Hold a Ph. D. in Civil Engineering from Sherbrooke University in Canada

Started his professional career in 1989 as Research Engineer for the Industrial chair on concrete technology and the Network of Centre of Excellence on High Performance Concrete in Canada

Joined Corporate Holcim Group Support in Switzerland in 1998 and hold several positions until 2017 in the area of R&D, Open Innovation, Advanced Concrete Technology & Technology Transfer

Since January 2018 Joined INSEE Lanka Ltd.

Society's Growing Need for Sustainable Construction

Dr. Moussa Baalbaki

Head Products & Solutions Portfolio

INSEE Lanka Ltd.

First, we should recognize that the construction sector has a proud tradition of being one of humanity's oldest businesses

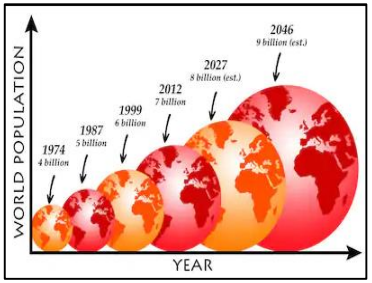
- *Its work stands as testament to human progress and arguably enhances our quality of life*

With the population growth and urbanization, the sector is in transition and is struggling with its role not in CSR but in sustainability

- challenged by changing customer and government expectations to further improve its social, economic and environmental impacts
- Cope with high pressure on demand on strategic resources as energy, raw materials and water
- … and also human resources, as construction sector use one of the world's largest workforces (13% of the world's GPD is due to construction-related spending)

→ All these forces can drive up costs and force businesses to innovate and look for alternatives

5 Megatrends Driving Societal Needs for Sustainable Construction Solutions



Self-driving public bus in Berlin

Indoor climate solutions with concrete thermal activation

Global population growth -
Population expected to grow from 7.5 to 9 billion by 2050

Urbanization & megacities -
2.5 billion more people expected to live in cities by 2050

Solutions for sustainable construction
Carbon footprint & materials scarcity

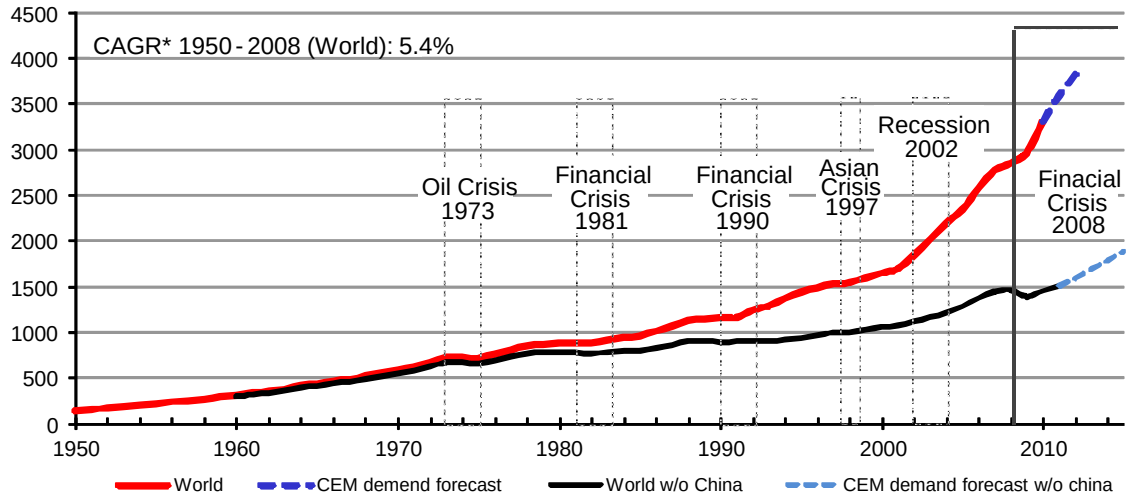
Digital transformation
connectivity and smart cities

Better living standard
more efficient technologies

Reality & Issues → **Implications & challenges** → **Opportunities for growth and innovation in sustainable & efficient solutions**

World cement demand constantly increased and held up well during recession

Estimated Cement Demand (1950 - 2015) [Mt]



* CAGR = Compound average growth rate

Source: Cembureau, The Global Cement Report 8th Edition, Internal Estimation

In 2017
World Cement Production **4.1Bt**

CEMBUREAU The European Cement Association **6.3%**

CHINA	INDIA	USA
56.5%	6.8%	2.1%

In 2017
World concrete Production **7 Bm³**

10 Mm³

Shanghai development within 30 years

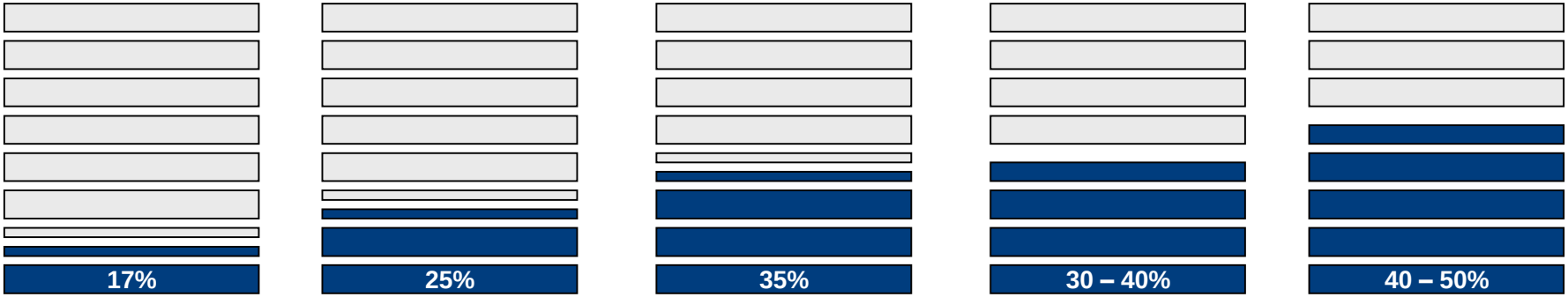
Source: Dr. Thushara Priyadarshana

Port City development in Sri Lanka

Source: Dr. Thushara Priyadarshana

Buildings have an important ecological footprint…

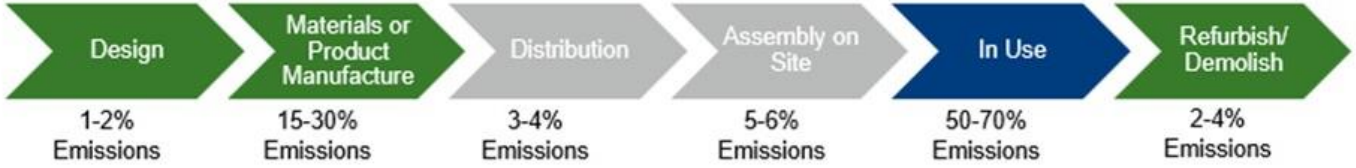
Unfortunately we use these natural resources at a rate that cannot be sustained indefinitely



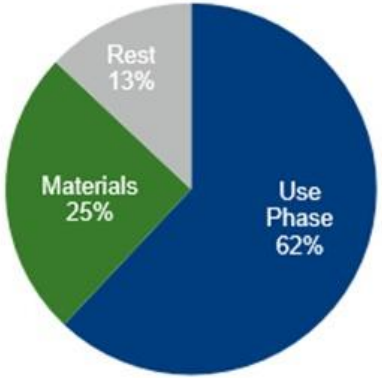
Source: World Green Building Council, The ecological footprint

Building Materials are likely to become the next area of focus in sustainable building standards

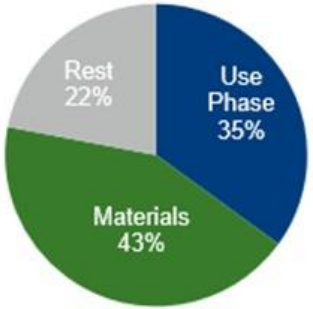
Embodied carbon as part of life cycle carbon emissions



Building Today



Future Building



Today, 'use phase' (heating, air conditioning, lighting, etc.) of buildings has largest impact.

With increased energy efficiency, **building materials come into the focus of green building and material standards***.

Source: the Green Building Council, ICE (Institution of Civil engineers)

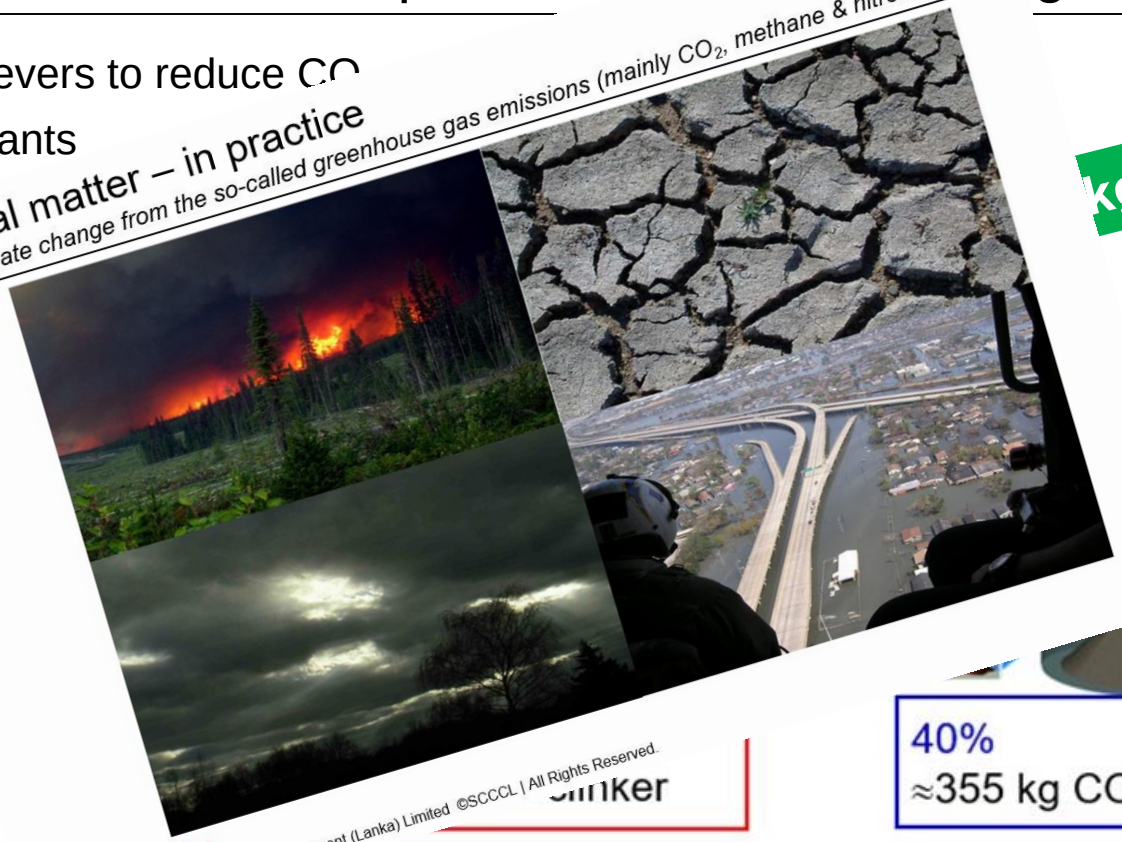
***LEED**: Leadership in Energy and Environmental Design; **BREEAM**: BRE Environmental Assessment Method; **EPD**: Environmental Product Declaration; **PCF**: Product Carbon Footprint

CO_2 - emissions in clinker production (a… …eglected)

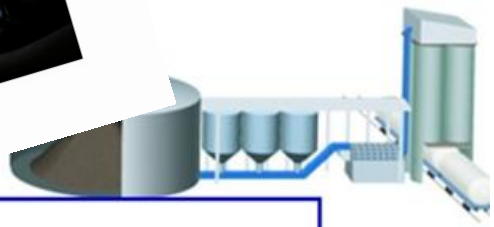
- Three main levers to reduce CO…
  - Modern plants
  - Reductio…
  - U…

The real matter – in practice

Global climate change from the so-called greenhouse gas emissions (mainly CO_2, methane & nitrous oxide)



…kg CO_2



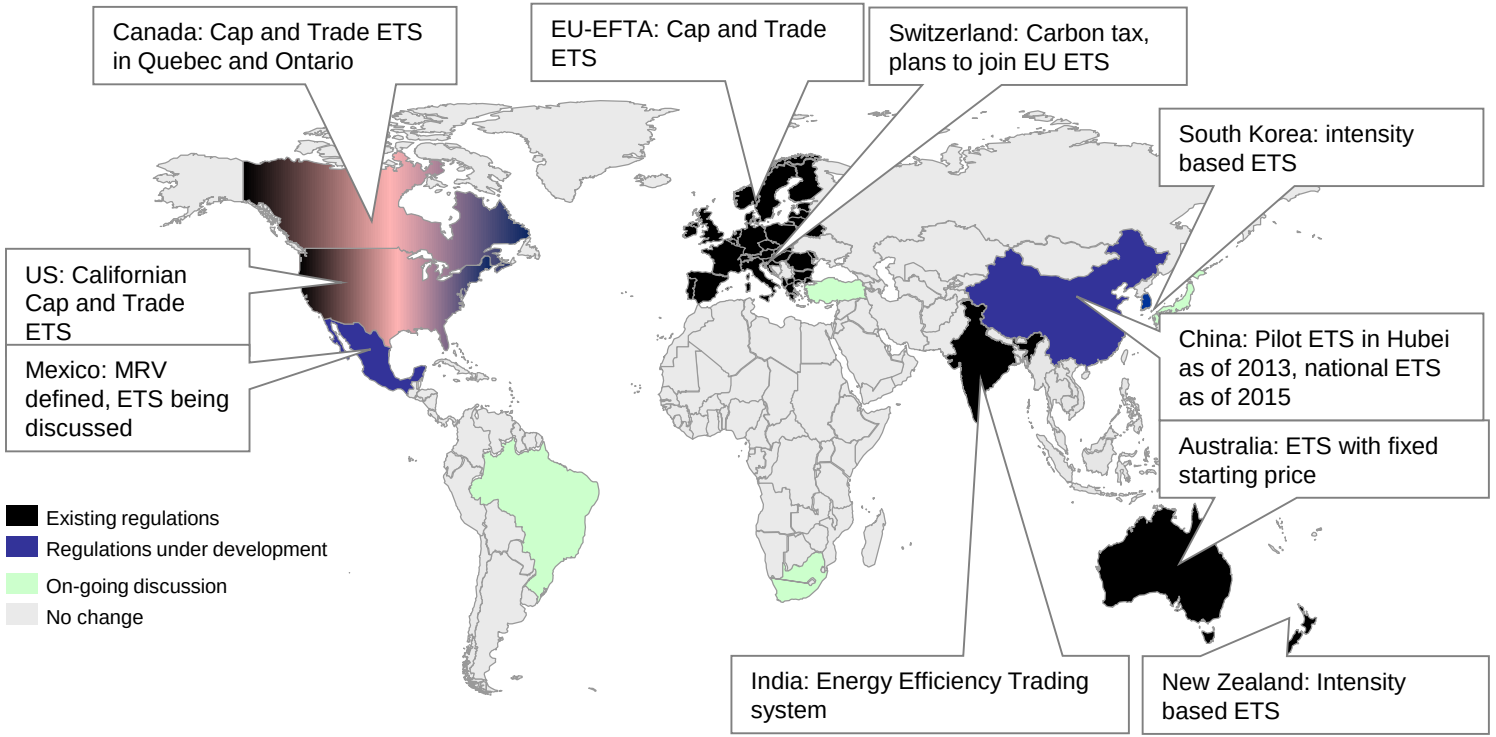
40%
≈355 kg CO_2 / t clinker

…linker

The retreat of Aletsch Glacier in the Swiss Alps due to global warming

1979 1991 2002

By 2025, 70% of cement demand will be in countries with carbon regulations

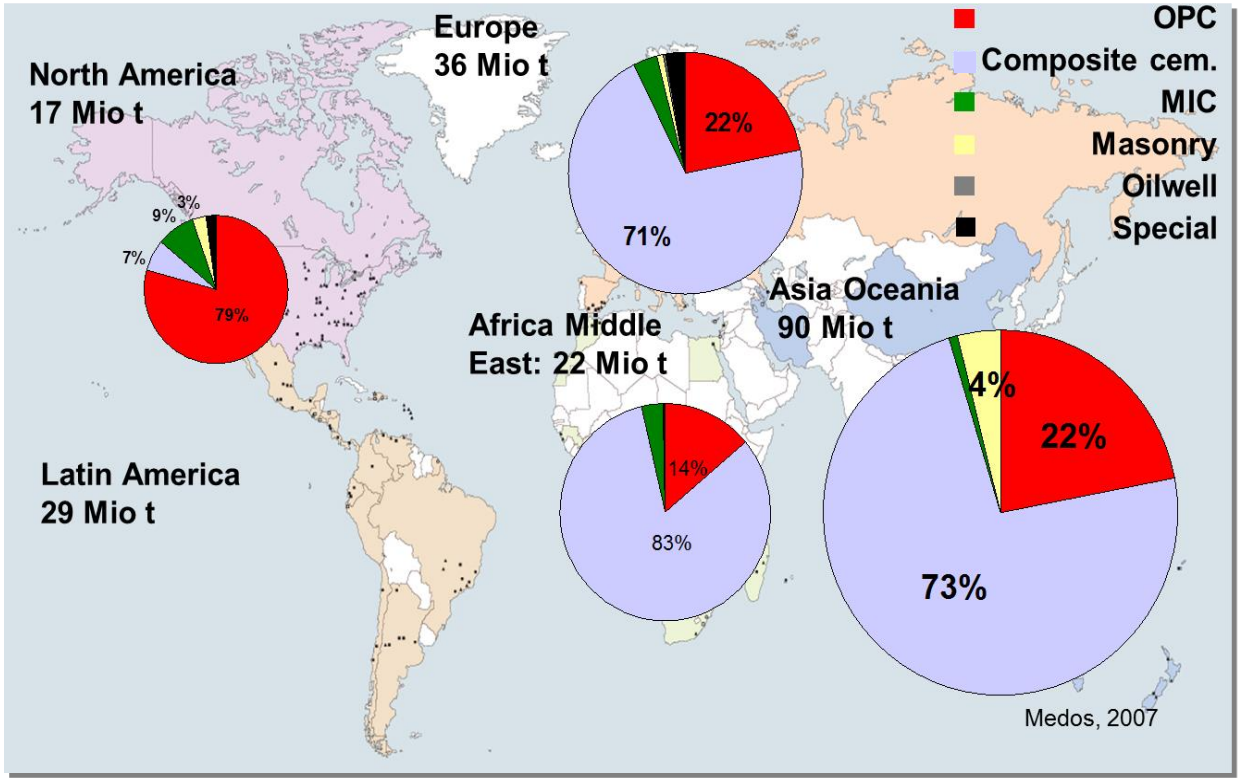


Source: SD/CC

Therefore the construction sector must promote sustainable and performing solutions which:

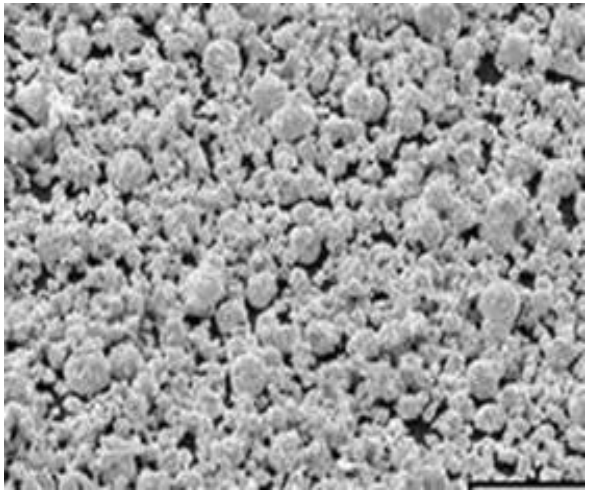
- Emit less CO2 (Green House Gas)
- Offer extended service life of concrete structures with reduced maintenance cost
- Is economically viable
- Support the overall commitment to sustainable development

Cement types by continents

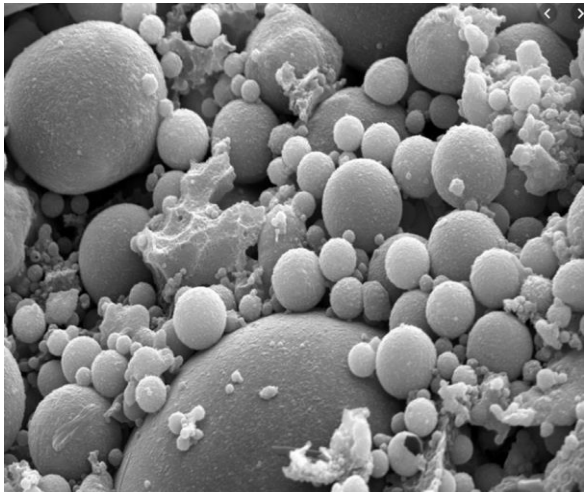


- *OPC dominant in countries, where SCM like limestone, fly ash and slag are added directly to concrete, e.g. N America and UK*

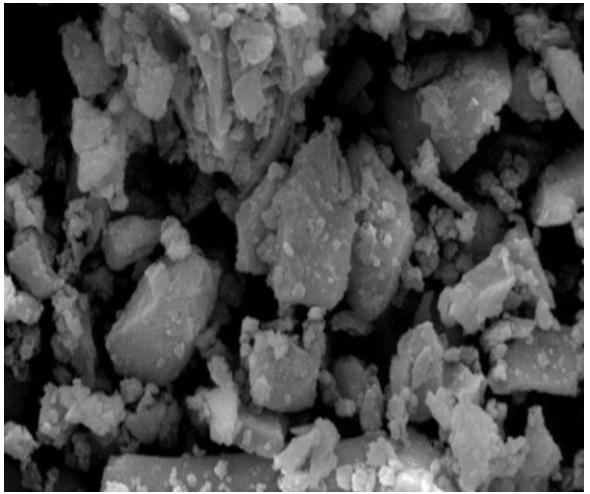
Proven technology with superior *blended cements* for sustainable performing concrete



High grade limestone
(Calcium carbonate)



Fly ash

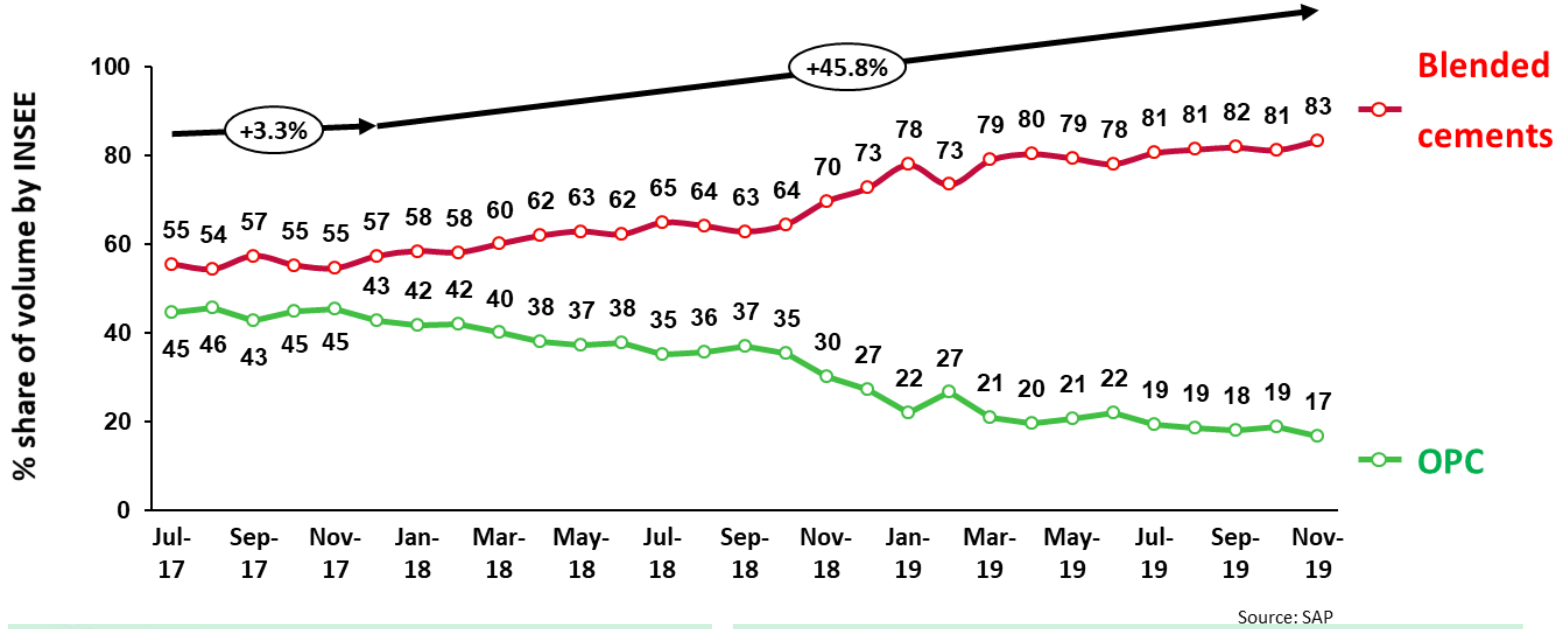


Ground slag

New Manufacturing Excellence for Slag Based Solutions

- Project Location: Galle port
- Technology: Modular grinding with 3rd generation compact Vertical Roller Mill
- Equipment supplied by Loesche GmbH, Germany
- Ability to produce customized products based on customer needs
- Enhanced flexibility in quality assurance due to the new technology
- Low energy consumption
- Minimum sound emission
- Minimum dust emission

INSEE products domestically sold since July 2017
OPC vs Blended cements share (%) - 400'000 t CO_2 saved every year



Source: SAP

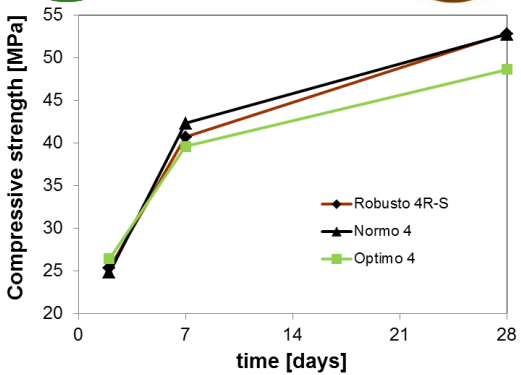
130'000 cooled apartments, 80 m^2 each

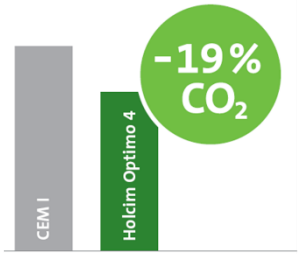
65'000 average cars driving 20'000 km/year each

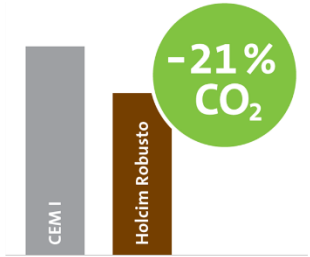
New low carbon cements based on burnt oil shale by legacy Holcim

Optimo

Robusto







Holcim Optimo 4
CEM II / B-M (T-LL) 42,5 N

Holcim Robusto 4R-S
CEM II / B-M (S-T) 42,5 R

INSEE CEMENT

i2i INNOVATION TO INDUSTRY

Sand in fact has become a scarce resource…with an increasing media attention

SPIEGEL ONLINE INTERNATIONAL

The Sand Thieves: World's Beaches Become Victims of Construction Boom

By Laura Höflinger

Sand is becoming so scarce that stealing it has become an attractive business model. With residential towers rising ever higher and development continuing apace in Asia and Africa, demand for the finite resource is insatiable.

Sandmining is destroying Asia's rivers

Uncontrolled and mostly illegal extraction of sand and rocks from riverbeds for construction is killing rivers across South Asia and China, and must be tightly controlled

DIE WELT

DIE WELT Digital 2 Monate für nur 0,99 €!

In Asien tobt ein Sandkrieg

Singapur und Malaysia streiten um eine künstliche Insel. Rohstoff weltweit immer begehrter Von Adrian Lobe

werden, um die Strände zu erhal… …rer Kreislauf. In Indonesien sind ganze 2… …nwunden. In Marokko stammt die Hälfte des San… …illionen Kubikmeter, aus illegalen Sand-Minen. Sand… …er haben einen Strandabschnitt bei Essaouira in ein Ber… …ber Tage transformiert. Wo eigentlich Urlauber in der Sonne am Strand liegen, stehen nun Lastwägen, die mit Sand beladen werden. Das Geschäft blüht, auch weil die Nachfrage nach Sand stetig steigt.

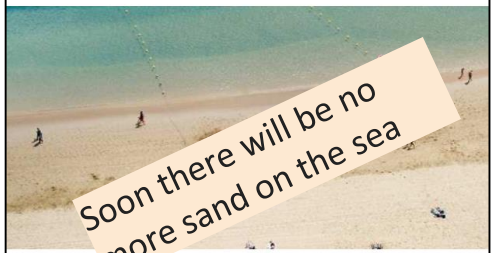
In Asia a sand war is raging

SAND WARS

HOME | SYNOPSIS | THE FILMMAKERS | CONTACT

AARGAUER ZEITUNG

Home | Leben | Forschung & Technik



Soon there will be no more sand on the sea

Gibt es bald keinen Sand am Meer mehr?

Kinder bauen mit ihm Burgen, die Bauindustrie macht daraus Beton: Die Rede ist vom Rohstoff Sand. Weil er so begehrt ist, könnten die Ferien am Strand mit Sand am Meer bald der Vergangenheit angehören. Was gibt es für Alternativen?

Von Sabina Galbiati

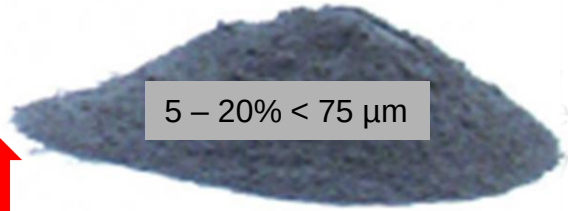
INSEE CEMENT

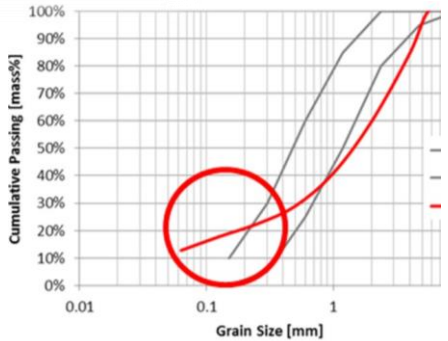
INNOVATION TO INDUSTRY

Fine aggregates are referred to by many names

- Crusher fines / quarry dust are not a purpose made product and are produced
  fro duct mix)
  →o
  - C 75 mm
  - D gradation
    r arious rock
    t

5 – 20% < 75 µm





Manufactured sand processing alignment with INSEE M-Sand decision tree approach for quality assessment

1 INSEE Blu™

High value

- Negative impact on workability
- Select admixtures carefully

Low value

2 INSEE Shape™

Difficult shape

- Improve shape [Flakiness and roughness of grains]
- Blend with other sand

Good shape

3 Fineness Modulus (FM)

Lower FM

4 Fines <150 µm

Too much fines

- Blend with other sand
- Fines correction

Good range of fines

Higher FM

4 Fines <150 µm

Not enough fines

- Fines correction
- Blend with other sand

Good range of fines

INSEE Flow ™ - Target flow expected

Cubicity according to crusher type and crushing Stage – bear in mind fines are produced at each crusher stage in the circuit

	Crushing Stage		
Crusher Type	Primary stage	Secondary stage	Tertiary stage
Jaw crusher	Poor	Poor	Poor
Primary gyratory	Poor	NA	NA
Horizontal shaft impactor	Fair	Fair / Good	Fair / Good
Vertical shaft impactor	NA	Good	Good
High speed cone crusher	NA	Fair	Good when operated correctly
New design high pressure roll crusher	NA	NA	Good when operated correctly

*slide adapted from Metso training materials

Crushers type

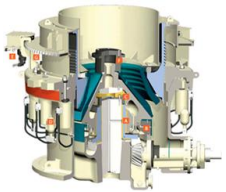
2 INSEE Shape™ → Difficult shape →
- Improve shape [Flakiness and roughness of grains]
- Blend with other sand

Crushing type for **ABRASIVE** Feed Material

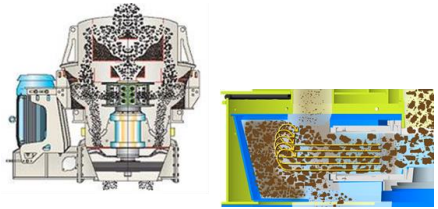
- **High Speed Cone Crusher** with fine liner manganese selection

OR

- **Rock-on-Rock** Vertical Shaft Impactor **(VSI)** (note a VSI will have a lower ratio of reduction thereby will produce larger recirculating loads)
- Feeder velocity is often tied into the power draw of the crusher to maximize production and avoid crusher overload
- Do not forget CRUSHER PROTECTION with magnet or metal detector !



High Speed Cone Crusher



VSI Rock on Rock

Crushing type for **NON-ABRASIVE** Feed Material

- **Horizontal Shaft Impactor (HIS)** noting that feed should fall across full width of interior rotor breaker bars

OR

- **Rock-on-Metal Anvils** Vertical Shaft Impactor **(VSI)**
- These type of impact crushers have a higher ratio of reduction thereby will produce a smaller recirculating loads than cone crusher circuits or VSI rock-on-rock circuits.
- Feeder velocity is often tied into the power draw of the crusher to maximize production and avoid crusher overload
- Do not forget CRUSHER PROTECTION with magnet or metal detector !

HSI

VSI Rock on Metal Anvils

Even being the most used universal construction material concrete is still prescriptively designed and its technology not well mastered

Concrete a universal construction material and a possible universal construction problem

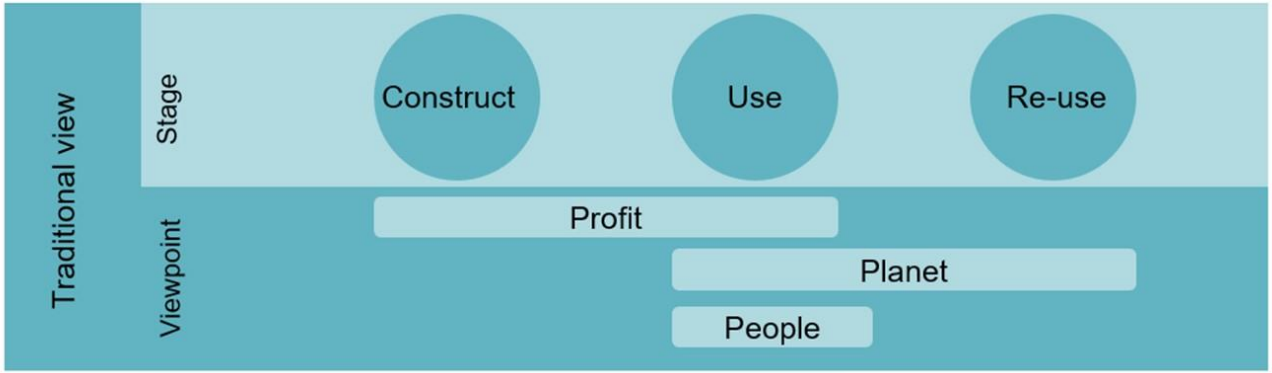
- Italy 2018: 55 years old Morandi bridge in Genoa collapsed tra… and left 600 homeless – *but also dealt a hammer blow to Italy… legacy*

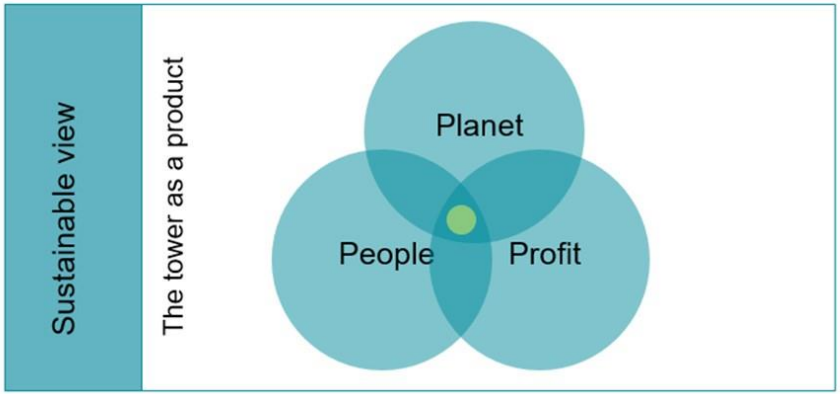
Transform subjective concept of "Performance" to design methods and tools that allow designers to design according to the required service life

- Severe e… posures
  - L… ability
  - Inc… d operations and maintenance costs
  - Premature end of service life

Changing viewpoints

Necessity of taking a holistic approach to sustainability considering not only the environmental element





Performance based design

Used in strategic infrastructures since more than 2 decades

Confederation bridge
Canada - 1997

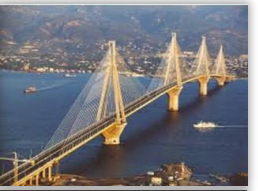
V. de Gama bridge
Portugal - 1998

Öresund tunnel
Sweden - 2000

Medway bridge
UK - 2001

Monaco floating dyke
France - 2002

Millau bridge
France - 2004



Rion Antirion bridge
Greece - 2005

100 – 120 years specified service life design

Performance based specifications including durability indicators

Designed with superior blended cements (Slag, FA, LS, PZ, SF, etc)

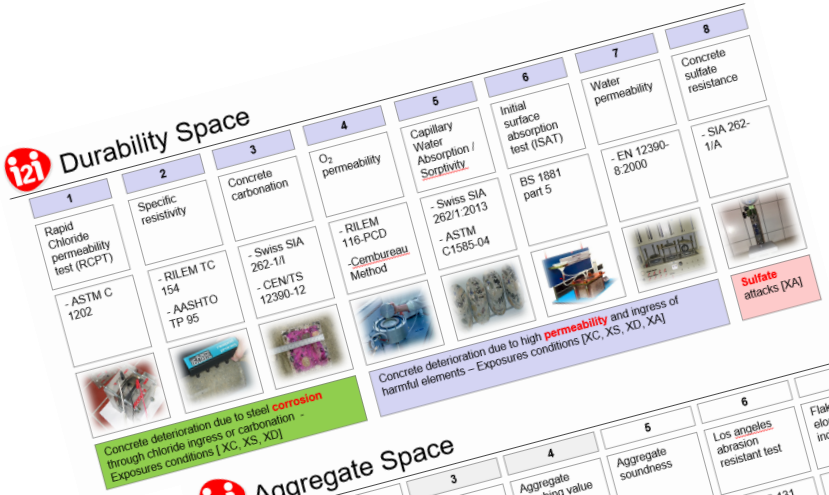
INSEE Collaboration & Solutions Development Space

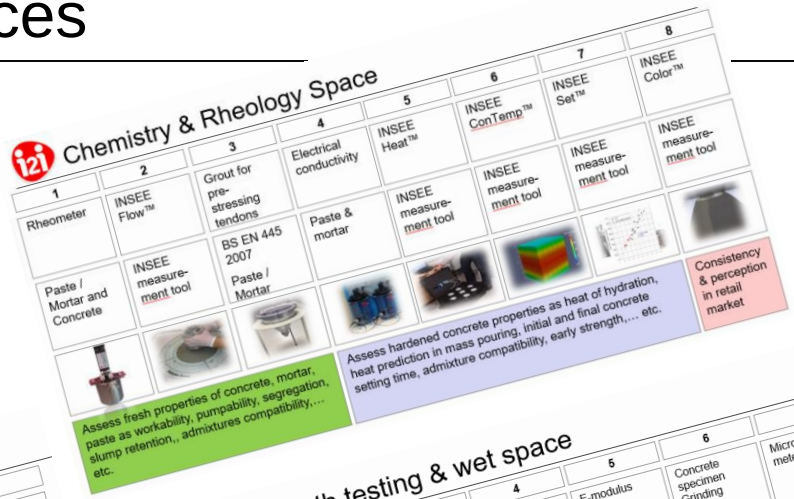
- Collaboration space to enable a closer link with industry partners

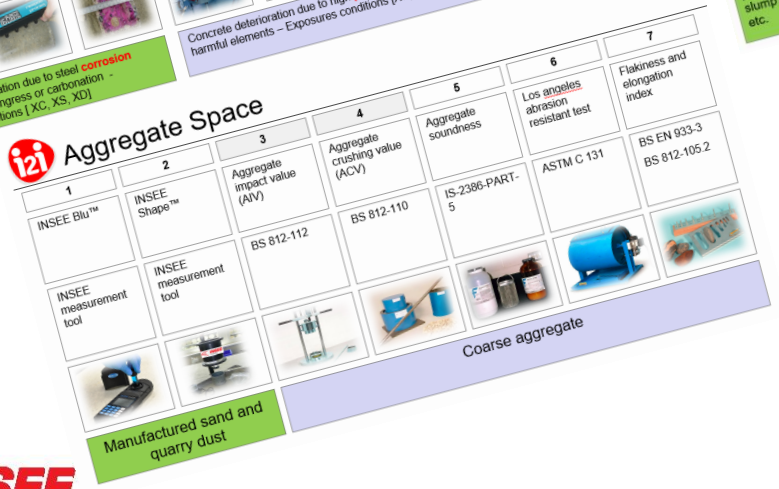
- Engage an <u>effective collaboration</u> driven by **openness**, **speed** and **connectivity** with focus on creating shared values (CSV)

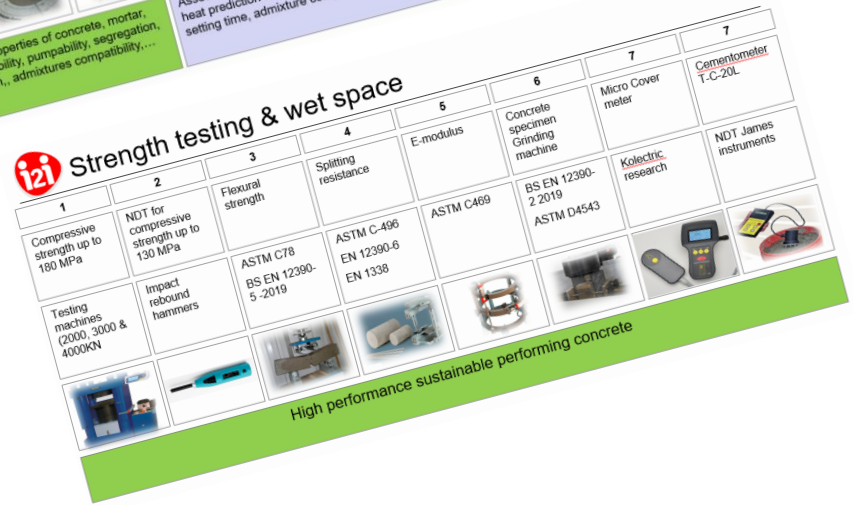
→ develop together innovative and efficient sustainable solutions for Sri Lanka

4 Functional Innovation Spaces







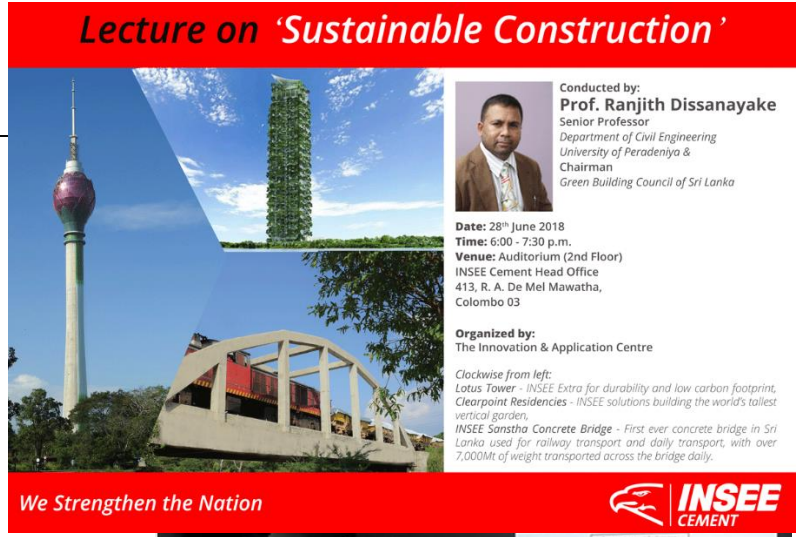


Monthly knowledge sharing session

13 Sessions organized since may 2018 at head office auditorium

+ 4 with central and provincials engineering department and IESL

1. **Durability of Mass Concretes** by Prof. Anura Nanayakkara, University of Moratuwa
2. **Sustainable Performing Concrete** by Dr. Moussa Baalbaki, Head of Products & Solutions, INSEE Cement
3. **Importance of Sustainable Constructions for Sri Lanka** by Prof. Ranjith Dissanayake, University of Peradeniya
4. **High-Strength, High-Performance Concrete in Practice** by Eng.W.J.B. Shiromal Fernando, Managing Director/Principal Structural Engineer, Civil & Structural Engineering Consultants (Pvt) Limited
5. **FIDIC Guidelines for Construction Project Management** by Eng.Malith Mendis, Mendis Cobain Consultants(Pvt) Limited
6. **High Performance Concrete with Novel Mineral Cement Additives** by Dr. Thushara Priyadarshana, Open University of Sri Lanka
7. **Eurocode for Performance based structural design** by Dr. D. L Pradeep, Open University of Sri Lanka
8. **Forensic Engineering** by Prof. Ranjith Dissanayake, University of Peradeniya
9. **Design and Construction Experiences in Mega Projects** by Eng.Udayanga Alwis, , Managing Director/Principal Structural Engineer, Civil & Structural Engineering Consultants (Pvt) Limited
10. **Managing Construction Timelines** by Eng.Budhdhi Sathsara Perera,Sanken Constructions
11. **Repair and Retrofitting of Structural Elements** by Dr.Harsha Sooriyaarachchi, University of Ruhuna
12. **Design of Shear-Critical Reinforced Concrete Elements** by Dr.Kushan Wijesundara, University of Peradeniya
13. **Manufactured sand as an alternative to river sand** by Dr. Moussa Baalbaki, Head of Products & Solutions, INSEE Cement



International Conference on Resource Efficiency and Circular Economy

Thank You...!