embodied carbon tool for buildings

One Click LCA Planetary

One Click LCA Planetary helps decarbonize buildings at a planetary scale. Now available globally.

METRO TUNNEL EXAMPLE

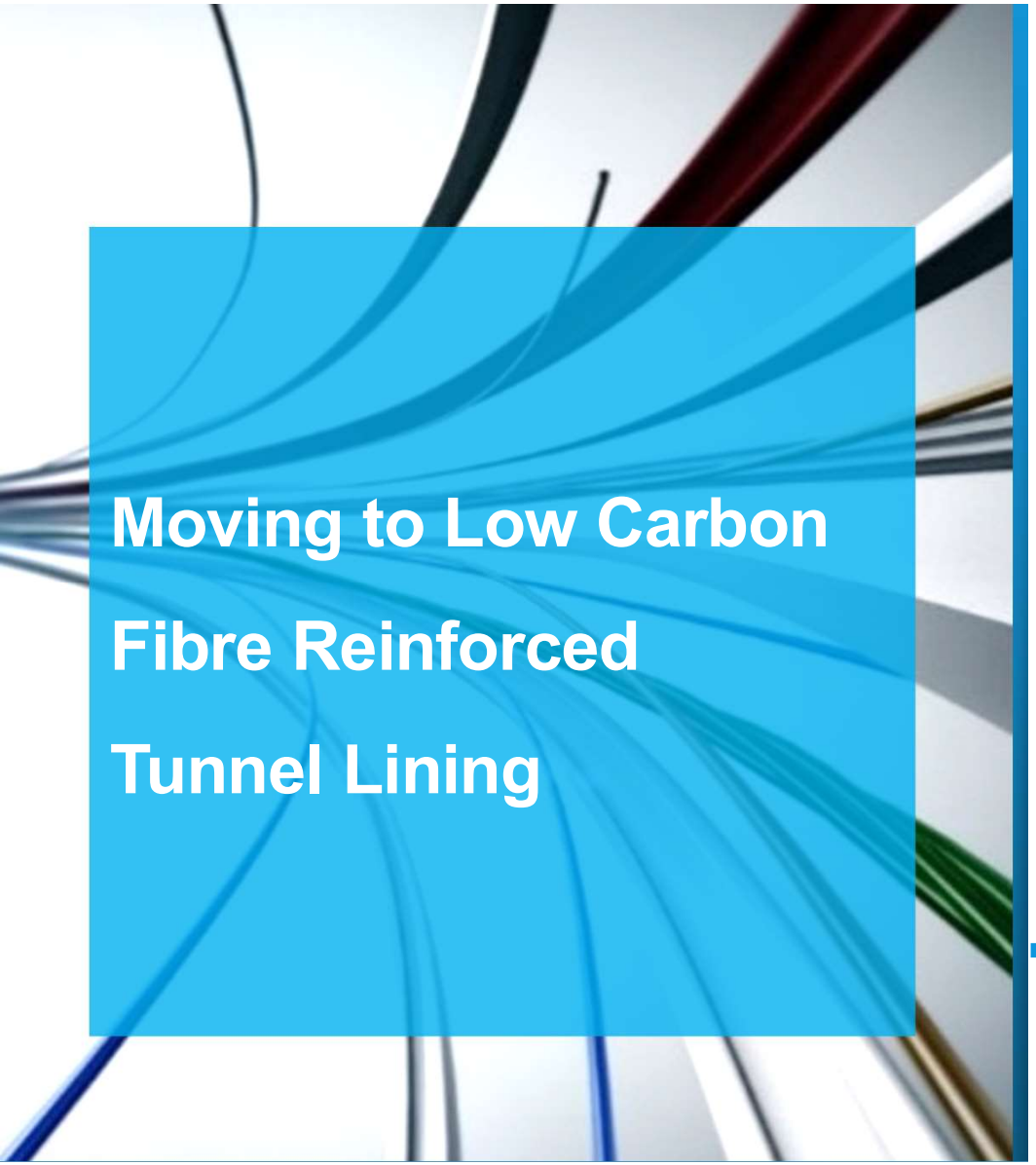


- Using a CEM III vs CEMI improves the CO2 score significantly.
- As we use 60% less reinforcement (100kg rebar vs 40 kg Dramix) and also average rebar EPD is higher than Dramix EPD, we end up with this difference with reinforcement
- Using Dramix allows thickness reduction by 2cm mini which results in additional savings in concrete

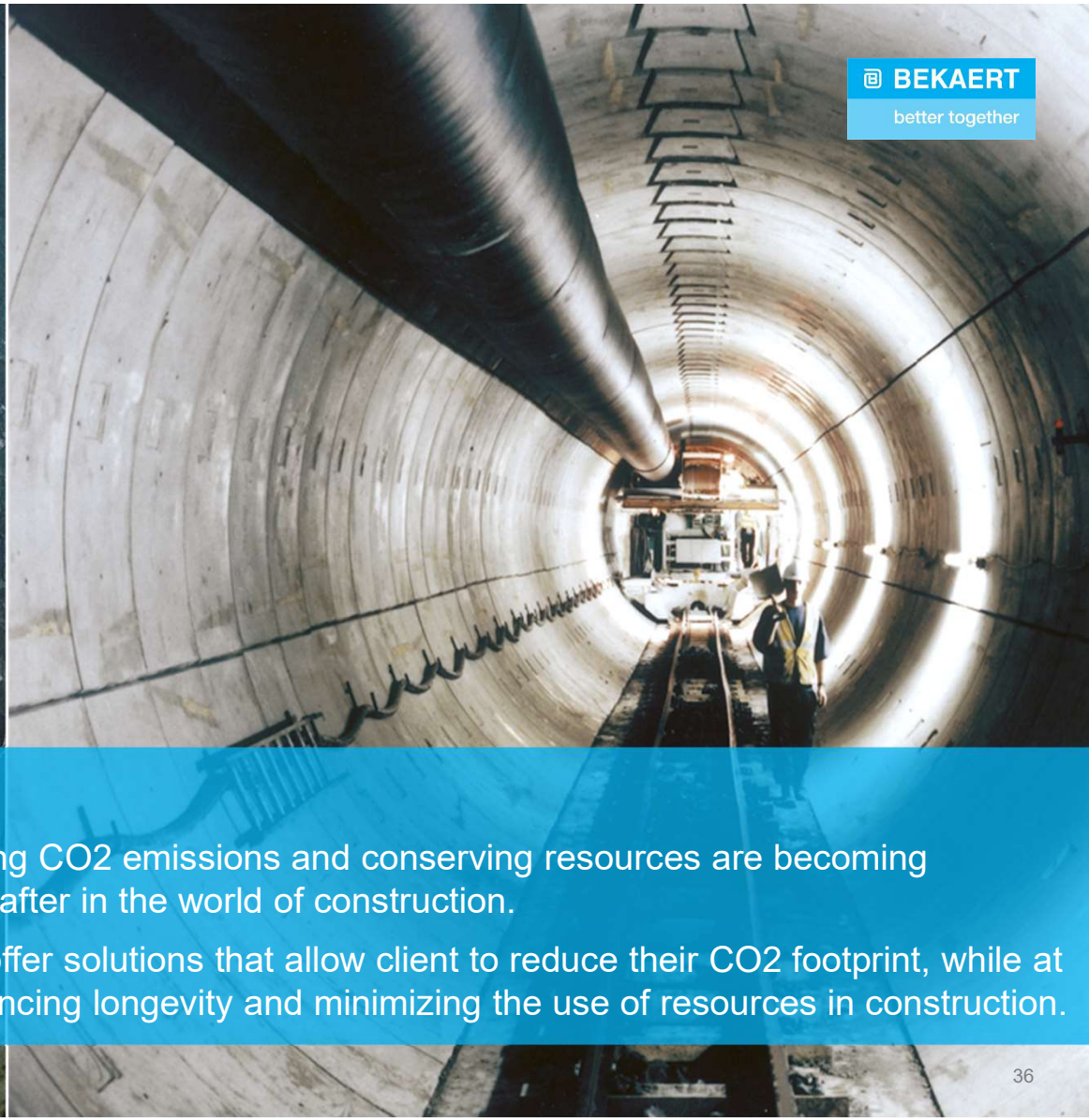
This calculation is based on the generic EPD values during the early design phase, indicative calculation to demonstrate potential CO2 savings, as project evolves the exact materials used during construction may change the results."

Recyclable fibers

- The Bekaert R&D team together with universities continue to investigate recyclability.
- We want clean fractions of aggregates, sand and steel.
- We are looking into reusing binder material.
- Reuse steel (remelted or reused as steel), without any quality loss and certain fractions could be directly reused as steel fibers.



Moving to Low Carbon Fibre Reinforced Tunnel Lining



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Conclusion

- Solutions for reducing CO2 emissions and conserving resources are becoming increasingly sought after in the world of construction.
- USING FRC lining offer solutions that allow client to reduce their CO2 footprint, while at the same time enhancing longevity and minimizing the use of resources in construction.


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