



O desafio da Construção de Baixo Carbono

Vanderley John



construindo
o amanhã



Porque Zero Carbono é importante

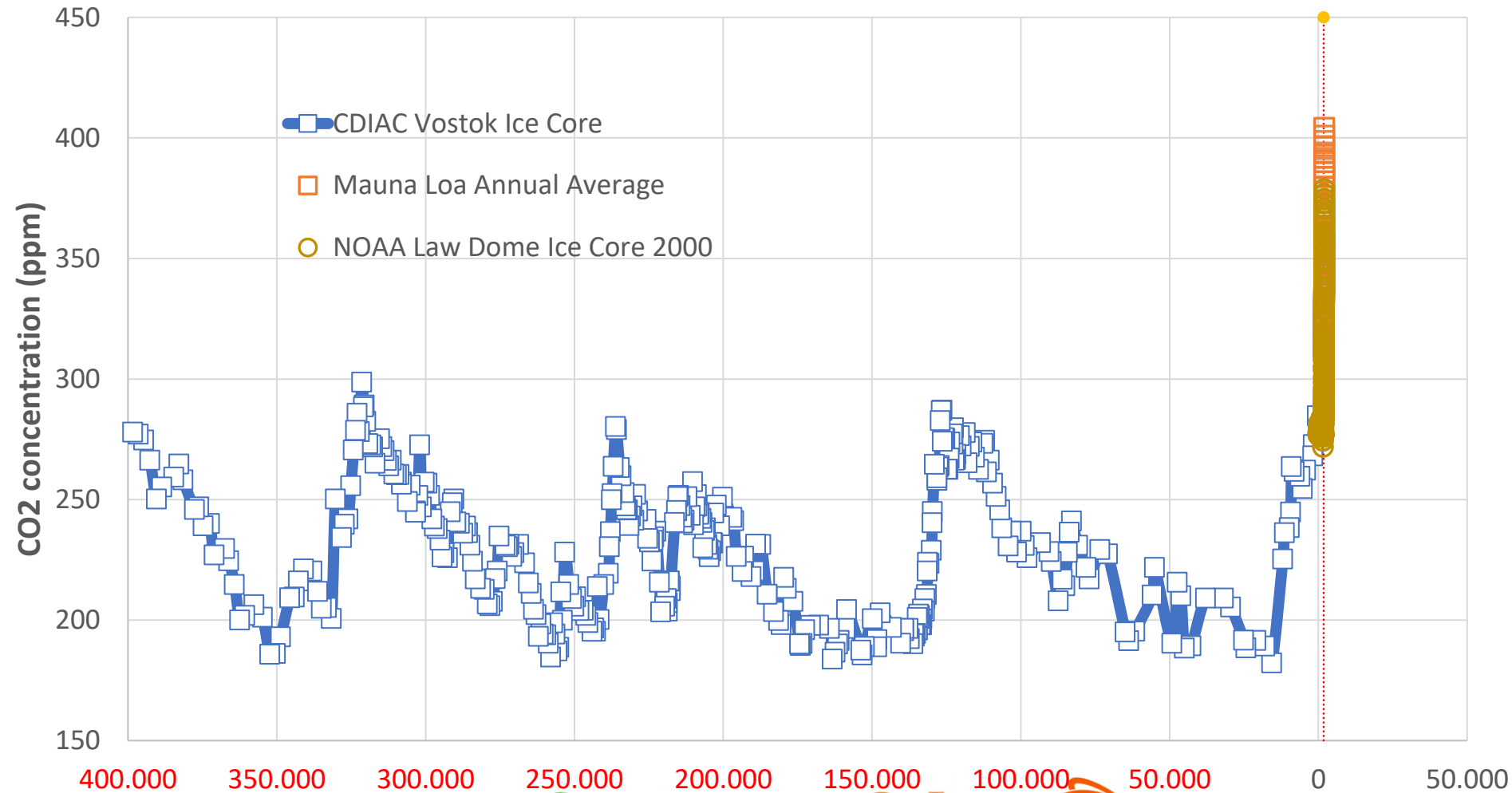
1850

Ed Hawking, U Reading

<https://showyourstripes.info/>

2020

CO₂ na atmosfera



Como aumentamos CO2 na atmosfera

- Decomposição de carbonatos (calcário)
- Oxidação de Carbono fixo na crosta terrestre
 - Fóssil – petróleo, carvão mineral, gas natural
 - Florestas nativas

Derretimento dos polos e geleiras



Credit: NASA/USGS [Landsat](https://svs.gsfc.nasa.gov/12633)
<https://svs.gsfc.nasa.gov/12633>

The
Economist

SEPTEMBER 2ND-8TH 2017

Floods

How to deal with them

State-sponsored quackery in China

Guatemala's unfunny president

America's biggest private firm opens up

When Ponzi schemes make sense



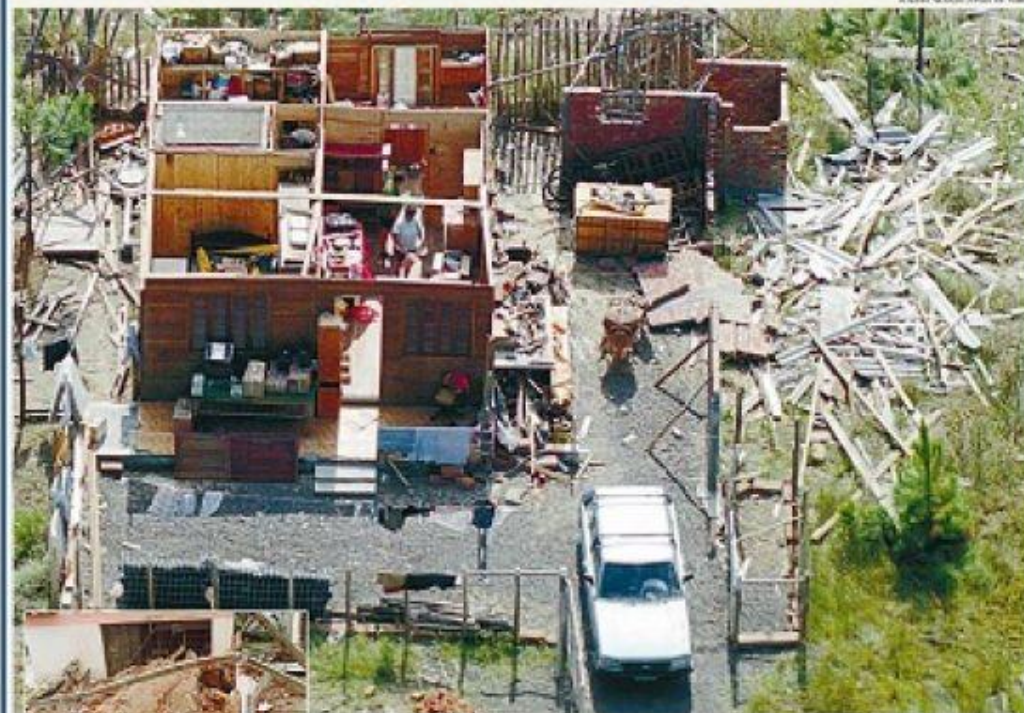
DIÁRIO CATARINENSE

ANO XVI - Nº 6528 - SC - SEGUNDA-FEIRA, 20 DE MARÇO DE 2017 - www.dccat.com.br

R\$ 1,50

A fúria dos ventos

CICLONE ATINGE SUL DE SC E NORTE DO RS, DEIXA UM MORTO E 12 DESAPARECIDOS



PÂNICO: 20 mil casas foram atingidas pelo vento, que chegou a 230 quilômetros por hora, em 40 cidades catarinenses

Estado e prefeituras apuram os prejuízos

O governador Luiz Henrique Assis, durante o dia, os trabalhos de recuperação e levantamento dos estragos. A noite, pediu aos prefeitos um detalhamento da situação para a busca de recursos. João Bernardo (Pso) pediu o corte até ao caso em Araraquã.

Após o susto, surge a solidariedade

Milhares de famílias foram desabrigadas pelo ciclone na madrugada de domingo. Em Criciuma, uma das áreas mais atingidas foi o bairro Paraíso (Fiel). A Assembleia Legislativa e as prefeituras iniciaram campanhas para receber doações e auxiliar os afetados.

COBERTURA COMPLETA NAS PÁGINAS QUATRO A 11

Erftstadt-Blessem

An aerial photograph showing a residential area in Erftstadt-Blessem, Germany, severely affected by flooding. The image captures a large-scale erosion event where a massive section of the earth's bank has collapsed into the floodwaters. The collapsed area is characterized by steep, exposed soil and rock faces, with a large, dark, irregular mass of earth and debris visible in the foreground. The surrounding area is a mix of residential buildings, some of which are partially submerged in the floodwater. The floodwater is a murky, brownish-yellow color, indicating a high concentration of sediment. The background shows more houses and trees, some of which are also surrounded by floodwater. The overall scene depicts a significant natural disaster with substantial damage to the local infrastructure and environment.

O colapso de uma pedra...

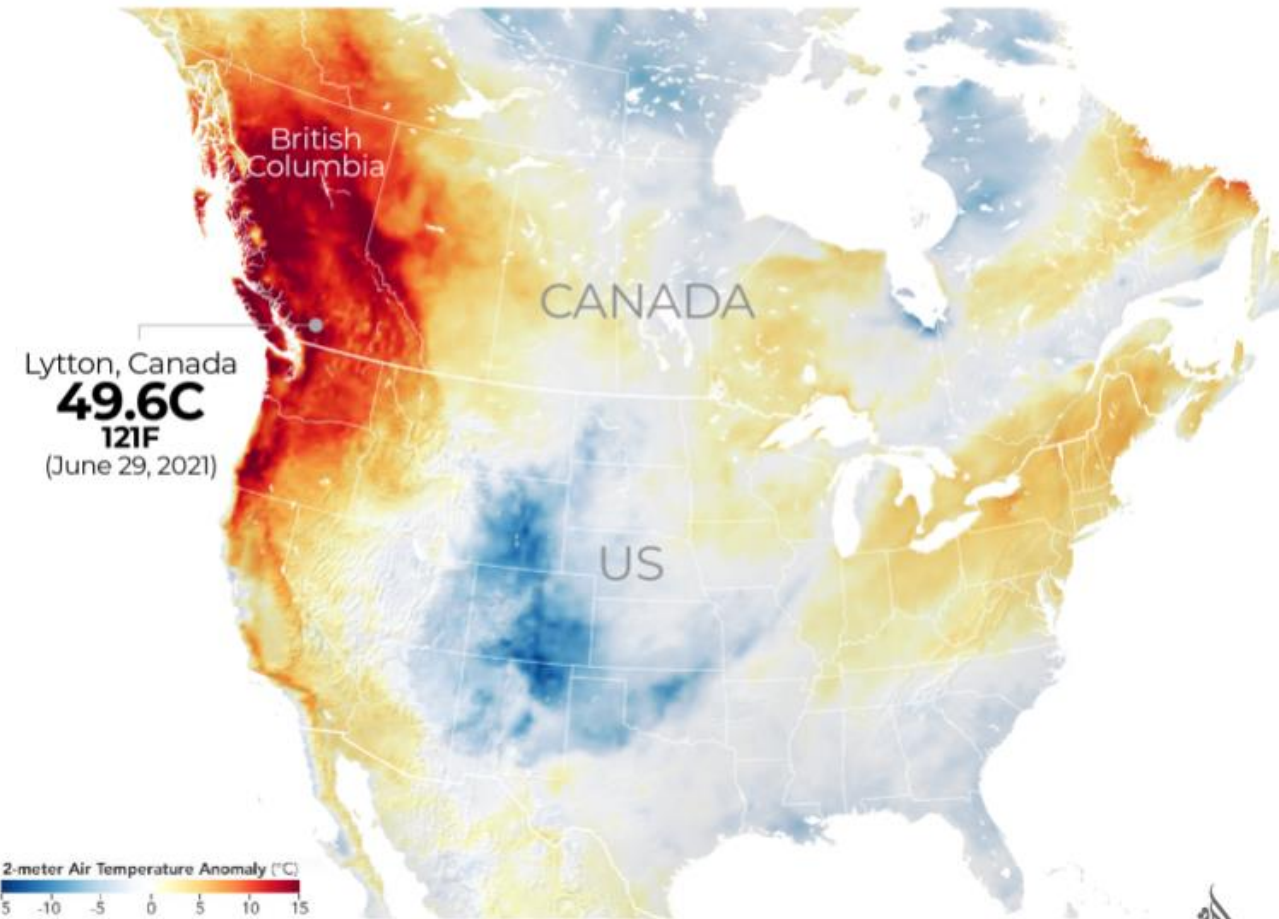
AM John USP ©

AP

WEATHER

100s dead in North America heatwave

At least **486 sudden deaths were recorded** in British Columbia, Canada over the past week as temperatures soared to nearly 50C (122F).



Source: NASA Earth Observatory | July 1, 2021



@AJLabs ALJAZEERA

[Mapping the hottest temperatures around the world | Infographic News | Al Jazeera](#)

Paradise, California (2021)



[Why California's Wildfires Are Getting Worse | Teen Vogue](#)

Canada

‘A tipping point’: how poor forestry
fuels floods and fires in western
Canada

Leyland Cecco in Toronto
Tue 16 Nov 2021 19.26 GMT



Franca, Brasil (26 set 2021)



Chapécó decreta situação de emergência após fortes ventos; uma idosa morreu



NSC Notícias - SC

SC e RS - 01/07/2020

Ciclone bomba: 10 mortes



9°

Chapécó

imagens

OSMAR GRANDO

NSC

00:16 / 03:00

19:18







produção
Yael Peretz

ARQUIVO



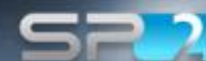
02:07 / 03:43



22 Dez 2014 - 4 min ▾

Estiagem é o grande problema para São Paulo
em 2014

SP2
Veja mais



An aerial photograph showing a vast, dry, and cracked riverbed. A small, yellow boat is stuck in a small pool of water in the center of the frame. The surrounding landscape is arid and brown, with some sparse vegetation visible in the distance.

An Economic Lifeline in South America, the Paraná River, Is Shriveling

The continent's second-largest river is drying up amid the biggest drought in 70 years, upending ecosystems, trade and livelihoods.

Chapécó decreta situação de emergência após fortes ventos; uma idosa morreu



NSC Notícias - SC

SC e RS - 01/07/2020

Ciclone bomba: 10 mortes



9°

Chapécó

imagens

OSMAR GRANDO

NSC

00:16 / 03:00

19:18



CLIMA • CHUVA

No Paraná, tempestades com vento de até 100 km/h danificam quase mil casas

Dezenove municípios foram atingidos; cinco unidades geradoras de Itaipu foram desligadas



Inundações, secas, furacões, ondas de calor

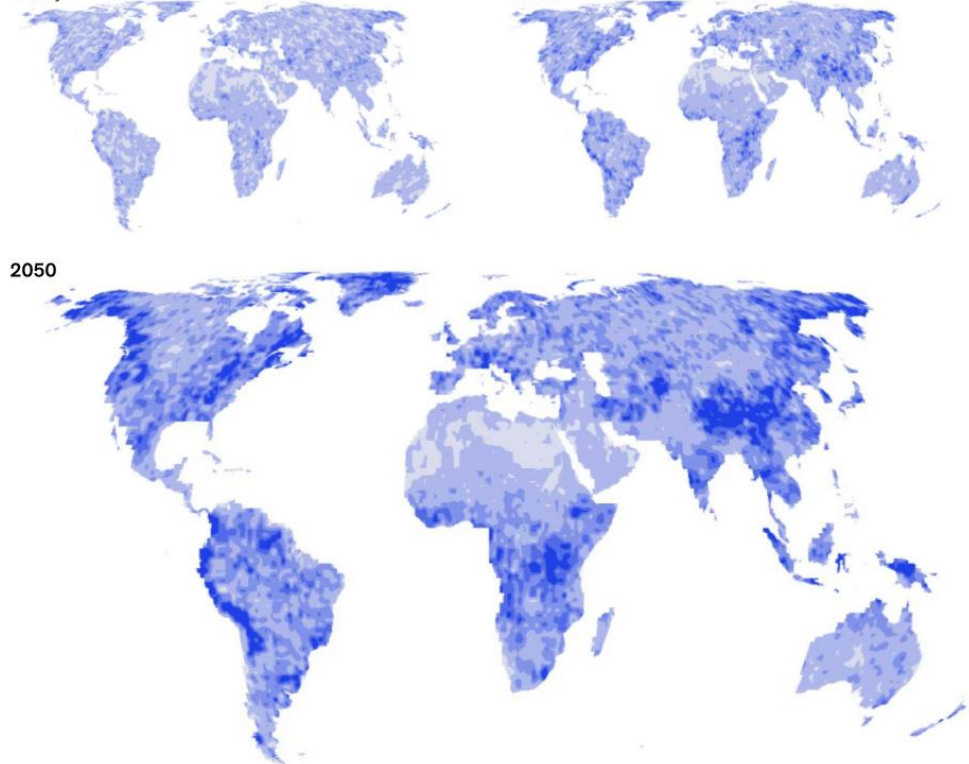
Extreme precipitation (based on RCP¹ 8.5),
change of likelihood of a 1950–81 (50-year) precipitation event



Today

2030

2050



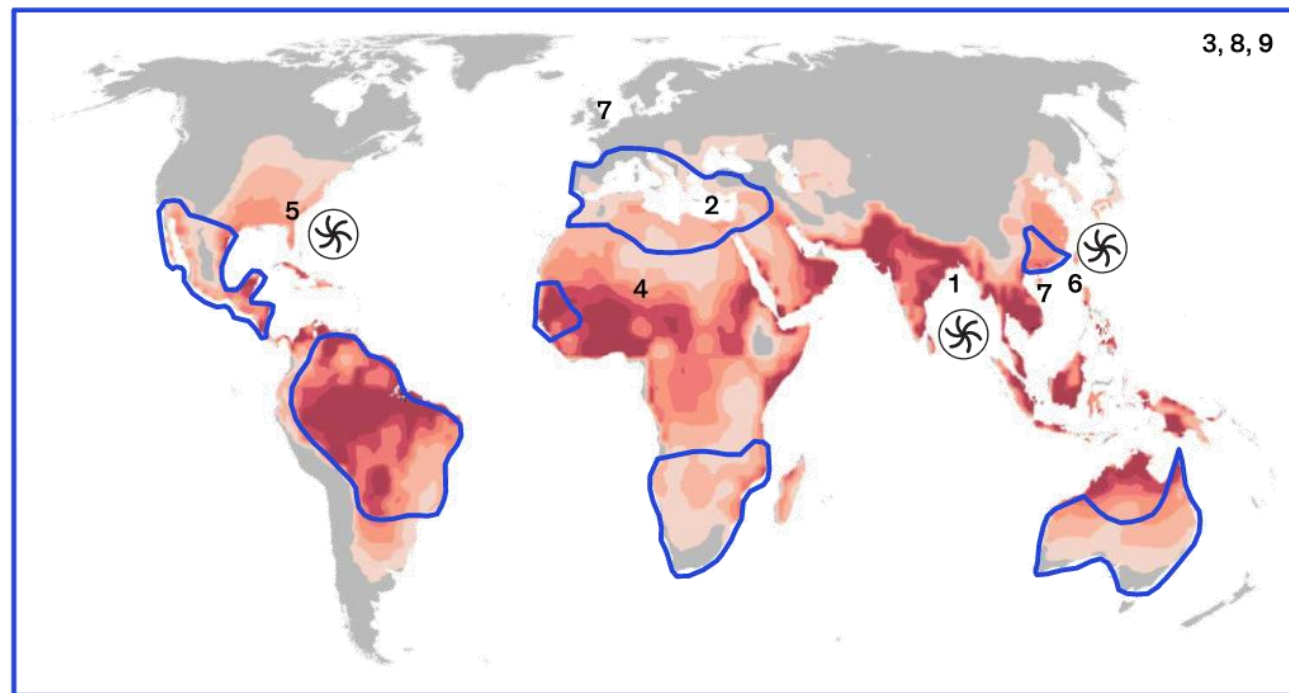
Drought-risk
areas by 2050²



Increase in hurricane/
cyclone severity



Heat stress
by 2050¹



¹Heat stress measured in wet-bulb temperatures.

²Drought risk defined based on % of month in drought according to Palmer Drought Severity index (PDSI).

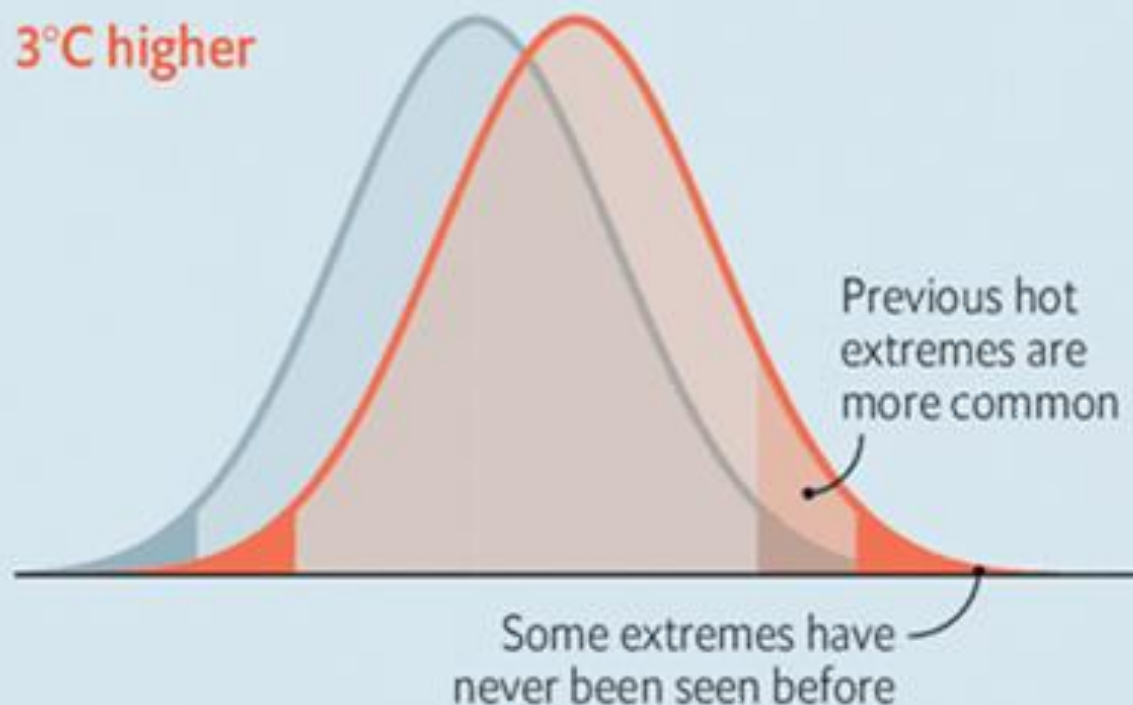
Source: Woods Hole Research Center; McKinsey Global Institute analysis

Climate risk and response Physical hazards and socioeconomic impacts 2020 | McKinsey

O problema não é aumento da temperatura, mas o efeito no Risco de Eventos Climáticos Extremos

Notional distribution of climate impacts

3°C higher



[Three degrees of global warming is quite plausible and truly disastrous | The Economist](#)

Briefing

Jul 24th 2021 edition >

What's the worst that could happen

Three degrees of global warming is quite plausible and truly disastrous

Rapid emission cuts can reduce the risks but not eliminate them



Finance & economics

Sep 4th 2021 edition >

Hot take

Could climate change trigger a financial crisis?

The clearer governments are about emissions reduction, the less likely financial turbulence becomes



Nosso futuro

depende da redução das
emissões de gases do efeito estufa.



EMERGENCIA CLIMÁTICA

Tem implicações práticas na vida e nos negócios atuais.

Pegada de CO₂ será um custo

Finance &
economics

Jul 17th 2021 edition >

Free exchange

The EU proposes a carbon tariff on some imports

The effort could prove an instructive example for others—or a cautionary tale





What Is Carbon Taxation?

Carbon taxes have a central role in reducing greenhouse gases

Ian Parry



on them. This provides incentives for producers and consumers alike to reduce energy use and shift to lower-carbon fuels or renewable energy sources through investment or behavior.

While addressing climate change by reducing greenhouse gases, carbon taxes can also generate more immediate environmental and health benefits, particularly by reducing deaths that result from local air pollution. They can also raise significant revenue

[What Is Carbon Taxation? - Back to Basics - June 2019 | imf.org](https://www.imf.org/publications/what-is-carbon-taxation-back-to-basics-june-2019)

[← Policies](#)

South African Carbon Tax

Source: IEA/IRENA Renewables Policies Database

Last updated: 30 June 2020

Country
South Africa

It is a tax aimed at businesses and companies that emit a high level of carbon, polluting the atmosphere. Industries which rely on fuel consumption and electricity generation are the most frequent offenders. It has been on the table since 2015 as a draft bill from Parliament.

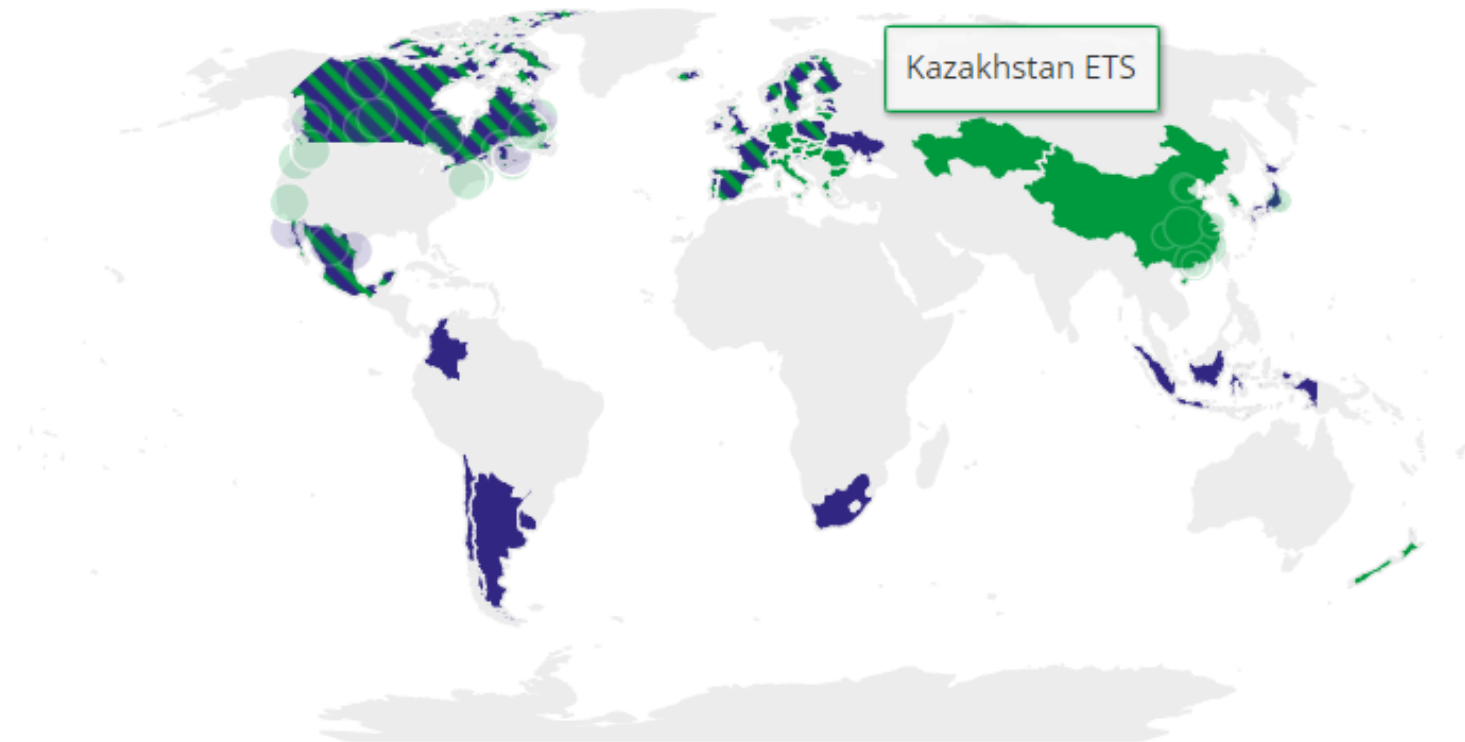
Year
2019



[South African Carbon Tax – Policies - IEA](#)

Carbono como custo: Imposto + Mercado

Summary map of regional, national and subnational carbon pricing initiatives



- ETS implemented or scheduled for implementation
- ETS or carbon tax under consideration
- ETS implemented or scheduled, ETS or carbon tax under con...

- Carbon tax implemented or scheduled for implementation
- ETS and carbon tax implemented or scheduled
- Carbon tax implemented or scheduled, ETS under considera...

https://carbonpricingdashboard.worldbank.org/map_data

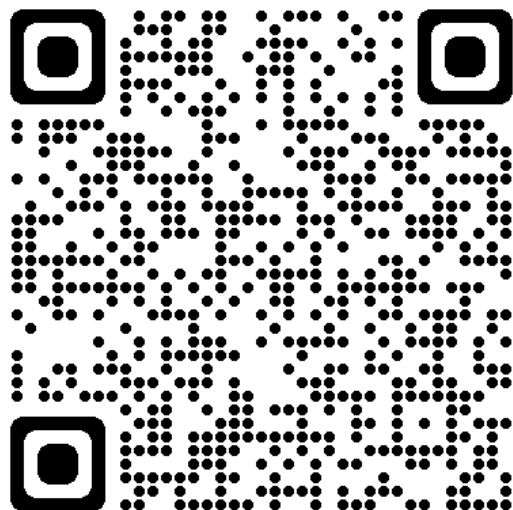
Roadmap apoia precificação de carbono



Global Cement and Concrete
Association

GCCA position

GCCA supports the use of market-based carbon pricing to incentivise decarbonisation at lowest cost



GCCA supports the use of market-based carbon pricing to incentivise decarbonisation at lowest cost

An appropriate carbon price, as well as long-term predictability, allows companies to make the investments needed to reduce their CO₂ emissions in line with the GCCA ambition for net zero by 2050.

The advantage of market-based instruments such as cap-and-trade schemes is that they direct financial resources towards wherever it is most economical to reduce emissions, lowering the financial burden on society.

pegada CO₂ vai definir
custo de produção e financeiro
o que torna viável novas tecnologias

30 50 **100** us \$/tCO₂

Precificação do carbono

Emissores passam a pagar pelo impacto ambiental.

Construtoras trocam concreto por madeira para erguer edifícios

[Folha de São Paulo 27/08/2021](#)
[Mercado](#)

SÃO PAULO Ainda raros na paisagem brasileira, os prédios feitos com estrutura de madeira entraram nos planos das construtoras.

A startup Noah, por exem-

presa, as estruturas já estão sendo produzidas. A obra deve levar cerca de cinco meses para ficar pronta.

“[A madeira é] um material natural, que provoca bem es-



AMATA

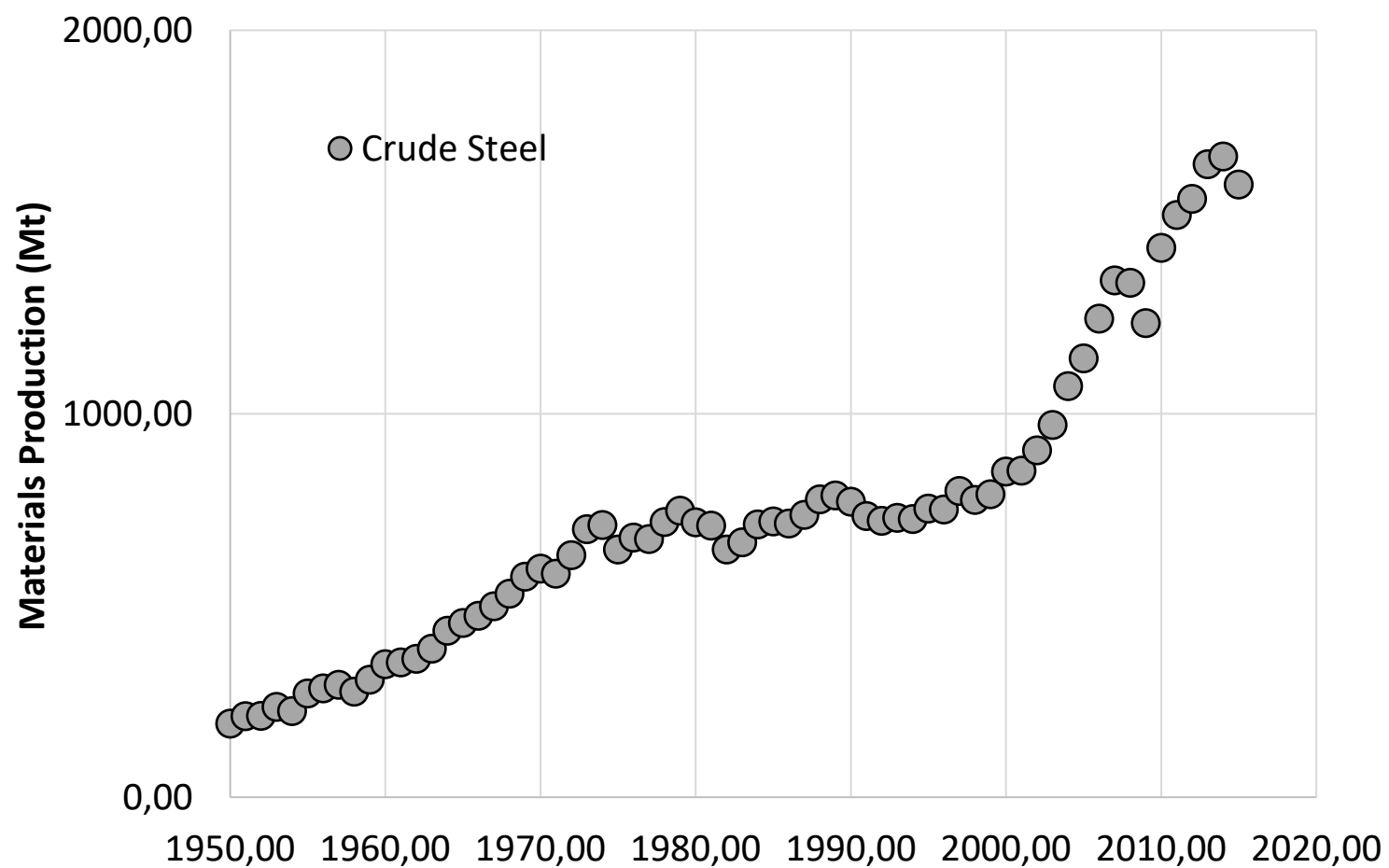


ESTÁ NO AR A PRIMEIRA
CALCULADORA DE LAJES
DE CLT ALINHADA ÀS
NORMAS BRASILEIRAS

SAIBA +

Aço

- Sucata
de ma



7-8% CO₂ antropogênico

Concreto armado



5% da massa do concreto armado

Aço de reforço



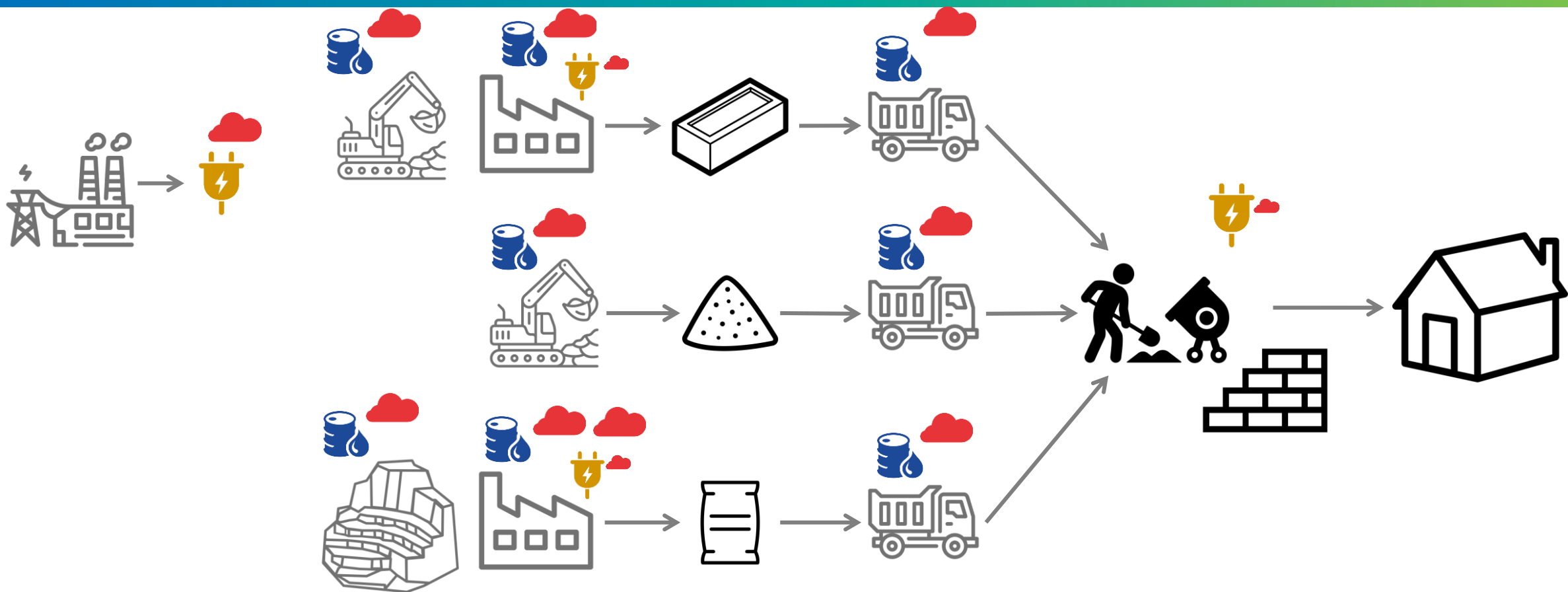
**Aço é
~20% do CO₂ concreto armado**



O que fazer

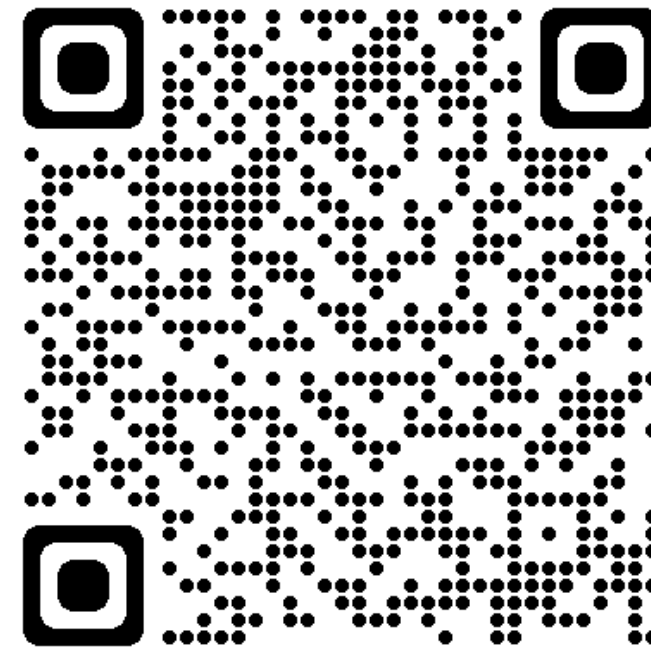
- Conscientizar
- Medir de forma padronizada
 - Empresa
 - Benchmark setorial
- Reduzir
 - Melhorias continua
 - Inovação

Todos os processos somados = emissão de CO₂ da alvenaria



Medir e declarar a pegada de CO₂: SIDAC: Metodologia padrão e dados confiáveis

- Pegada de CO₂
- Pegada cumulativa de Energia

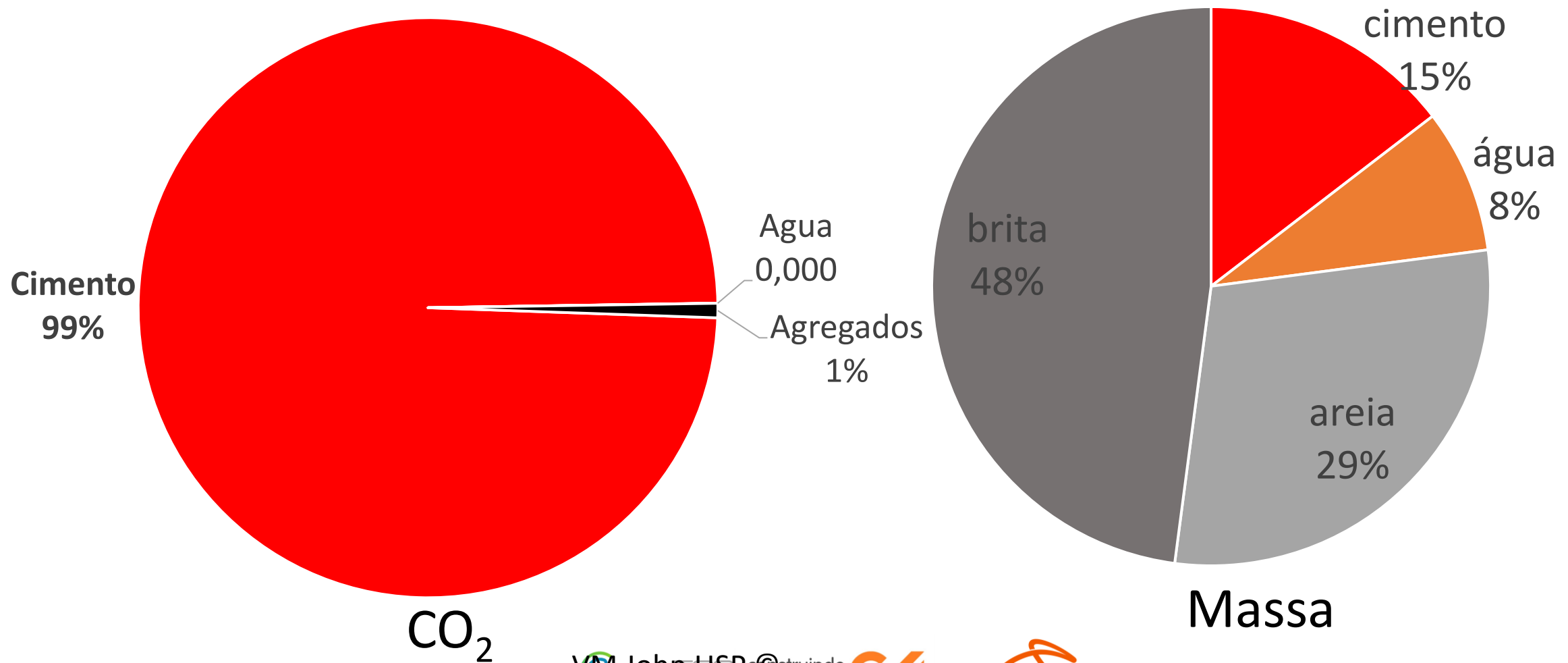


<https://sidac.cbcs.org.br>

MINISTÉRIO DE
MINAS E ENERGIA

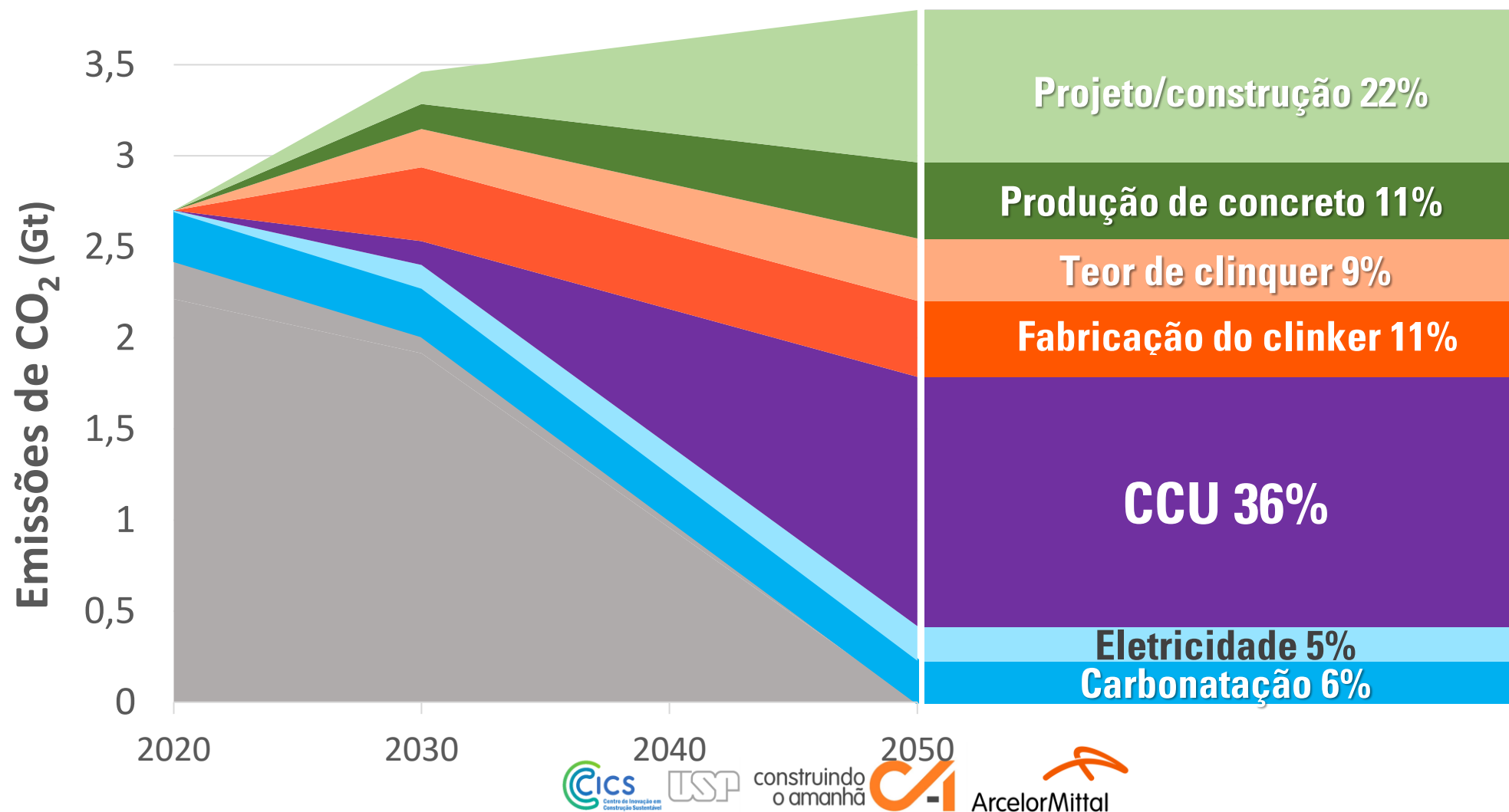


componentes do concreto – CO₂ x Massa

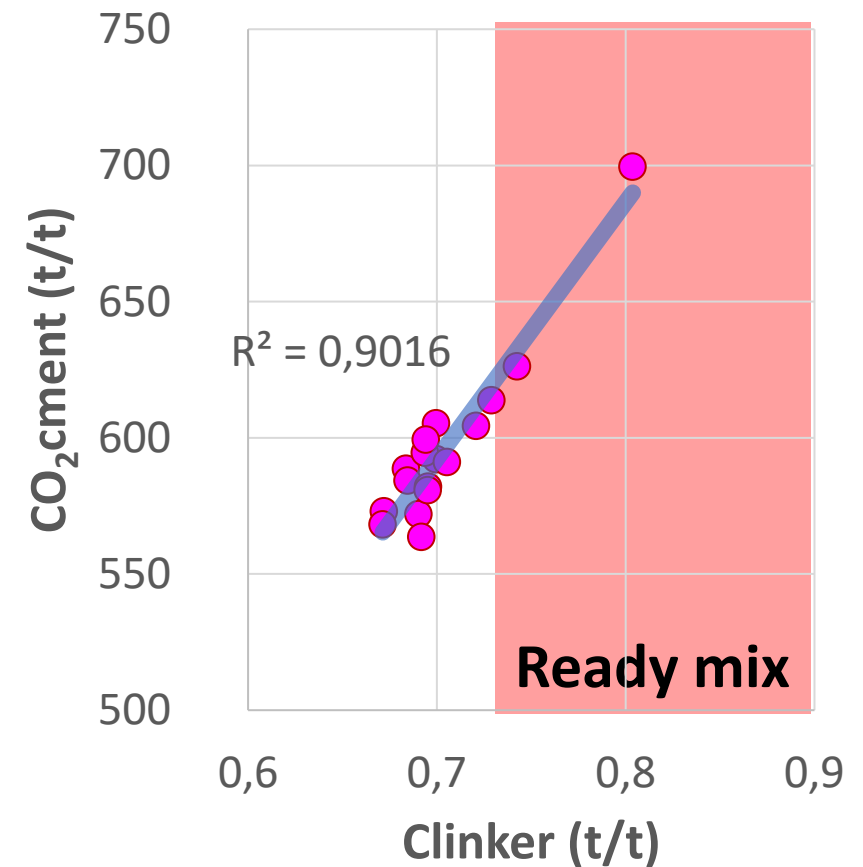
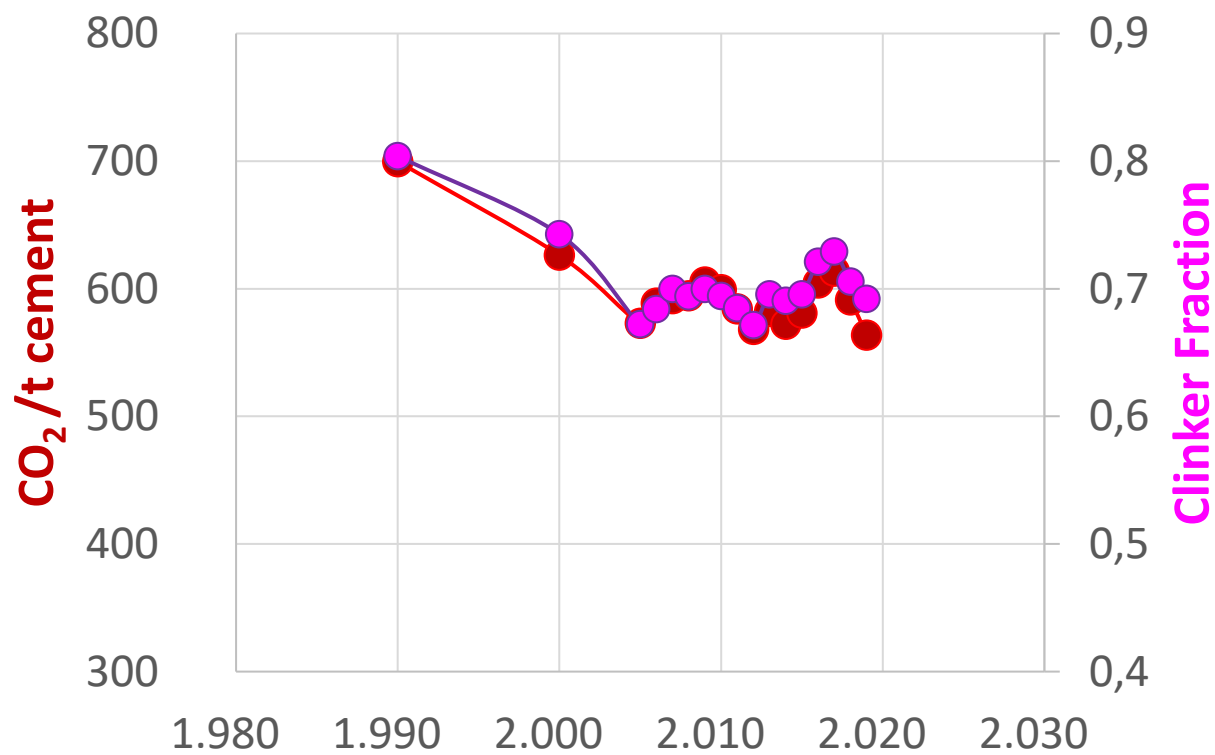


Estratégias de mitigação para carbono zero

Roadmap GCCA 2021



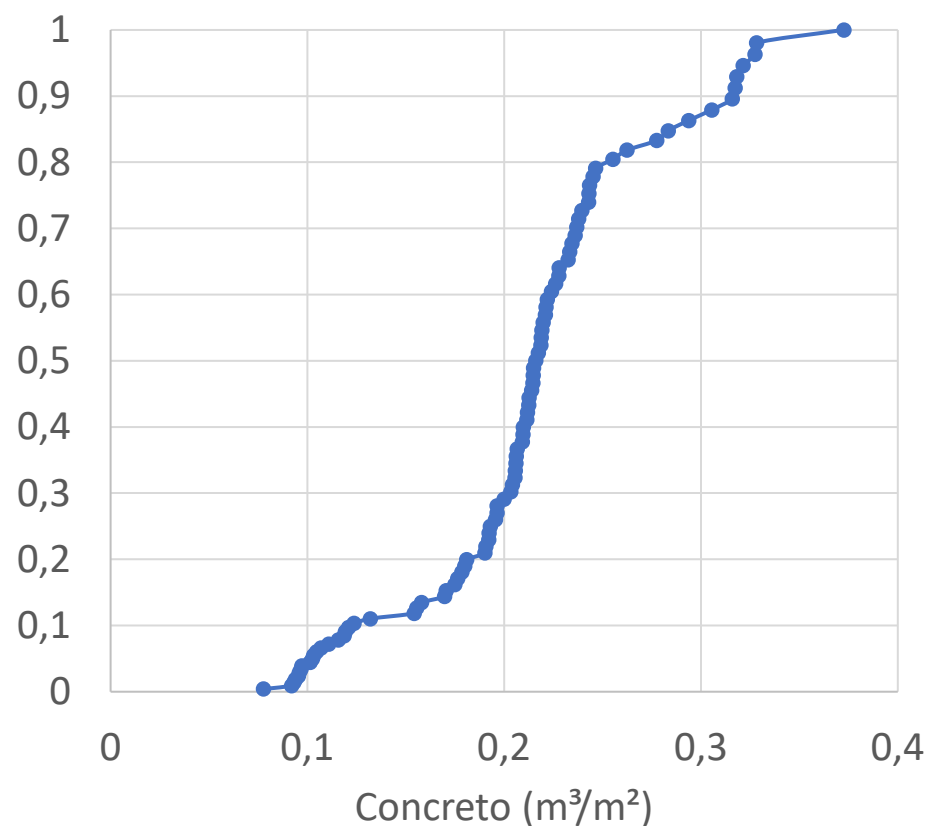
Mitigação por adições minerais atingiu seu limite (GNR 2019)



Projetar edifícios de menor pegada

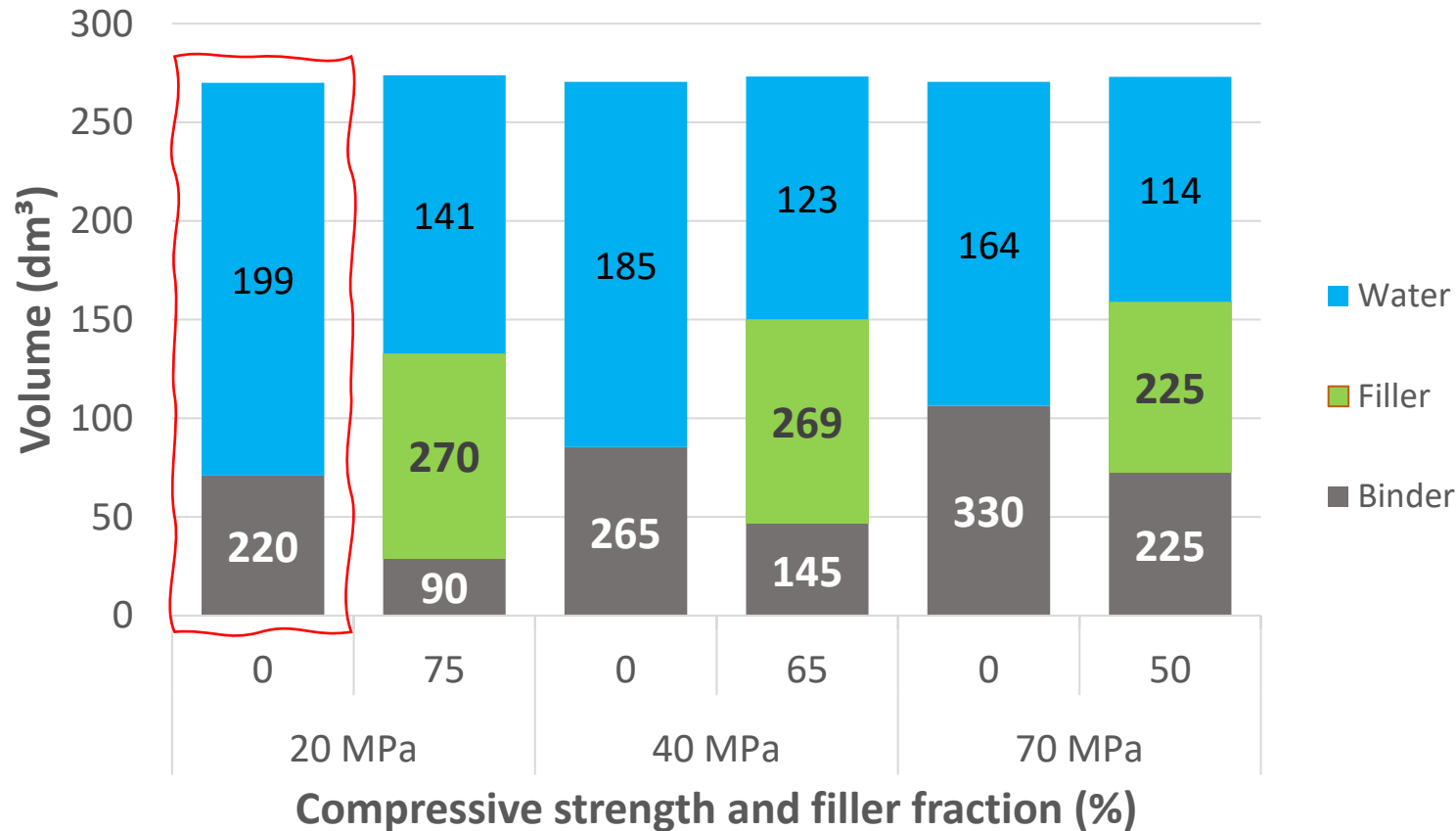
Benchmark setorial estruturas de concreto armado (Brasil)

Concreto por área de pavimento



Potencial de filler + packing + dispersão

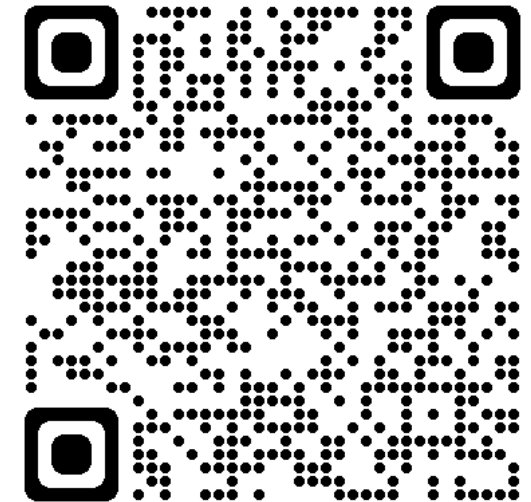
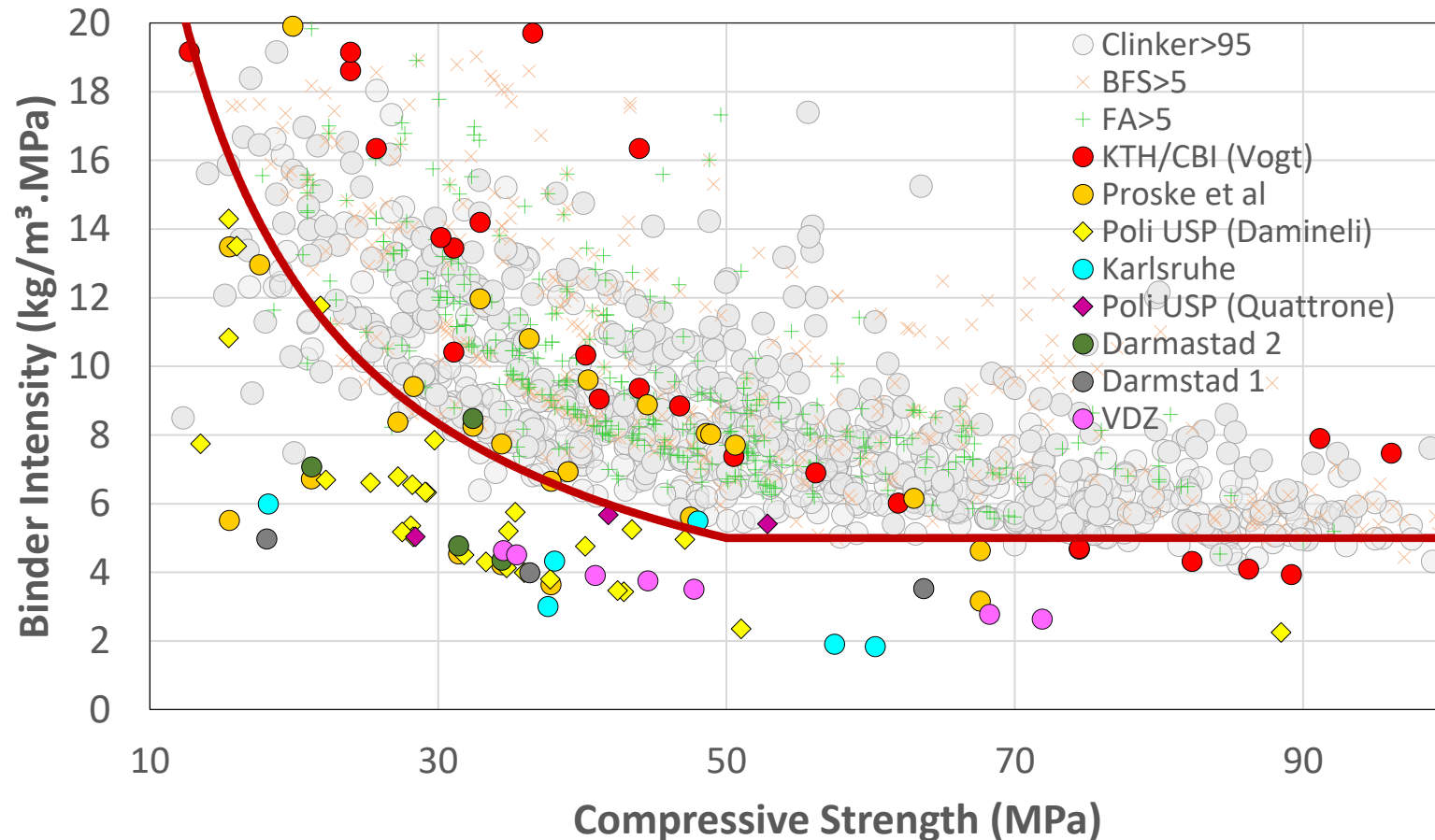
U Darmstadt / VDZ



35-90%
binder+filler
increase

Packing + dispersant + filler in concretes

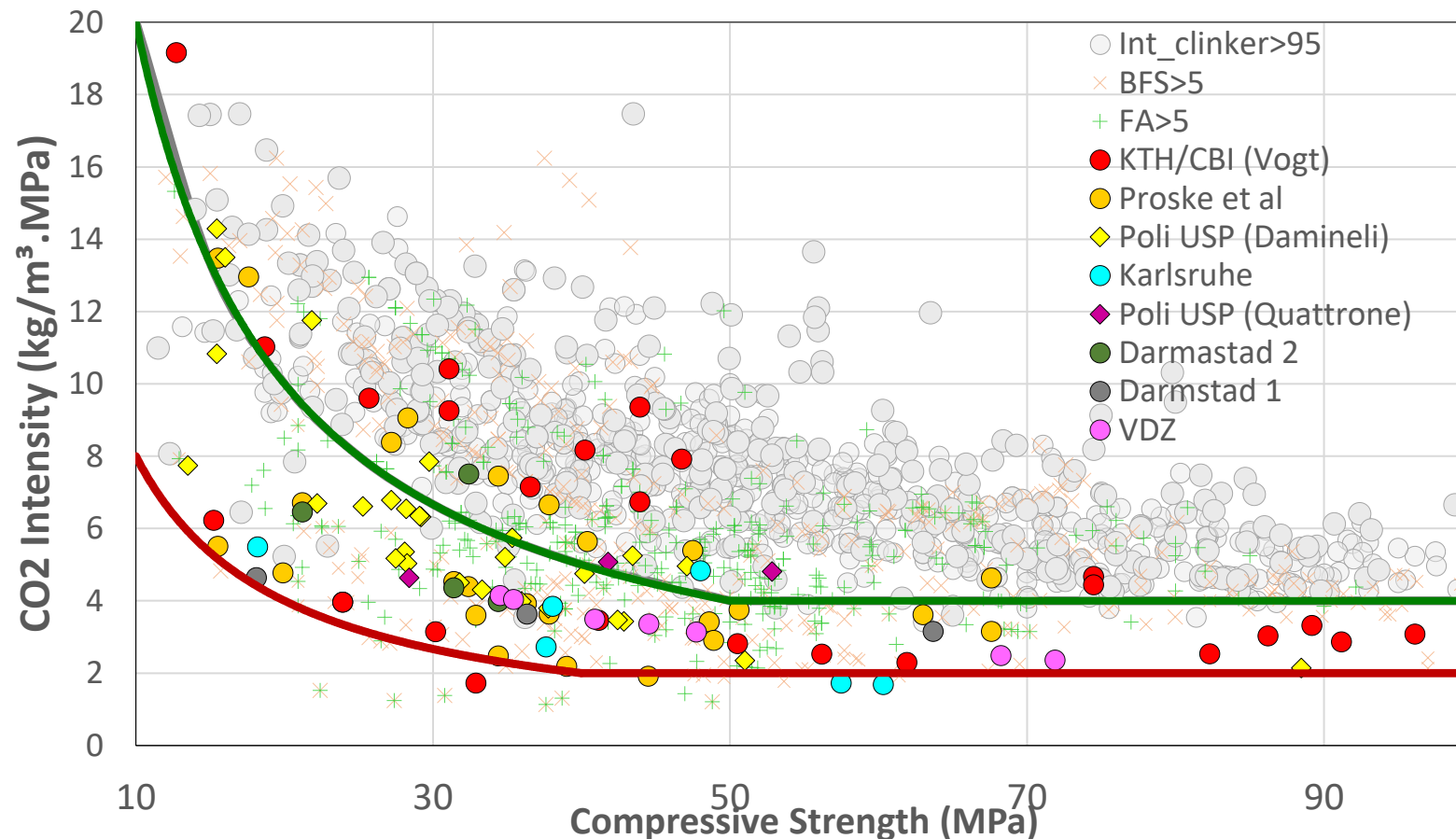
Binder intensity



John et. All [Fillers in cementitious materials - Experience, recent advances and future potential](#) 2018 DOI: [10.1016/J.CEMCONRES.2017.09.013](#)

Packing, filler potential for concretes

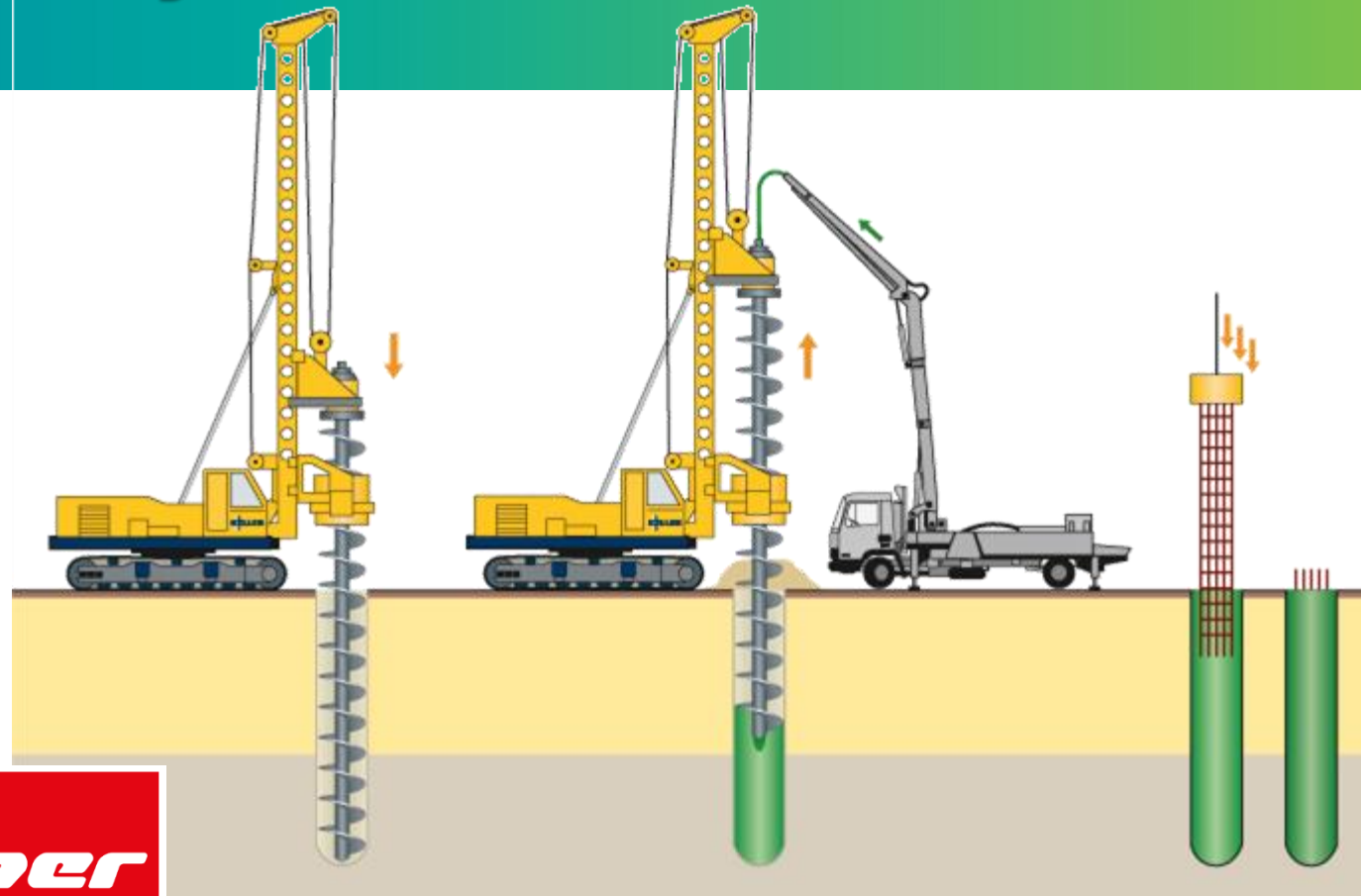
CO2 Intensity



John et. All [Fillers in cementitious materials - Experience, recent advances and future potential](#) 2018 DOI: [10.1016/J.CEMCONRES.2017.09.013](https://doi.org/10.1016/J.CEMCONRES.2017.09.013)

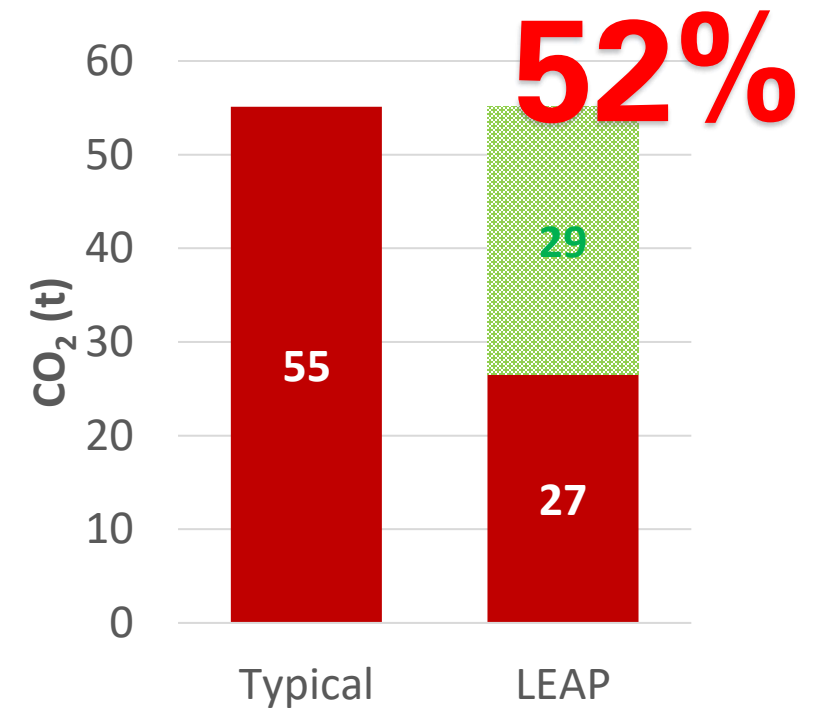
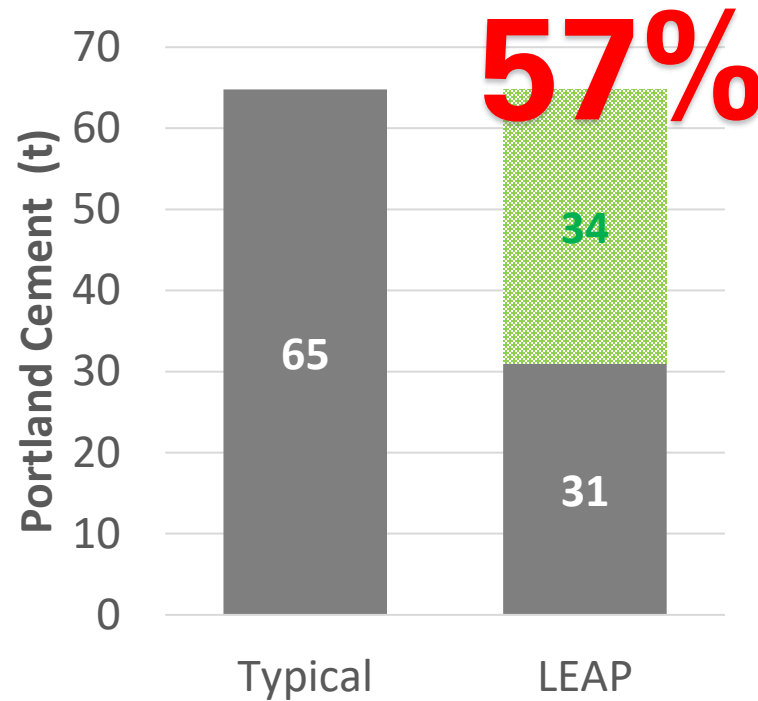
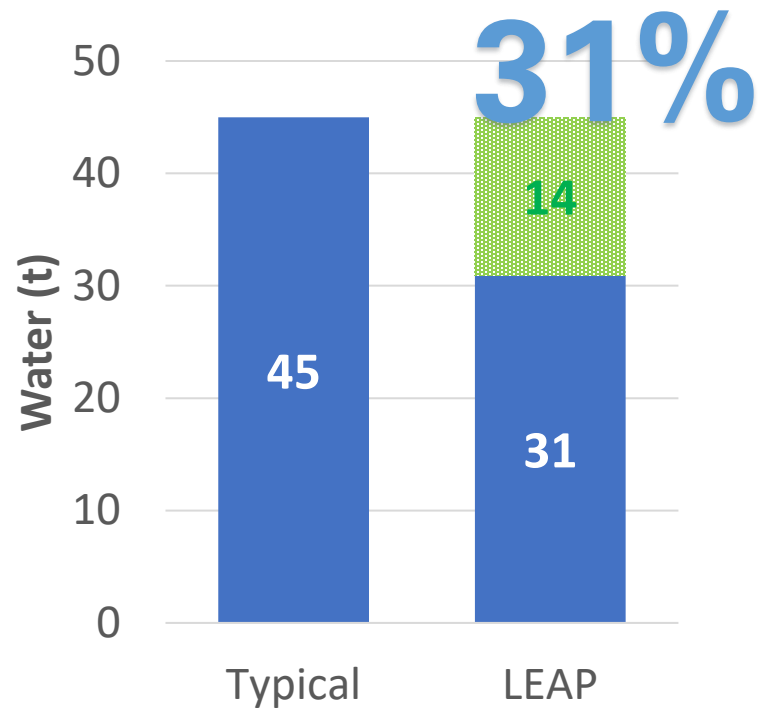
Prova de Conceito: Construção de Fundações Profundas

- Estaca hélice contínua
- 180m³ concreto usinado
- Geotermia incorporada
- Armaduras de c/12m





Resultados

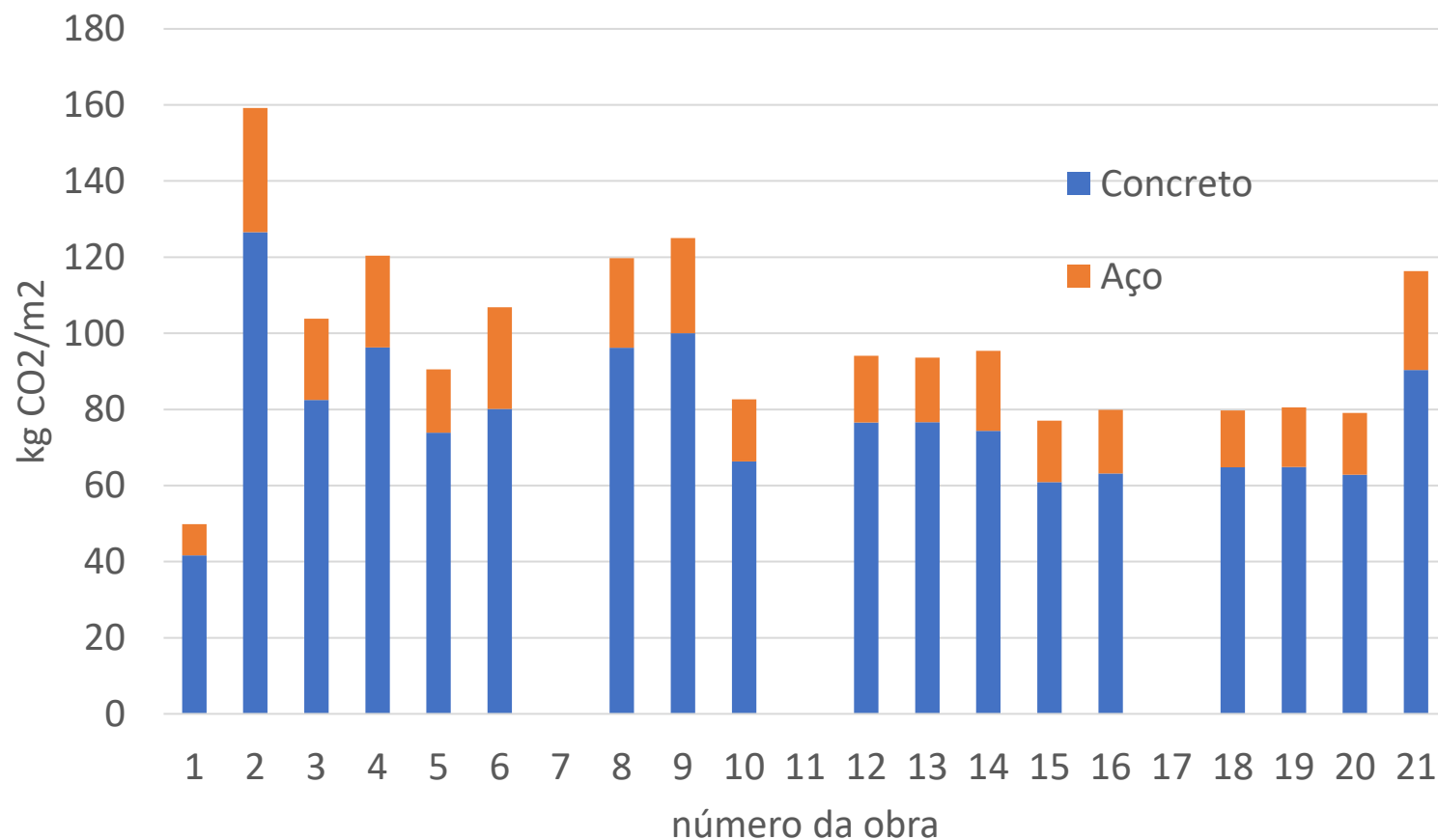


Adição de filer + dispersante

- Alta resistência inicial
- Redução da demanda de água
 - Retração reduzida
 - Fluência reduzida
- Baixo calor de hidratação
- Controle de reação álcali-agregado
- Custo do aditivo
- Robustez
- Exige
 - Clínquer reativo
 - Moagem separada
 - Controle de processo

O conhecimento é a barreira mais importante TRL ~6

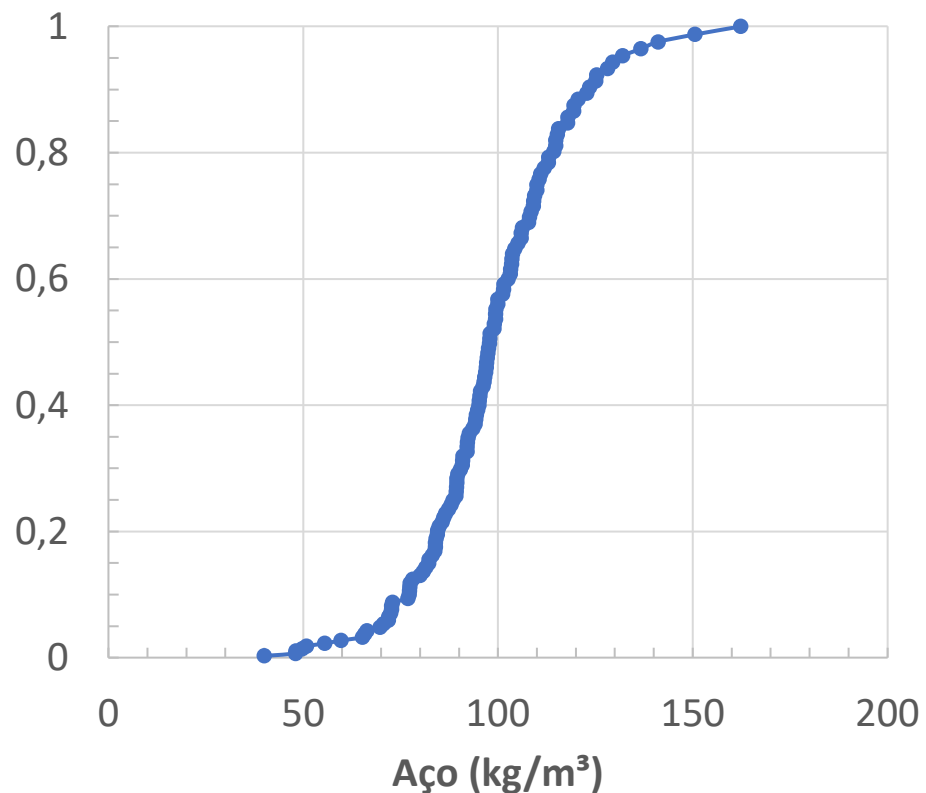
O Aço e a pegada de CO2 de estruturas de concreto convencional



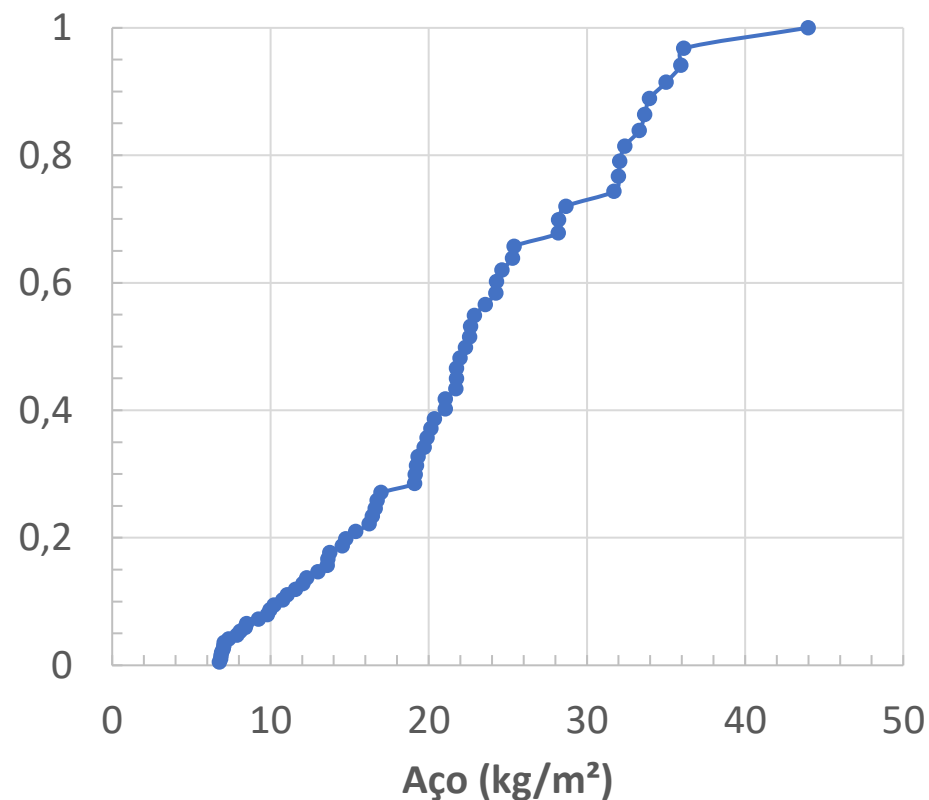
Projetar edifícios de menor pegada

Benchmark setorial estruturas de concreto armado (Brasil)

Consumo de aço no concreto



Consumo de aço no edifício



Aço

- Sucata
- Energia mais limpa
- Novos processos

Inovação é a saída

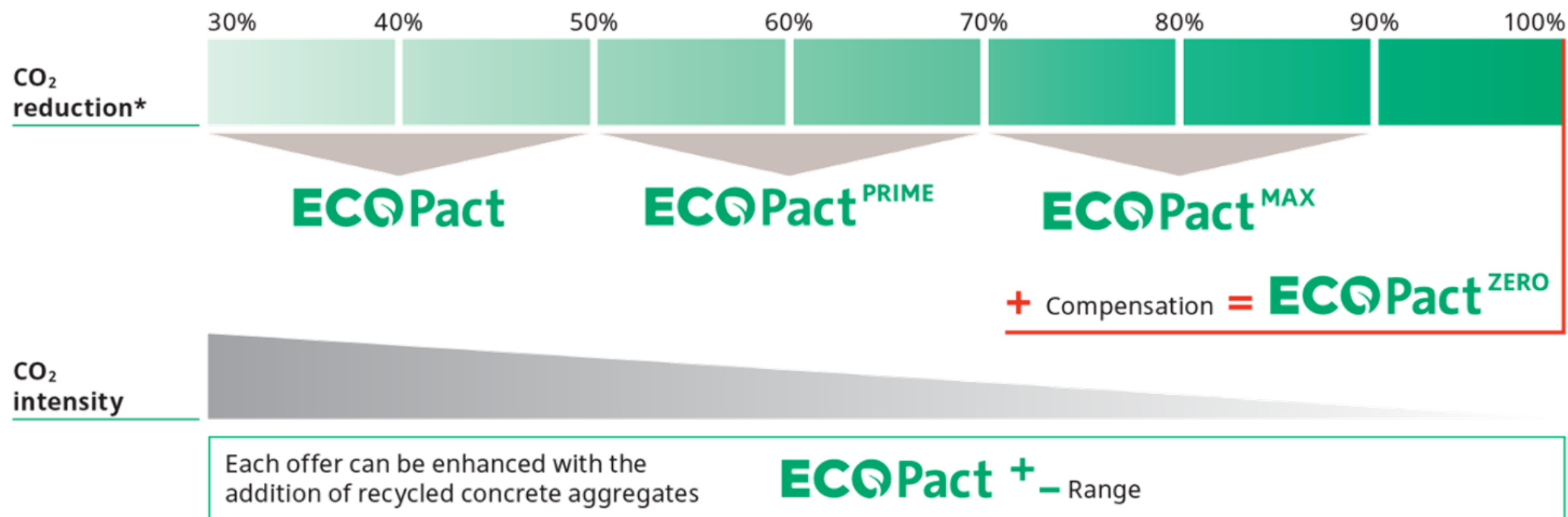
Durabilidade?

Desenvolver produtos de baixo carbono

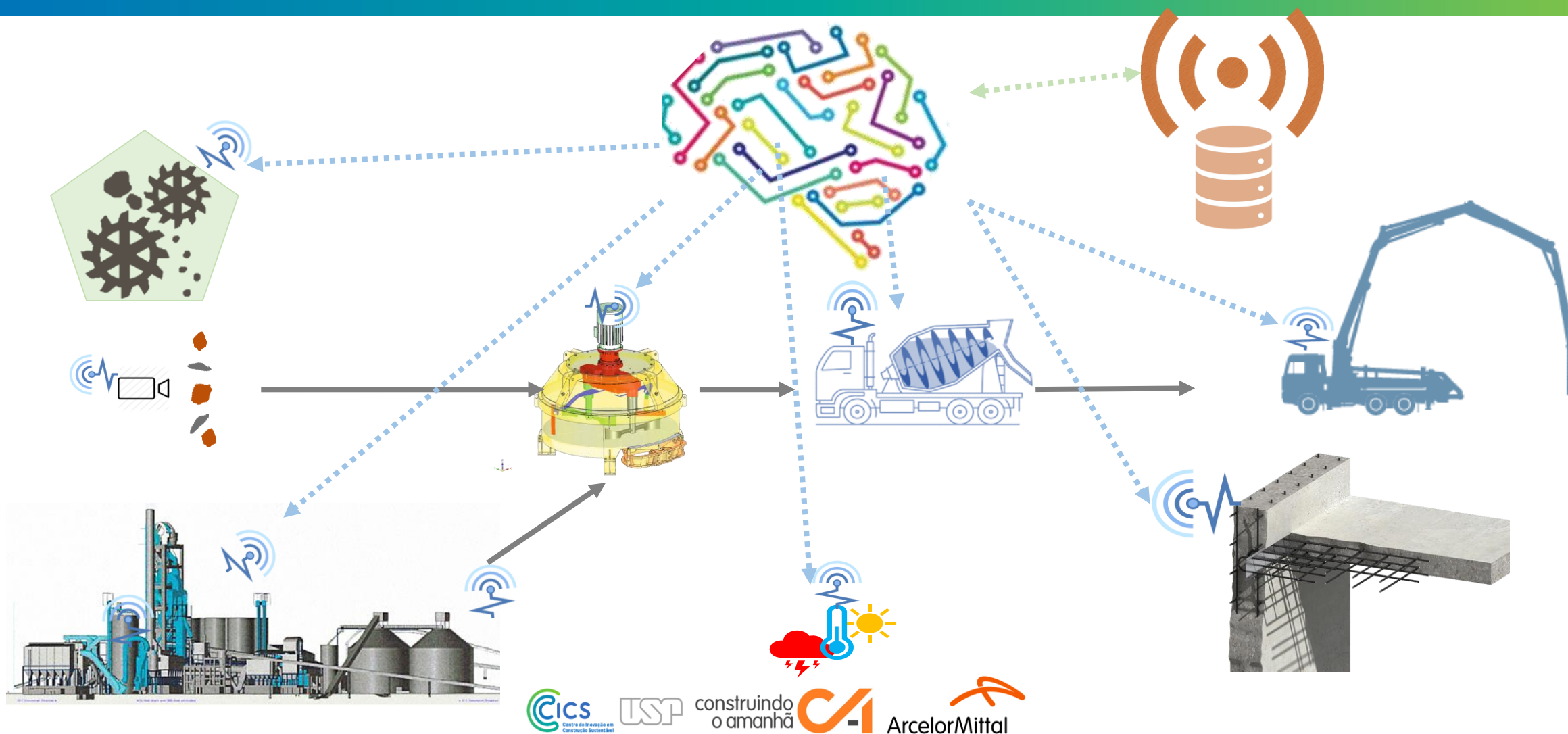
Precisamos desenvolver o mercado. Ganhar experiencia.
Melhorar continuamente.

ECOPact Holcim

diluição por Filer + Captura & Compensação



IA e otimização de estruturas de concreto





construindo
o amanhã



Quais as oportunidades para sua empresa?

vmjohn@usp.br



construindo
o amanhã



ArcelorMittal

