Low Carbon Concrete Using Byproducts Aiming for Contribution to Carbon-Neutral Society

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Introduction

Concrete is essential material for social infrastructure

- The second most used material in the world after water

  Concrete production : 14 billion m^3/year

  Cement production : 4 billion t /year

  → occupies 8% of CO_2 emission of the world

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CO_2 Emission during Cement Manufacturing

material Fuel

CO_2 60 : 40 → Approx.800kg/t

Raw materials

Limestone（$CaCO_3$）
Clay (Al source)
Silica stone(Si source)
Iron (Fe source)

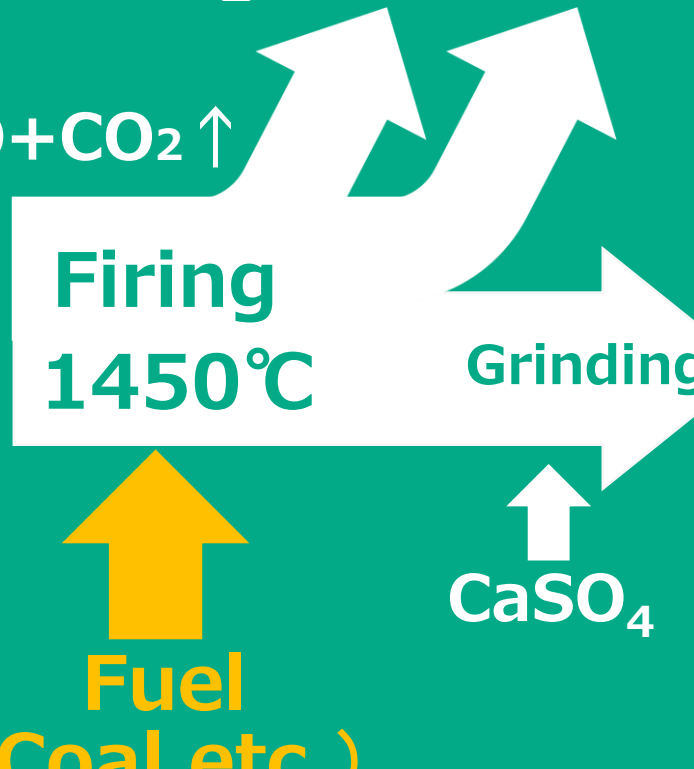

Photo TAIHEIYO CEMENT HP

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Ingredients of Concrete and their CO_2 Emission

Material composition (Volume)

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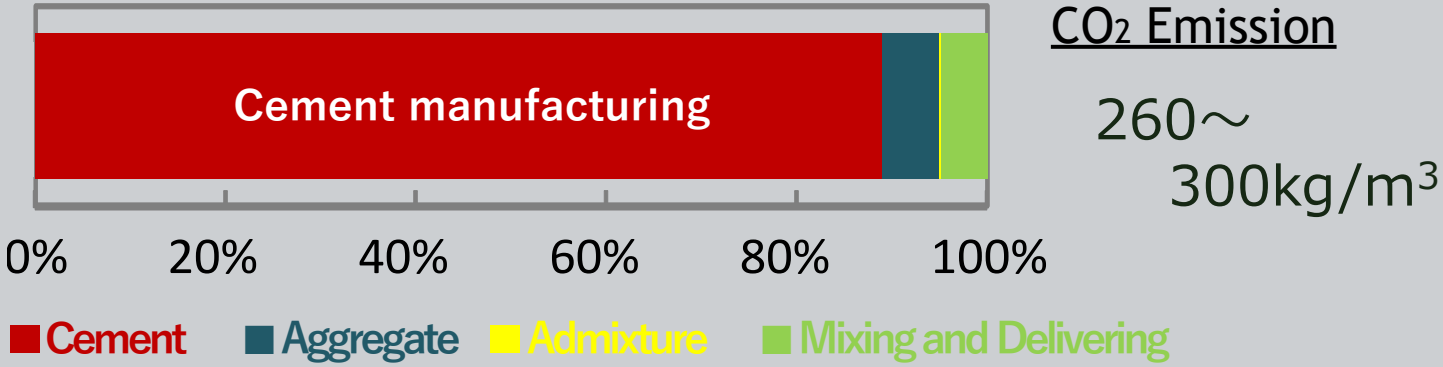
Ingredients of Concrete and their CO_2 Emission

Material composition (Volume)

CO_2 emissions during manufacturing of materials



CO_2 Emission

260～ 300kg/m³

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Ingredients of Concrete and their CO_2 Emission

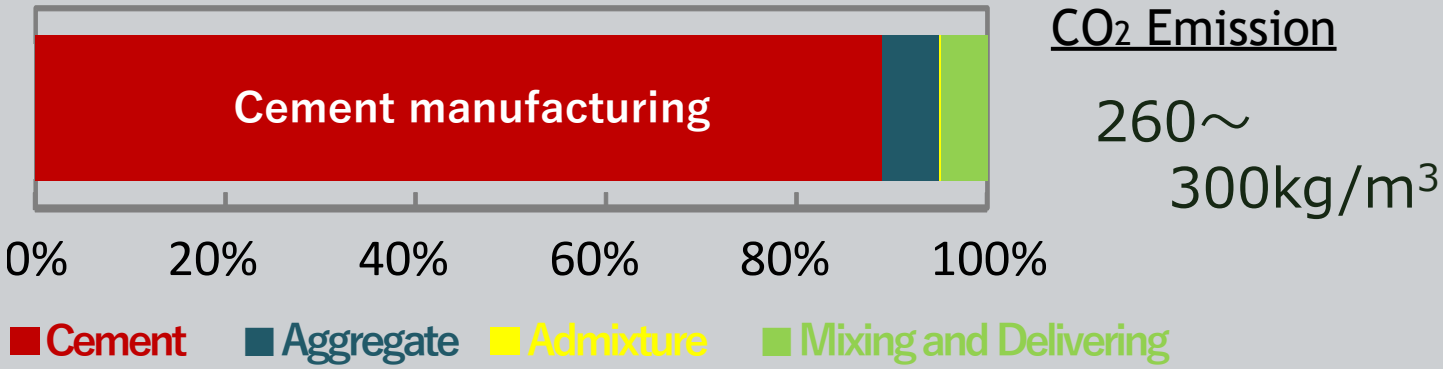
Cement

Chemical addmixture

Air(4.5vol%)

Reduction of cement usage is effective way in order to reduce the CO2 emissions of concrete.

CO_2 emissions during manufacturing of materials



CO_2 Emission

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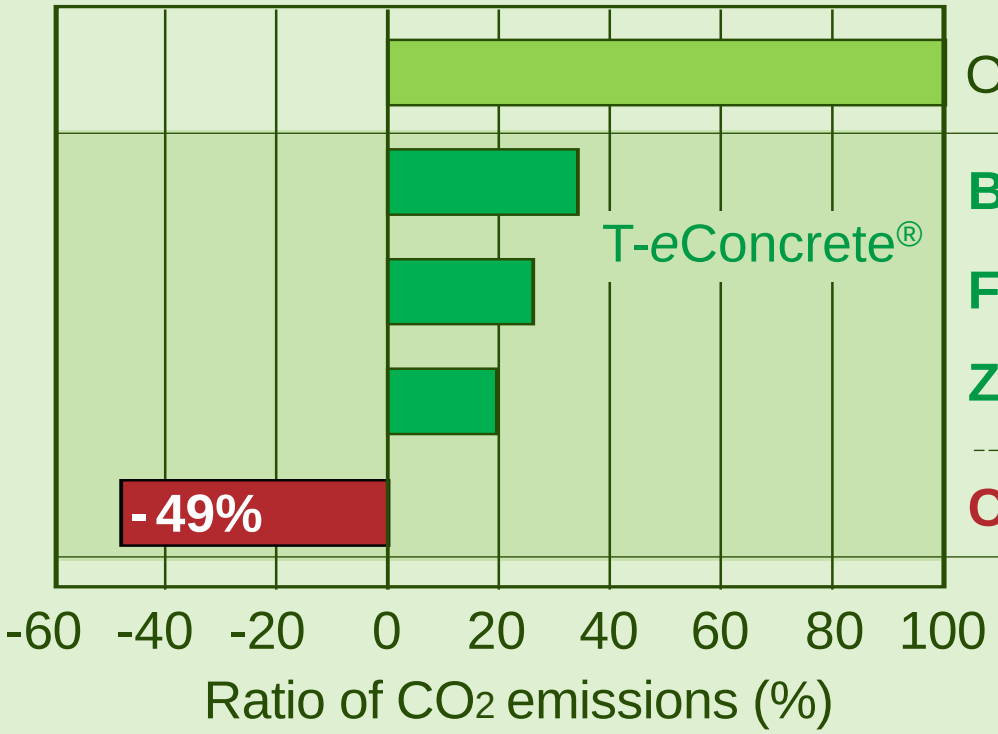
T-eConcrete® family

2009～



Ordinary Concrete / cement :100%

Building Standards Law compliant type / cement ≧ 30%

Fly ash utilization type / cement ＜30%

Zero-Cement type / cement = 0%

CO_2 reduction

Carbon-Recycling / cement = 0%

CO_2 capture and utilization

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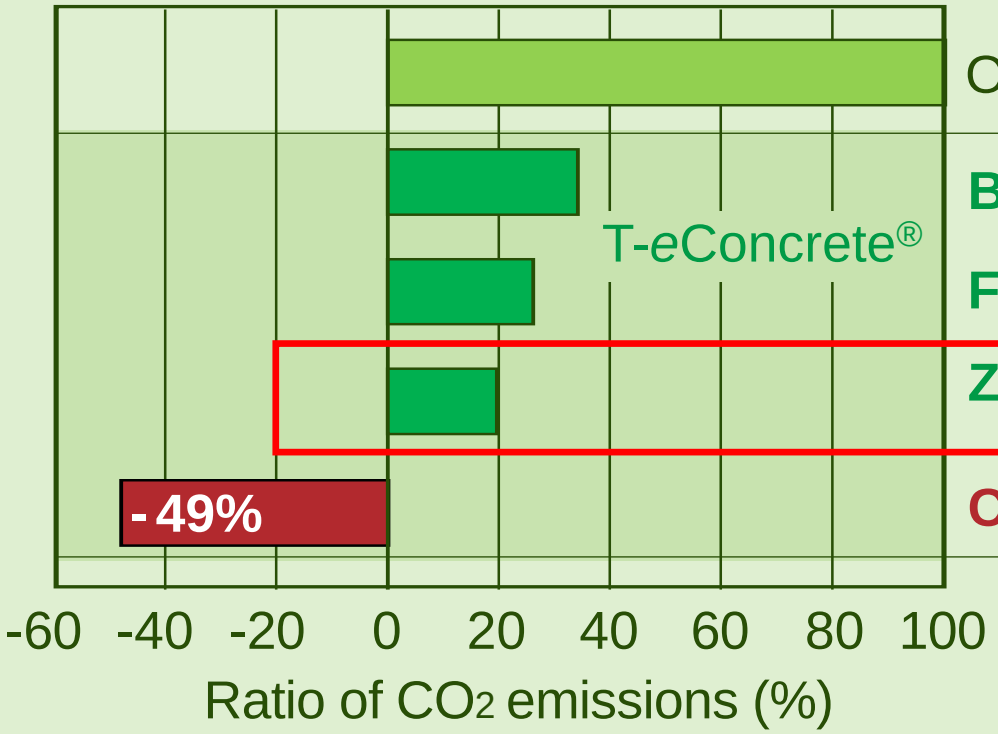
T-eConcrete® family

2009～



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CO_2 reduction

CO_2 capture and utilization

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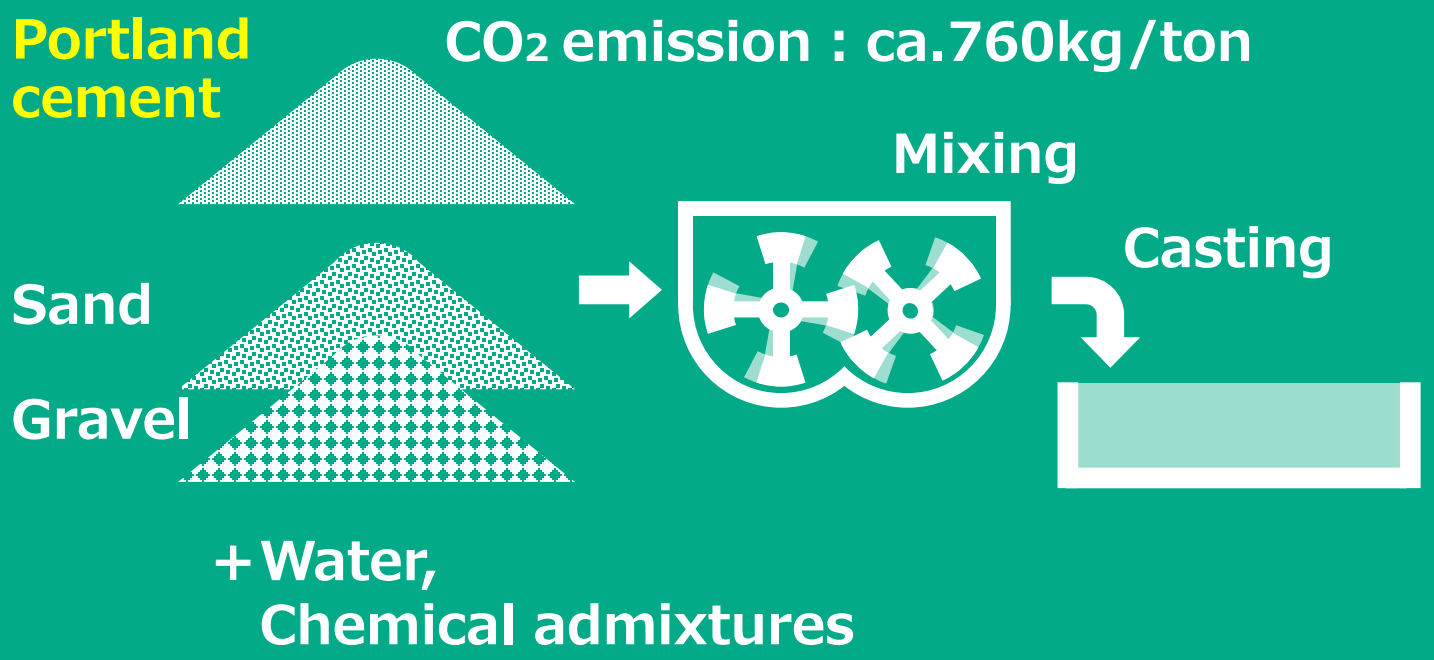
Ordinary Concrete

CO_2 emission : 260～300 kg/m^3



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T-eConcrete® / Zero-cement type

CO_2 emission ： 52～90 kg/m³

CO_2 reduced amount ： 182～240 kg/m³

CO_2 reduction rate ： 70～ 80 %

Iron Ore,
Cokes,
Limestone

Hot air

Pig iron

Steel mills / Blast furnace

Ground Granulated
Blast Furnace Slag

+Stimulator

Sand

Gravel

+Water,
Chemical admixtures

Mixing

Casting

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T-eConcrete® / Zero-cement type

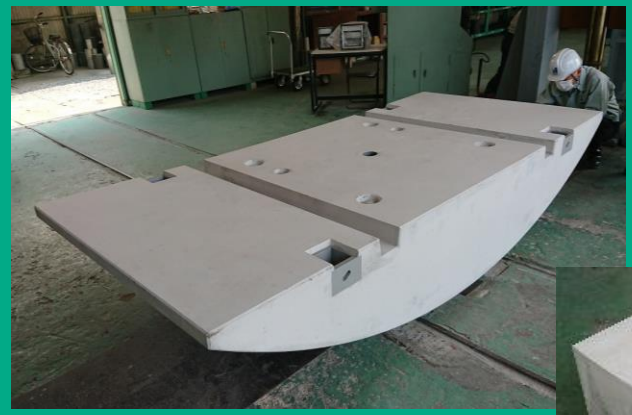
Applications

Cast-in-place concrete

2013

Segments for shield tunnel

2021



Blocks for shield tunnel

2021～

2018

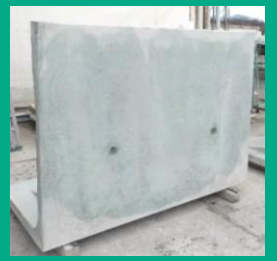
Recommendations for Design and Construction by Japan Society of Civil Engineers

2019

Prototypes

Box culvert
Retaining wall

2020



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T-eConcrete® / Zero-cement type

Applications

Application for Cast-in-Place Concrete

Pumping

Bucket Placing

Site Work of a Basement Slab

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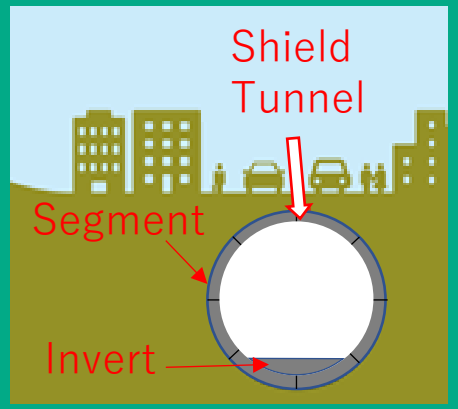
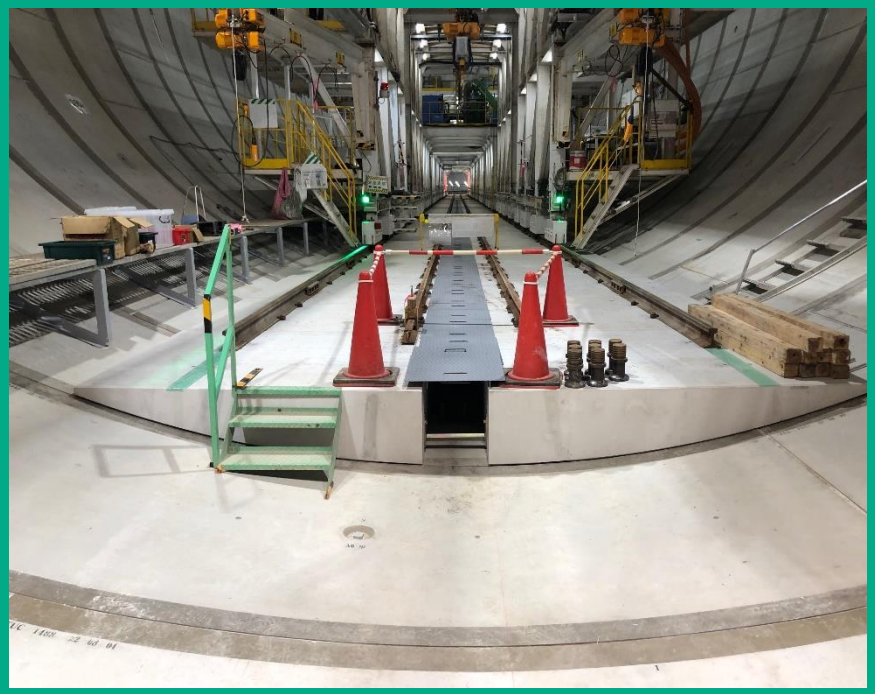
T-eConcrete® / Zero-cement type

Application for Precast Concrete



Shield Segment



Shield Invert

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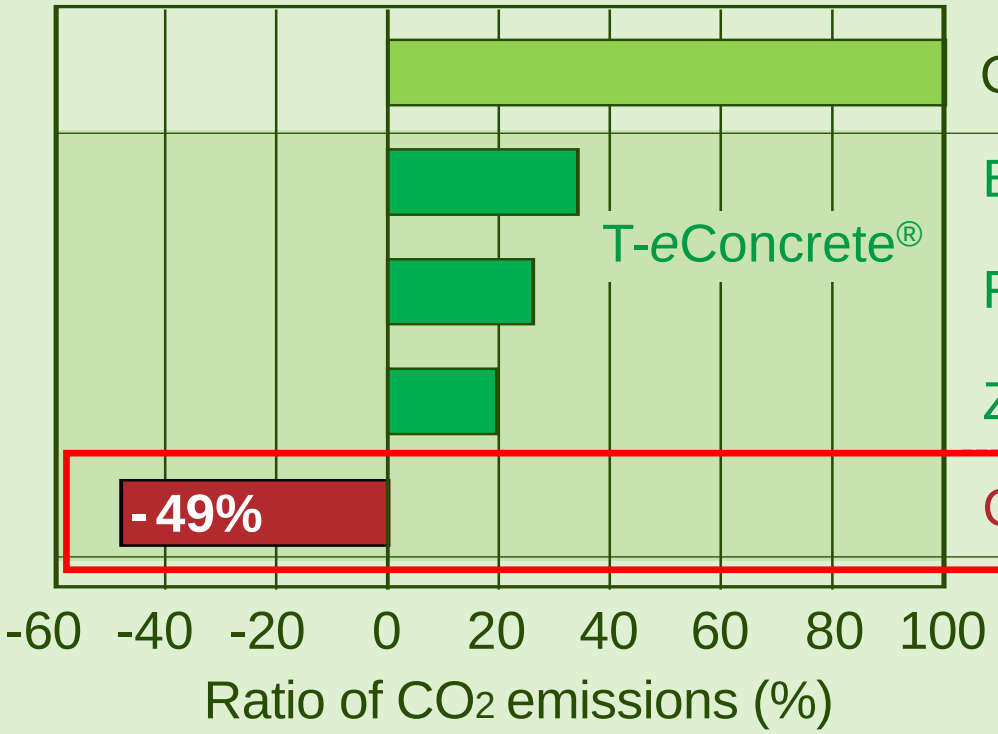
T-eConcrete® family

2009～



Ordinary Concrete / with Portland cement

Building Standards Law compliant type

Fly ash utilization type

Zero-Cement type

CO_2 emission reduction

Carbon-Recycling

CO_2 capture and utilization

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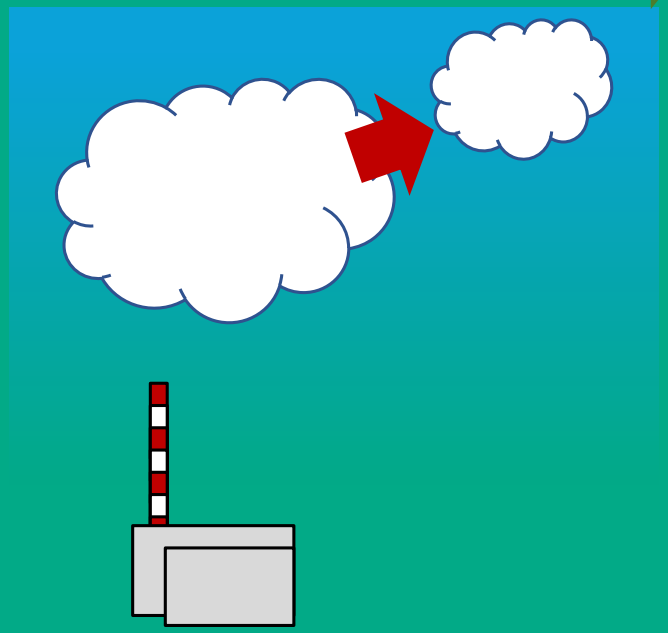
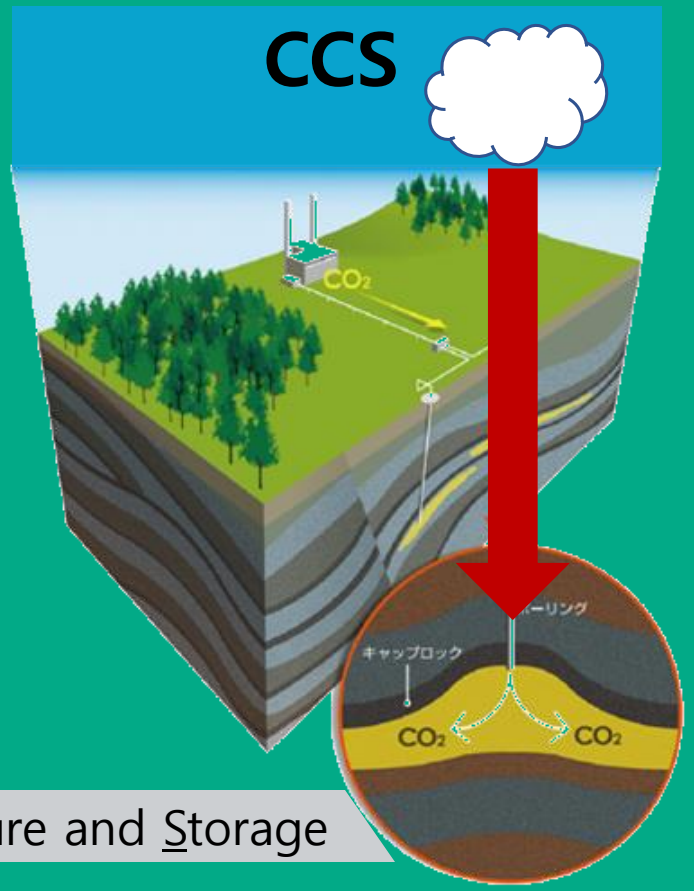
From CO_2 Reducing to Recycling

Reduction



Storage

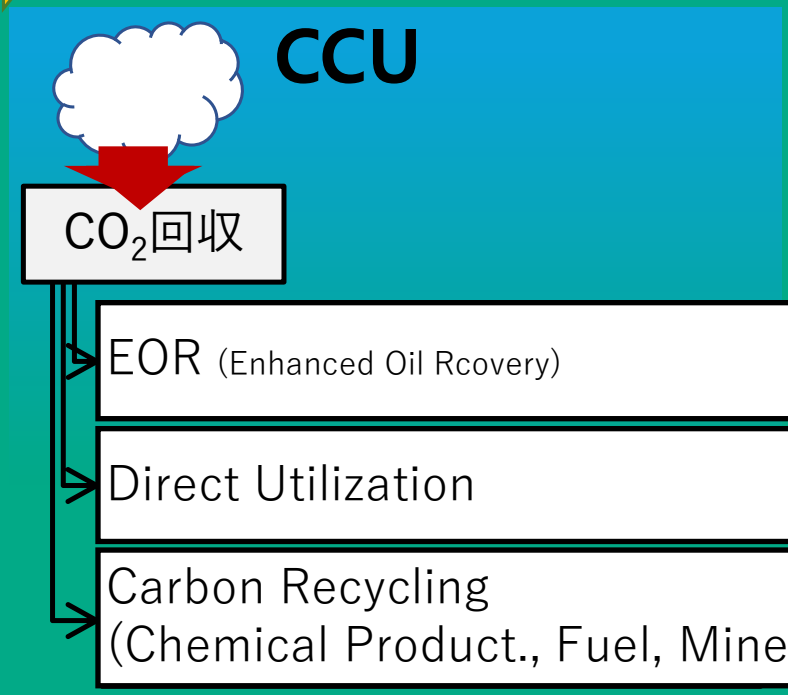
CCS



Carbon dioxide Capture and Storage

Recycle and Utilization

CCU



Carbon dioxide Capture and Utilization

2019年→ **Carbon Utilization**

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T-eConcrete® / Carbon-Recycling

CO_2 emission ： - 116～ - 45 kg/m³

CO_2 absorption ： 98～ 171 kg/m³

CO_2 reduction amount：280～ 351 kg/m³

CO_2 reduction rate： 118～ 149 %

Air / Exhaust

CO_2

Ca

Waste / Byproducts

Calcium Carbonate; $CaCO_3$

Ground Granulated Blast Furnace Slag

+Stimulator

Sand

Gravel

+Water, Chemical admixtures

Mixing

Casting

CO_2

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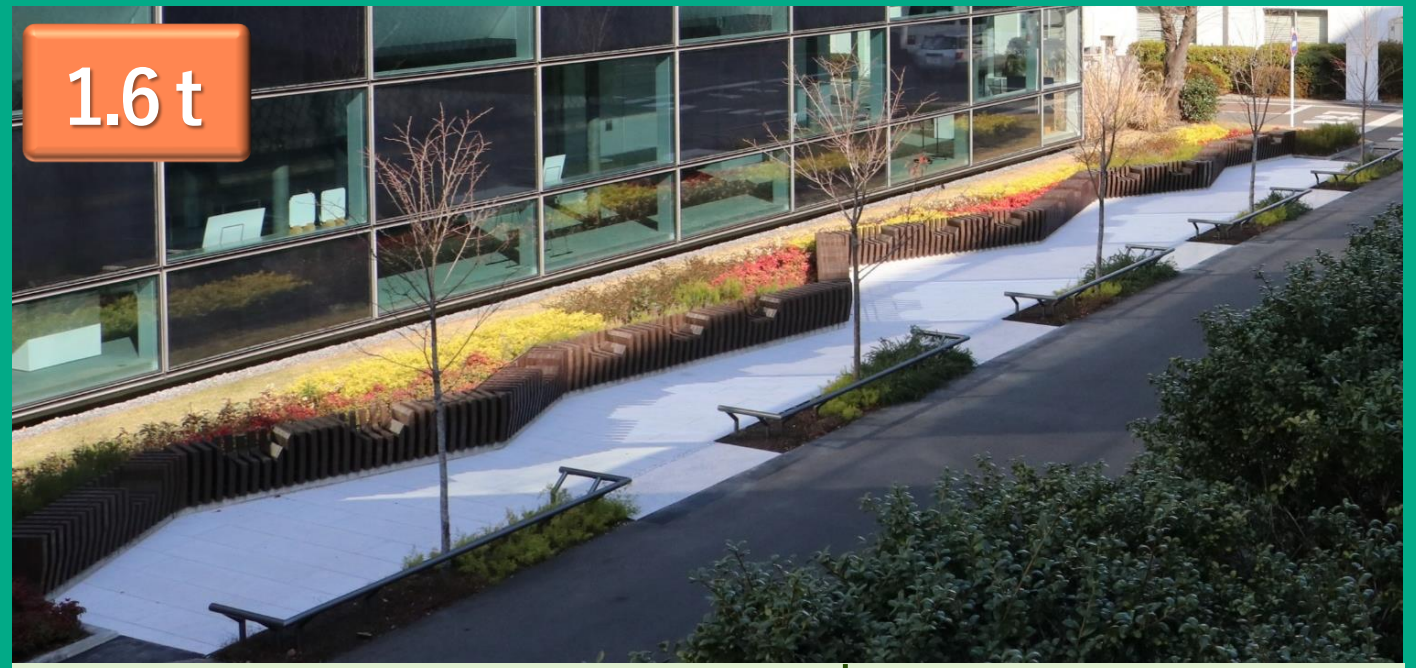
T-eConcrete® / Carbon-Recycling　Mixing procedure

T-*e*Concrete / Carbon-Recycling

Applications

Applied in paving as cast-in-place concrete and concrete blocks



Ordinary Concrete		253 - 274	
Cast-in-place/Mix A	▲171	55	Balance : ▲116
Mix B	▲115	65	▲50
Concrete Blocks	▲98	53	▲45
	CO_2 absorbed ⇦	⇨ CO_2 emitted	

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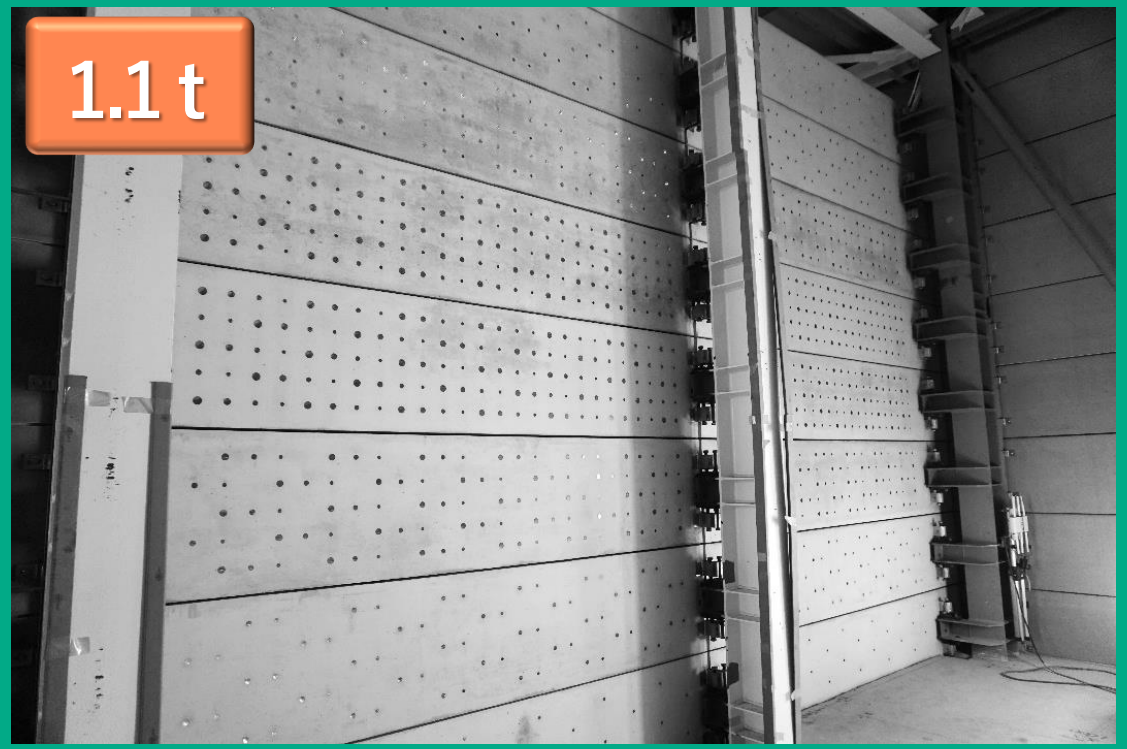
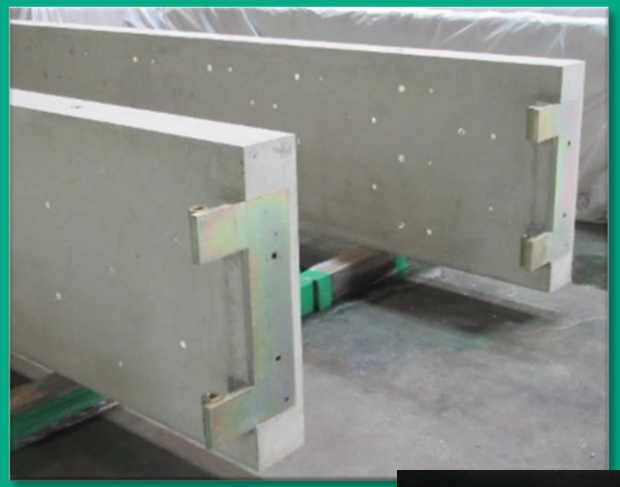
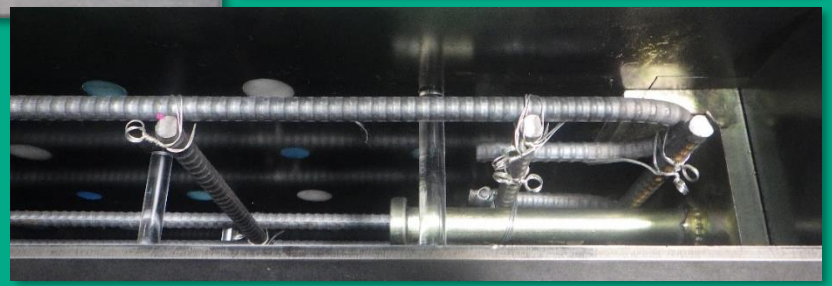
Applications

T-eConcrete / Carbon-Recycling

Applied to a building as wall components







Ordinary Concrete		274	
Wall components	▲119	69	Balance : ▲50
	CO_2 absorbed ⇦	⇨ CO_2 emitted	

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Challenges Toward Carbon Neutral

Toward the smooth transition of Traditional Concrete⇒Zero-Cement type or Carbon-Recycling

- Accumulation of actual achievement
- Development of standard and/or guideline
- Cost Management
  (Who can share the cost increase and how?)

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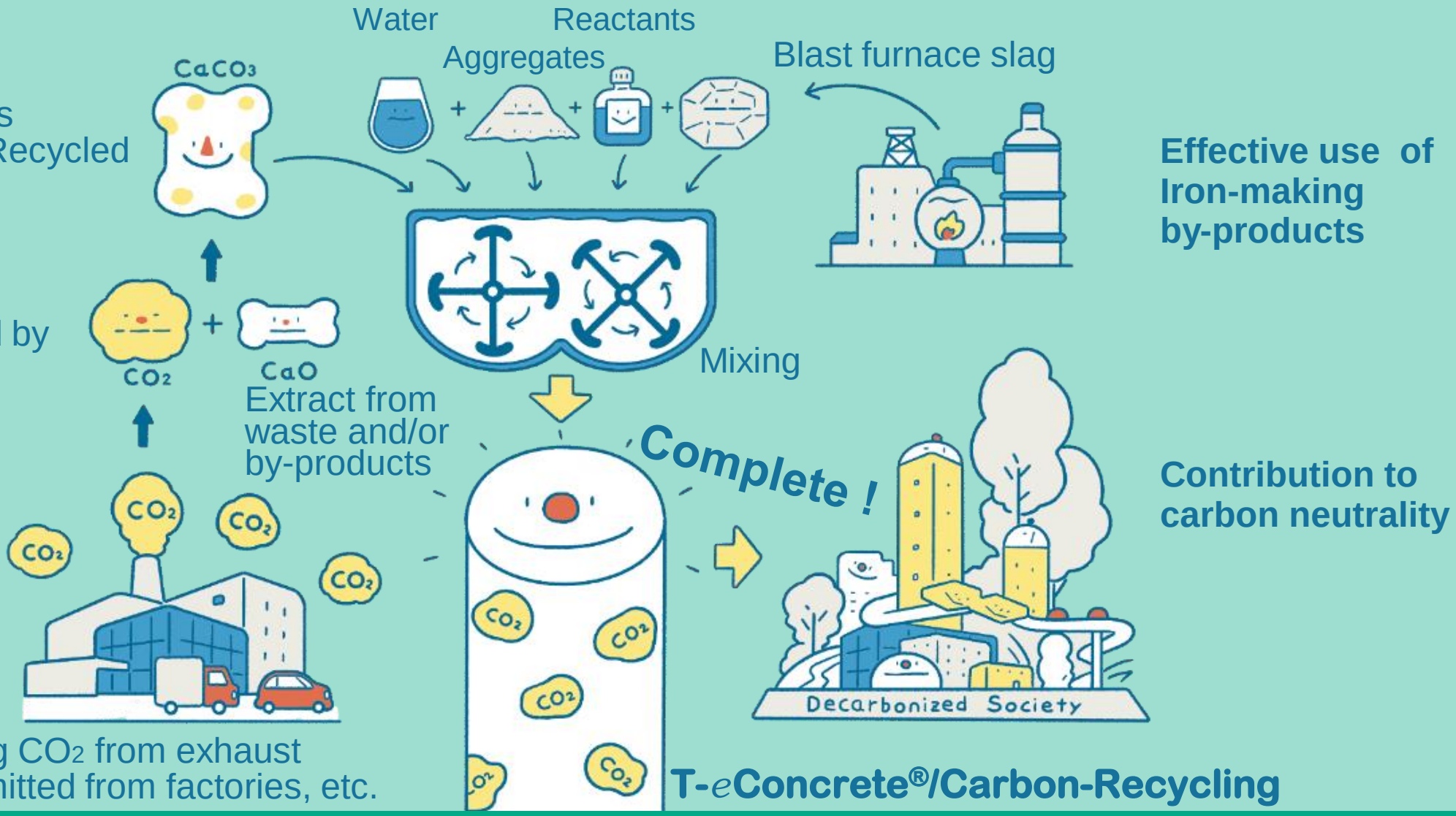
Illustration by Sho Fujita



Thank you for your attention

https://www.taisei.co.jp/english/t-econcrete/